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Emission difference between natural gas usage and digester gas usage.

Mahyar Ghorbanian 1986-
University of Louisville

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EMISSION DIFFERENCE BETWEEN NATURAL GAS USAGE AND DIGESTER GAS USAGE

By

Mahyar Ghorbanian
B.S., Petroleum University of Technology, Iran, 2008

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Submitted By. ________________________
Mahyar Ghorbanian
B.S., Petroleum University of Technology, Iran, 2008

A Thesis Approved on

07/23/2010
(Date)

By the Following Reading and Examination Committee:

Dr. J. P. Mohsen, Thesis Director

Mr. R. A. Barnett

Dr. T. D. Rockaway

Dr. R. E. Berson

DEDICATION

This dissertation is dedicated to my parents

Mr. Mohsen Ghorbanian

and

Mrs. Roghayyeh Mirhassannia

who have given me invaluable educational opportunities.

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I am heartily thankful to my supervisors, Dr. J.P. Mohsen and Mr. Russell A Barnett, whose encouragement, guidance and support from the initial to the final level enabled me to develop an understanding of the subject. It is an honor for me to offer my regards and blessings to my mom and dad for their love and support in any respect during the completion of the project. I also would like to thank my family for their support. I also would like to thank my friends.

ABSTRACT

EMISSION DIFFERENCE BETWEEN NATURAL GAS USAGE AND DIGESTER GAS USAGE

Mahyar Ghorbanian

July 23, 2010

It is important to burn the air toxics and harmful gases which come from water and wastewater treatment processes. In common practice, instead of natural gas, digester gas is used for economical reasons. This burning process takes place in the Regenerative Thermal Oxidizer (RTO).

The current research was conducted to identify if there exists any differences between natural gas and digester gas in outlet emission. The location of the experiment was at Morris Forman Wastewater Treatment Plant of Metropolitan Sewer District (MSD) of Jefferson County, Kentucky, USA. In this experiment, the RTO was run in two cases: one fueling by digester gas and next fueling by natural gas; then samples were obtained from a sampling port during each case. The captured samples were analyzed in the laboratory at the University of Louisville, Kentucky. The resulted data from these two cases showed that there are not much emission differences between these two fuels. Therefore, use of digester gas instead of natural gas is an economical move without causing any harmful emission.

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CHAPTER I

INTRODUCTION

The most important needs for human beings are food, water and a continuous supply of air. The amounts of water and air are relatively constant and steady (1-2 liters per day and 10-20 m^3, respectively) (1). A person can live about five weeks without food and about five days without water, but only five minutes without air (2). It's an essential human right that all people need to freely access an acceptable quality of water and air in their life (1), but the atmosphere, that invisible ocean of different gases called air, is as susceptible to pollution from human activities (2).

The quality of air will be affected by chemicals from both natural and man-made (anthropogenic) sources. The various chemicals are emitted into the atmosphere. The quantities of these chemicals may vary in the range from hundreds to millions of tons annually (1). U.S. Environmental Protection Agency (USEPA) had designated a list of Hazardous Air Pollutants (HAPs) in the Clean Air Act (CAA). This list includes 188 HAPs (3).

Natural air pollution is caused by several biotic and abiotic sources like plants, radiological decomposition, forest fires, volcanoes and other geothermal sources, and emissions from land and water. These result in a natural background concentration that varies according to local sources or specific weather conditions.

Man-made or anthropogenic air pollution has existed from when people learned to use fire, but it has increased rapidly since the industrialization period began. The increase in air pollution resulting from the expanding use of fossil fuel energy sources and use of chemicals has been accompanied by mounting public concern about its detrimental effects on health and the environment. Moreover, knowledge of the nature, quantity, physiochemical behavior and effects of air pollutants has greatly increased in recent years. Nevertheless, more needs to be known. Certain aspects of the health effects of air pollutants require further assessment (4). Air pollution certainly is not a new phenomenon. Indeed, early references are to the Middle Ages, when smoke from burning coal was already considered such a serious problem before industrial revolution, King Edward I banned its use in London. In more recent times, though still decades ago, several serious episodes focused attention on the need to control the quality of the air we breathe. The worst of these occurred in London, in 1952. A week of intense fog and smoke resulted in over 4000 deaths that were directly attributed to the pollution. In the United States the most catastrophic episode occurred during a 4-day period in 1948 in Donora, Pennsylvania, when 20 deaths and almost 6000 illnesses occurred during an air inversion. At the time, Donora had a population of only 14000, making this the highest per capita death rate ever recorded from an air pollution episode (5).

The impact of air pollution is broad. In humans, the pulmonary deposition and absorption of inhaled chemicals can have direct effects for health. Nevertheless public health can also be indirectly affected by air pollutants in environmental media and by plants and animals, resulting in chemicals entering the food chain or being present in drinking water and therefore producing additional sources of human exposure. Furthermore the direct effect of air pollutants on plants, animal, and soil can influence the structure and function of the ecosystems.

In recent decades, major efforts have been made to reduce air pollution globally. The emission of the main air pollutants has declined significantly (4). International efforts to combat emissions are undertaken, for instance within the framework of the Convention on Long-range Transboundary Air Pollution established by the United Nations Economic Commission (6, 7).

The task of reducing levels of exposure to air pollutants is a complex one. It begins with an analysis to determine which chemicals are present in the air and at what exposure level is hazardous to human health and the environment. It can then be determined whether an unacceptable risk is present. When a problem is identified, mitigation strategies should be developed and implemented so as to prevent excessive risk to public health in the most efficient manner (8).

> "Analyses of air pollution problems are exceedingly complicated. Some are national in scope (such as the definition of actual levels of exposure of the population, the determination of acceptable risk, and the identification of the most efficient control strategies), while others are of a more basic character and are applicable in all countries (such as analysis of the relationship between chemical exposure levels, and doses and their effects)" (8).

Indoor pollution and occupational exposure contributes to overall human exposure, since 90% of human's time is spent indoors. Indoor exposure of nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matters (PM_{10} and $PM_{2.5}$), ozone (O_3) and sulfur dioxide (SO_2) are higher than outdoor exposure (8).

Outdoor air pollution can be caused from a single point source, which may affect only a relatively small area. More often, outdoor air pollution is caused by a mixture of pollutants from a variety of sources, such as transportation and heating, and from point sources. Finally, in addition to those emitted by local sources, pollutants transported over long distances contribute further to the overall level of air pollution.

The relative contribution of emission sources to human exposure to air pollution may vary according to regional and lifestyle factors. As far as some pollutants are concerned, indoor air pollution is more important than outdoor pollution, because people spend 90% or more their time indoors. However this does not diminish the importance of outdoor pollution. In terms of amounts of substances released, the latter is far more important and may have harmful effects on animals, plants and materials as well as effects on human health. Pollutants produced outdoors may penetrate into the indoor environment and may affect human health by exposure both indoors and outdoors (9).

In this study, the outdoor air pollution control system in the Morris Forman Wastewater Treatment Plant of Metropolitan Sewer District (MSD), Louisville, Kentucky was investigated. In this plant, Regenerative Thermal Oxidizers (RTO) are used to burn the air toxics and Volatile Organic Compounds that are discharged from the solid waste handling processes. Thermal oxidizers achieve VOC destruction through high temperature thermal oxidation, converting the

VOCs to carbon dioxide and water vapor, and recycling released energy to reduce operating costs. Regeneration refers to regenerating the heat of a large thermal mass. For generating high temperatures in thermal oxidation, the RTO can be fueled by either digester gas or natural gas. FIGURE 1 shows the RTOs which are being used at the plant.

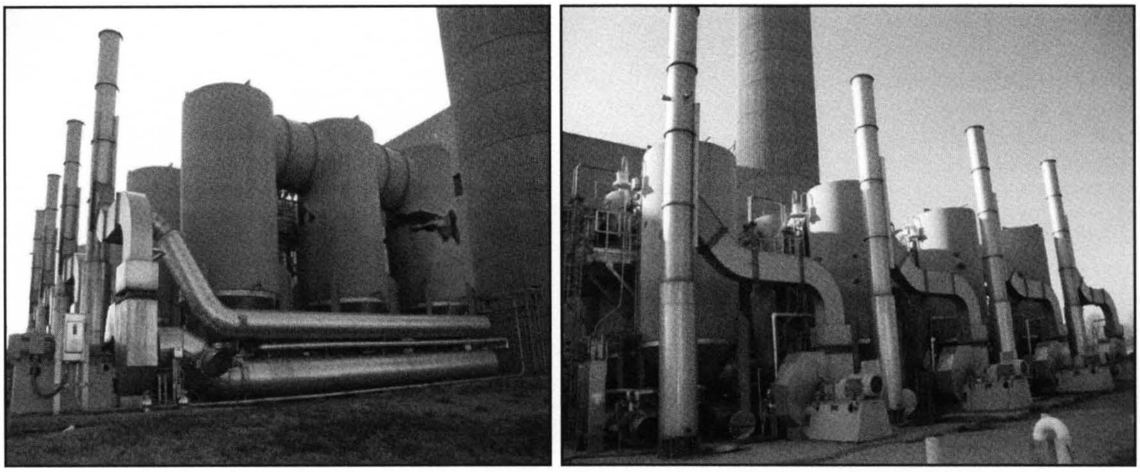

Figure 1- Regenerative Thermal Oxidizer at Morris Forman plant

The required digester gas will be produced in the plant from anaerobic digestion of solid in the wastewater. The typical compounds (by volume) in digester gas are: Methane (50-75%), Carbon Dioxide (25-50), and Nitrogen, Hydrogen, Hydrogen Disulfide, and Oxygen. From an economical point of view, it is better to use digester gas than pipeline Natural gas; but theoretically and environmentally, natural gas is cleaner than digester gas. The purpose of this study is to find out the difference of pollutant emissions between the two cases when the plant is fueled by the mentioned gases. This study will answer questions like what pollutants are in both cases emissions, what pollutants have higher concentration in digester gas usage than pipeline natural gas usage or vice versa, how these pollutants come, which of them are more critical than others and etc. If the pollution from using digester gas is not too much and does not exceed the regulatory emission limit, it will be proposed using digester gas rather than natural gas for fueling at RTO.

CHAPTER II

LITERATURE REVIEW

Historical Background

Air pollution from human activities can be said to have originated with the discovery of fire; even today, most air contaminants are produced in combustion processes from mobile and stationary sources.

In the 17th century, the development of the steam engine and the beginning of the industrialization outstand a new era of air pollution. Early in the 20th century, yet another significant air pollution era began when the gasoline-powered automobile became a major contributing source. But it was not until the mid-1900s that any lasting efforts were made to protect air quality. Meaningful efforts to control air pollution were initiated about that time, largely as the result of deadly air pollution episodes, particularly those in Donora, Pennsylvania; London, England; and the Meuse Valley, Belgium (2).

Those air pollution episodes were the result of exceptionally high concentrations of sulfur oxides and particulate matter, the primary constituents of “industrial smog” or “sulfurous smog”. Sulfurous smog is caused almost entirely by combustion of fossil fuels, especially coal, in stationary sources such as power plants and smelters. In contrast, the air pollution problem in many cities is caused by emissions of carbon monoxide, oxides of nitrogen, and various hydrocarbons that move around in the atmosphere reacting with each other and with sunlight to form “photochemical smog”. Although stationary sources also contribute to photochemical smog, the problem is most closely associated with motor vehicles.

Much of the work on air pollution in the last few decades has centered on six compounds, called criteria pollutants (will be described later in this chapter), that have been identified as contributors to both sulfurous and photochemical smog problems (5).

The Donora episode, London's "Killer Smog" and other events helped focus public attention on air pollution and prompted development of new approaches, laws, and technologies needed to solve the problem (2).

Summary of the Clean Air Act

Initial efforts on the part of the U.S. Congress to address the nation's air pollution problem began with the section of the Air Pollution Control Act of 1955. Although it provided funding only for research, and not control, it was an important event because it opened the door to federal participation in efforts to deal with air pollution. Up until that time, air pollution had been thought to be a state and local problem. This was followed by a series of legislative actions by Congress that included the Clean Air Act of 1963, the Motor Vehicle Air Pollution Control Act of 1965, the Air Quality Act of 1967, the Clean Air Act Amendments of 1970, the Energy Supply and Environmental Coordination Act of 1974, and the Clean Air Act Amendments of 1977, all of which are sometimes lumped together and referred to as the Clean Air Act (CAA) (5).

Much of the real structure to the Clean Air Act was established in the 1970 Amendments. In those amendments, the Environmental Protection Agency (EPA) was required to establish National Ambient Air Quality Standards (NAAQS), and states were required to submit State Implementation Plans (SIPs) that would show how they would meet those standards. In addition, the Act required New Source Performance Standards (NSPS) to be established that would limit emissions from certain specific types of industrial plants. Emission standards were also written for mobile sources that required manufacturers to reduce emissions from new cars by 90 % (5).

There is a difference between these two types of standards that should be noted. Ambient air quality standards are acceptable concentrations of pollution in the atmosphere, whereas emission standards are the allowable rates which pollutants can be released from a source (5).

Air Quality Standards

National Ambient Air Quality Standards have been established by the EPA for two cases: primary and secondary. Primary standards are at levels that will protect public health and include “adequate margin of safety,” regardless of whether the standards are economically or technologically achievable. Primary standards must protect the most sensitive individuals, including children, the elderly and those with respiratory ailments. NAAQS are conceptually different from maximum contaminant levels (MCLs) that have been set drinking water (5).

Secondary air quality standards were set to be even more stringent than primary standards. Secondary air quality standards are established to protect public welfare such as animals and fabrics. Table I lists the current NAAQS standards (5).

Table I - National Ambient Air Quality Standards (Source: USEPA)

	Primary Standards		Secondary Standards	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour (1)	None	
	35 ppm (40 mg/m^3)	1-hour (1)		
Lead	0.15 $\mu g/m^3$ (2)	Rolling 3-Month Average	Same as Primary	
	1.5 $\mu g/m^3$	Quarterly Average	Same as Primary	
Nitrogen Dioxide	0.053 ppm (100 $\mu g/m^3$)	Annual (Arithmetic Mean)	Same as Primary	
Particulate Matter (PM_{10})	150 $\mu g/m^3$	24-hour (3)	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 $\mu g/m^3$	Annual (4) (Arithmetic Mean)	Same as Primary	
	35 $\mu g/m^3$	24-hour (5)	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour (6)	Same as Primary	
	0.08 ppm (1997 std)	8-hour (7)	Same as Primary	
	0.12 ppm	1-hour (8)	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)	0.5 ppm (1300 $\mu g/m^3$)	3-hour (1)
	0.14 ppm	24-hour (1)		

(1) Not to be exceeded more than once per year.

(2) Final rule signed October 15, 2008.

(3) Not to be exceeded more than once per year on average over 3 years.

(4) To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m3.

(5) To attain this standard, the 3-year average of the 98th %ile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3 (effective December 17, 2006).

(6) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (effective May 27, 2008)

(7) (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

(8) (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is $\leq$ 1.

(b) As of June 15, 2005 EPA has revoked the 1-hour ozone standard in all areas except the fourteen 8-hour ozone nonattainment Early Action Compact (EAC) Areas. For one of the 14 EAC areas (Denver, CO), the 1-hour standard was revoked on November 20, 2008. For the other 13 EAC areas, the 1-hour standard was revoked on April 15, 2009. (Source: USEPA)

Emission Standards

Besides establishing National Ambient Air Quality Standards (NAAQS), the Clean Air Act (CAA) also requires EPA to establish emission standards for some certain industries. New Source Performance Standards (NSPS) have been promulgated for a large number of stationary sources such as fossil-fuel-fired power plants, incinerators, Portland cement plants, nitric acid plants, petroleum refineries, sewage treatment plants, and smelters of various sorts" (5). Notice the allowable emissions are expressed as pounds of pollutants per million BTU of heat input to power plant. Table II is an example of NSPS for electric power plants (5).

Table II - NSPS for Steam Electric Power Plants (lb/106 Btu Heat Input) (5)

Particulates	0.03 lb/10^6 Btu of heat input (13 g/10^6 kJ)
Nitrogen oxides (NO_x)	
Gas-fired	0.20 lb/10^6 Btu (86 g/10^6 kJ)
Oil-fired	0.30 lb/10^6 Btu (130 g/10^6 kJ)
Coal-fired	0.60 lb/10^6 Btu (260 g/10^6 kJ)
Sulfur dioxide (SO_2)	
Gas or Oil	0.20 lb/10^6 Btu (86 g/10^6 kJ) for gas or oil.
Coal-fired	Allowable emission rates are based on the sulfur content and heating value of the fuel. Controls must reduce emissions by at least 70%. If emissions reduction is less than 90%, emissions cannot exceed 0.6 lb/10^6 Btu; above 90%, emissions cannot exceed 1.2 lb/10^6 Btu.

Atmospheric Factors

To understand topics related to the effects and control of air pollution, it is first necessary to know something about the composition and physical behavior of the atmosphere. What does "pure" air consist of, and how do meteorological or weather conditions affect the mixing and dispersion of pollutants? Meteorology, the science of the atmosphere and weather forecasting, involves the study of both large-scale and small-scale atmospheric circulation patterns. During some types of adverse weather conditions, small-scale circulation patterns are such that emitted pollutants are confined to a restricted volume of air. It is necessary to know how these weather patterns develop and to understand their impact on air pollution control requirements. Large-scale weather patterns are also of concern with regard to global air pollution problems (2).

Composition of the Atmosphere

The atmosphere is a mixture of many different gases, but mostly it consists of molecular nitrogen and oxygen (N_2 and O_2). About 78 % of dry air is nitrogen and about 21 % is oxygen. These %ages are expressed on a volume basis. For example, a container holding 1 m^3 or 1000 L of air (at standard pressure) includes about 780 L of nitrogen and 210 L of oxygen.

The nitrogen and oxygen combined make up approximately 99 % of the atmosphere. The remaining 1 % of clean air is a mixture of several other gases. Most of that remaining 1 % (about 0.9 %) is the inert gas argon. The rest of it includes carbon dioxide, methane, hydrogen, helium, neon, ozone, and numerous other gases in trace (very small) amounts. Figure 2 shows the relative amounts of atmospheric gases. It is seen that the "pure" atmosphere is normally a mixture of many different substances.

The relative amounts or concentrations of gases in air can be expressed in terms of part per million (ppm) as well as in terms of %age. For example, since 1 % = 10,000 ppm, an oxygen level of 21 % in air can also be expressed as 21,000 ppm. Obviously, it is more convenient to express that concentration in %. On the other hand, the concentration of carbon dioxide in the atmosphere, about 0.034 %, may be more conveniently expressed as 340 ppm. A very wide range of concentrations is related to air quality; for instance, natural ozone concentrations can be as low as 0.02 ppm. Concentrations of air pollutants are also expressed in terms of mass per unit volume.

Water vapor is also a normal component of the atmosphere, but the amount may vary significantly over time and location. Local climate is a major factor that affects the amount of water vapor or moisture in the air. In very humid regions, for example, moisture content may be as high as 5 %. Moisture affects air quality in several ways. For instance, as it condenses or evaporates, water releases or absorbs heat, which affects atmospheric stability and air circulation patterns.

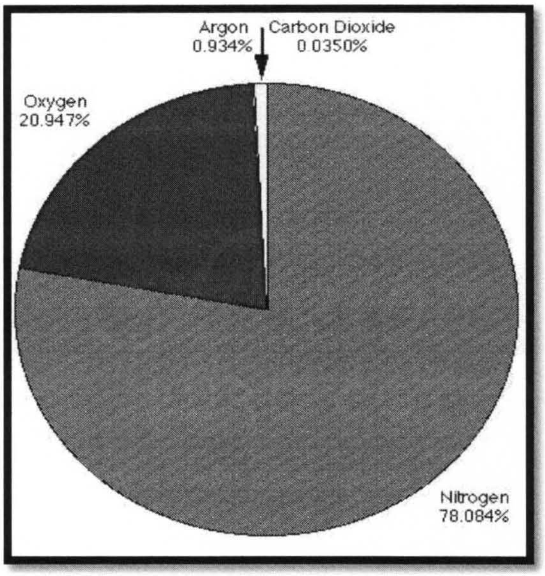

Figure 2 - Air Composition

Also, when atmospheric moisture condenses, fogs are formed; fogs tend to occur more frequently in urban areas due to higher levels of particulates, which serve as nuclei for the formation of fog droplets. Fogs are typically involved in serious pollution episodes (for example, at Donora) because the droplets help the conversion of sulfur oxides into sulfuric acid. Fogs also block heat energy from the sun and extend weather circulation patterns that tend to capture the pollutants (2).

Atmospheric Layers

The full atmosphere extends upward roughly 160 km (100 mi) above the surface of Earth. But the mixture of gases just discussed refers only to the troposphere the lowest surface layer of the atmosphere. The troposphere, which is roughly 12 km (8 mi) in depth, contains about 95 % of the

Total air mass. It is in this relatively thin layer of air that oxygen-dependent life is sustained, clouds are formed, weather patterns develop, and most air pollution problems occur. The density of air increases significantly with a decrease in altitude or distance above Earth's surface, and it is for this reason that most of the total air mass is in the bottom layer. The "skin of the apple" refers to this life-supporting layer. Above the troposphere, there is not enough oxygen to support life.

The layer of air above the troposphere, called the stratosphere, is a stable layer (in terms of air circulation patterns) that extends upward from Earth's surface to an altitude of about 50 km (30 mi). Even though it is deeper than the troposphere, the stratosphere contains only a small part of the total air mass because of its lower air density. It does, however, contain much more naturally occurring ozone (O_3) than the troposphere.

This stratospheric ozone plays a crucial role as a barrier to harmful ultraviolet (UV) radiation from the sun. Layers of the atmosphere existing above the stratosphere include the mesosphere, the ionosphere, and the thermosphere. These portions of the atmosphere are essentially unaffected by air pollution.

A basic physical characteristic that distinguishes one atmospheric layer from the next is the temperature gradient, that is, the gradual change of air temperature with altitude. For example, air temperature normally decreases with increasing altitude in the troposphere, but increases with altitude in the stratosphere. This is illustrated in Figure 3. Naturally occurring variations in the temperature gradient of the troposphere cause certain weather patterns that directly affect air quality (2).

Effects of Weather

Air quality at any given location can vary greatly over time, even though the rate of emission of pollutants remains relatively constant. This is because the air pollutants are mixed, dispersed, and diluted within the troposphere by movement of air masses, both horizontally and vertically. (2)

Air movements and therefore air quality are very dependent on local as well as regional weather conditions. Knowledge of horizontal and vertical circulation patterns is of importance with regard to implementation of air pollution survey site selection for new industrial plants, establishment of maximum allowable air pollutant emission rates (2).

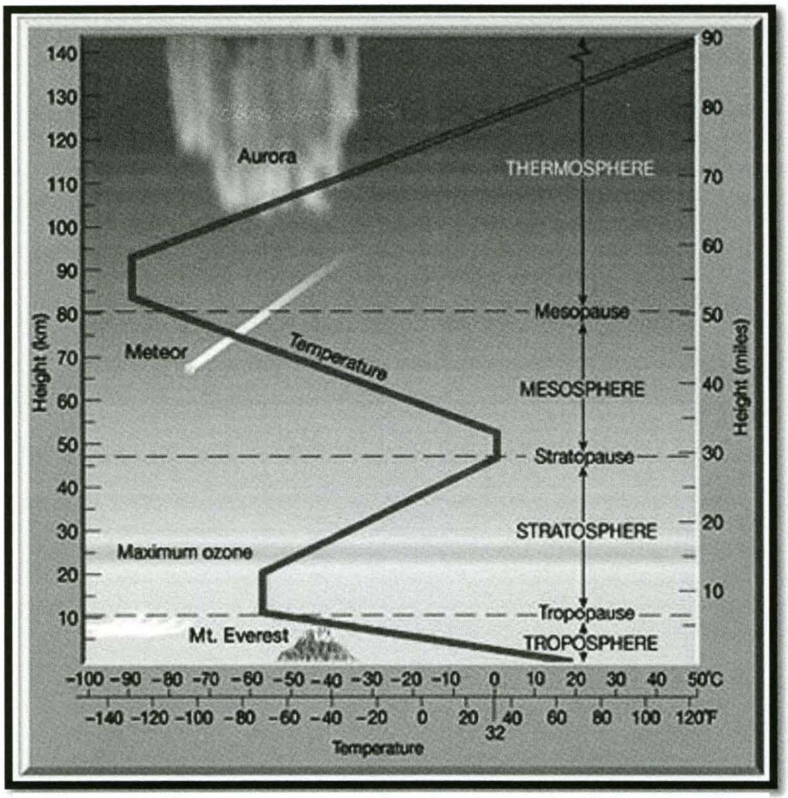

Figure 3 - Changing temperature in atmospheric layers with regard to altitude

Horizontal Dispersion of Pollutants

Horizontal dispersion of air pollutants depends on wind speed and direction: The concentration of air pollutants decreases with increasing wind speed because, as the pollutants are discharged from the source, they are more rapidly separated and dispersed by the quickly moving air. Knowledge of prevailing wind speed and direction in a given locality makes it possible to select sites for new industrial facilities or power plants so as to minimize local air pollution effects.

Locating such sites downwind of residential areas is preferable, naturally, to upwind location. Wind velocity data plotted in a graph called a “wind rose”, gives a picture of the speed and direction from which the wind tends to come.

Vertical Dispersion of Pollutants

In addition to wind patterns and horizontal dispersion, the vertical motion of air is very important with regard to air quality. Vertical mixing of air and dispersion of pollutants depends on the kind of atmospheric stability prevailing at any given time. The atmosphere is considered to be stable when there is little or no vertical movement of air masses and therefore little or no mixing and dispersion of pollutants in vertical direction. Air pollution tends to accumulate near the ground under stable conditions, and severe pollution episodes may occur. An unstable atmosphere, on the other hand, is one in which the air moves naturally in a vertical direction, increasing mixing and dispersion of the pollutants. With regard to local or regional air quality, a condition of atmospheric instability is preferable to a stable condition. (2)

Atmospheric stability depends on the rate of change of air temperature with altitude, that is, on the temperature gradient (or profile) that may prevail at a particular time and location. Normally, air temperatures in the troposphere decrease with increasing altitudes. But the rate at which the air temperature drops, called the “environmental lapse rate” which is important with regard to atmospheric stability (Environmental lapse rate is also called prevailing or ambient lapse rate). To understand the relationships among lapse rates, stability, and vertical mixing, a brief discussion of basic atmospheric physics is necessary. (2)

Atmospheric pressure decreases with increasing height above the ground. As a volume or parcel of air rises, it naturally expands and cools, provided that heat energy is not added or withdrawn a physical process in which there is no heat transfer is called an adiabatic process. Since a parcel of air that is not in immediate contact with the ground is well insulated by its surroundings, it can be assumed that naturally occurring expansion (or compression) of air parcels, as they move vertically, is adiabatic. (2)

Environmental lapse rates are classified as being either strong or weak (superadiabatic or subadiabatic), as illustrated in Figure 4. Strong lapse rates are associated with an unstable atmosphere, while weak lapse rates are associated with a stable atmosphere. A lapse rate characterized by an increase in actual air temperature with increasing altitude is called a "temperature inversion" and results in an extremely stable atmosphere. Temperature inversions, which effectively prevent the upward mixing and dispersion of contaminants, are usually the major causes of air pollution episodes, such as those in Donora and London. In urban areas, air quality will decrease rapidly due to the lack of movement caused by an inversion until weather conditions change and a superadiabatic lapse rate is restored. (2)

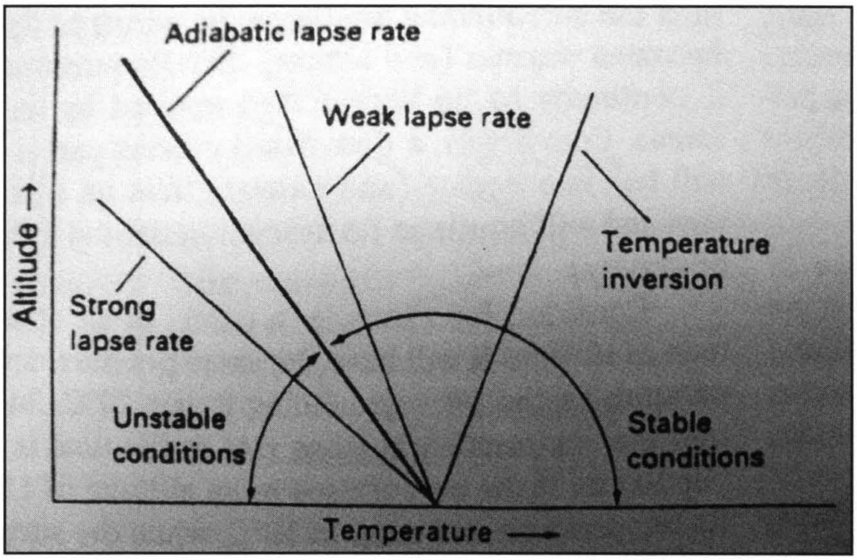

Figure 4 - Environmental lapse rate in temperature profile

Temperature inversions can be caused by a variety of local meteorological conditions, and they can occur just about anywhere, but certain geographic conditions can increase their frequency and duration; An inversion can be particularly severe, for example, for a community located in a valley, which acts as a holding basin or sink for the cold, denser air masses near the ground. Hills surrounding the valley tend to block much of the horizontal air motion, thus adding to the lack of movement problem. The city of Los Angeles, for example, lies in a mountain-bordered bowl that traps air pollutants during the frequent temperature inversions that occur in Louisville which is located in a major river valley. (2)

Three types of temperature inversions, each associated with a specific weather pattern, are “frontal inversions”, “subsidence inversions”, and “radiation inversions”. Frontal inversions generally develop at relatively high altitudes when a warm air mass exceeds a cold air mass; they are not particularly important with regard to air quality control. Subsidence aversions, however, are very important. Although they also develop at relatively high altitudes, subsidence inversions may persist for several days or even weeks, especially in the summer months. This inversion is caused, as its name implies, when a large warm mass of air subsides over a community (for example, Los Angeles). The actual inversion may occur at an altitude of 300 m, for example, while the lapse rate below is sub- or superadiabatic. This kind of inversion forms a lid or cap that literally traps pollutants and prevents further vertical mixing, as shown in FIGURE 5. The plume from a smokestack will abruptly stop rising when it reaches the inversion altitude. If the ambient lapse rate below the inversion is superadiabatic, a fumigating condition may develop near ground level due to the strong mixing effects. Fumigation results in very high ground-level pollutant concentrations. Radiation inversions develop at low altitudes and are caused by the rapid cooling of the ground due to radiation, mostly on clear winter nights. The temperature of the air in contact with the ground also drops, causing the inversion. Air pollutants emitted during the night are trapped and do not disperse until later the next day, when the ground warms sufficiently to break the inversion. Fumigating conditions are common during radiation inversions; fortunately, these inversions are not long-lasting, although they are frequent. (2)

Sophisticated mathematical models have been developed to calculate and predict ground-level concentrations of pollutants downwind from sources such as smokestacks. Most computer programs that relate emissions to air quality use the Gaussian dispersion equation. Although the results of the calculations are uncertain, the Gaussian model provides engineers and scientists with an analytical tool useful for comparing various pollution control strategies (2).

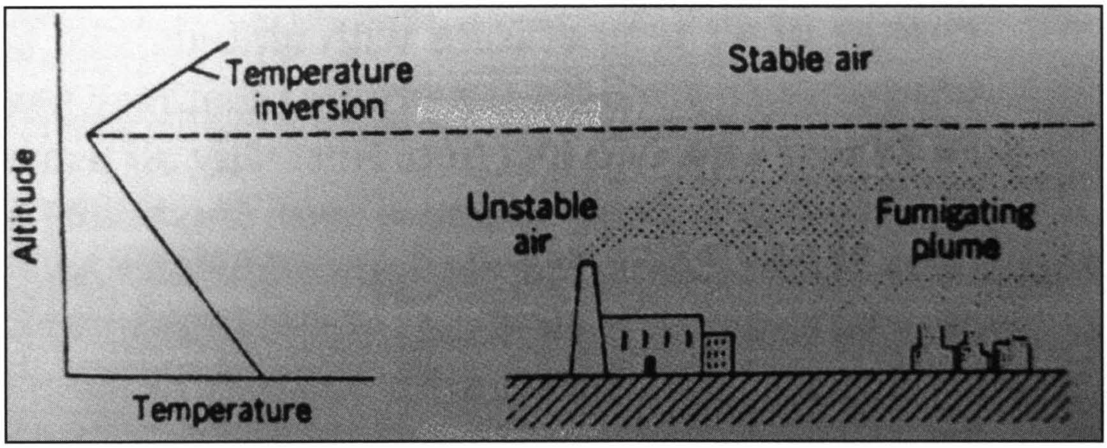

Figure 5 - Temperature Inversions

Types, Sources, and Effects of Pollutants

Air pollution may be simply defined as the presence of certain substances in the air in high enough concentrations and for long enough duration to cause undesirable effects. "Certain substances" may be any gas, liquid, or solid, although certain specific substances are considered significant pollutants because of very large emission rates or harmful and unwanted effects. "Long enough durations" can be anywhere from a few hours to several days or weeks; on a global scale, durations of months and years are of concern. Before considering those substances as the major pollutants, it is useful to first consider some of the general distinctions among the various types of air contaminants. Implicit in this definition is the assumption that the air pollution is anthropogenic, that is, caused by human activities. But air pollution may also result from natural causes. In fact, at certain times pollution from natural sources can be far more severe and longer lasting than air pollution from human activities. For example, the 1991 volcanic eruption of Mount Pinatubo in the Philippines spewed vast quantities of dust and gases into the atmosphere in a relatively short period of time. Pollutants from this eruption reached the upper atmosphere and acted as sunlight reflectors, causing global temperatures to fall slightly for a few years. Obviously, there is not much that can be done to control or regulate these natural occurrences, although there may be certain actions that can be taken to mitigate their harmful effects. (2)

Another general distinction among air pollutants involves the difference between primary pollutants and secondary pollutants. Primary pollutants are emitted directly into the air from a specific source, such as a power plant stack. Secondary pollutants, however, are not emitted directly from a source, but are formed in the atmosphere by complex chemical reactions involving the primary pollutants and sunlight: The sources of primary air pollutants are either mobile (for example, automobiles) or stationary (for example, coal-fired electric power generating stations). The distinction between mobile and stationary sources of pollutants is important because of the different pollution control technology applied to each type, as well as the different kinds of contaminants that they emit. (2)

Air pollution occurs indoors as well as outdoors. Until recently, outdoor or ambient air quality problems received most of the attention of scientists, engineers, and regulatory agencies. Two kinds of ambient pollutants are regulated under the Clean Air Act: criteria pollutants and hazardous air pollutants. According to the National Ambient Air Quality Standards (NAAQS) under the Clean Air Act, there are five primary pollutants and one secondary pollutant as criteria air pollutants. These six pollutants are emitted in relatively large quantities by various sources and tend to threaten human health or welfare. Although the discharge of hazardous air pollutants is not the same as that of the criteria pollutants, they are considered to be immediately harmful to human health (2).

Criteria Pollutants

As a result of the Clean Air Act, most of the monitoring of emissions, concentration and effects of air pollution have been directed toward the criteria pollutants. The EPA has published many volumes of Air Quality Criteria documents, which summarize all of the pertinent literature on each of the criteria pollutants. It is from this information that standards have been written. The documents are an invaluable source of detailed information.

Table III summarizes 2005 U.S. Pollutant emissions by source category and compares the total to that released in 1970. The emissions correspond to the criteria pollutants, except particulates refers to all particulates regardless of size. Also, a class of pollutants known as volatile organic compounds (VOCs) substitutes for ozone. Ozone is a secondary pollutant; that is, it is not actually emitted but rather is formed by reactions that take place in the atmosphere. VOCs are inputs to the photochemical reactions that produce ozone (5).

Table III - US Emission Estimates (1012 g/yr) (Source: USEPA 2005)

Source	Particulates	SO_x	NO_x	VOC	CO	Lead
Transportation	12	0.5	11	7	70	0.001
Stationary source fuel combustion	3.5	12.5	6.5	1.2	8.5	0.0002
Industrial processes	1.8	1.2	1.2	6	2.2	0.001
Solid waste disposal	0.6	0.0	0.2	0.5	2	0.0001
Miscellaneous	8	0.0	0.0	1.6	0.0	0.0001
Total (2005)	25.9	14.2	18.9	16.3	82.7	0.0024
Total (1970)	18.5	28.4	18.1	27.5	98.7	0.2038

Carbon Monoxide (CO)

Carbon Monoxide is a colorless, toxic gas composed of carbon and oxygen. The sources which produce this pollutant are from combustion of carbon containing materials such as coal, oil, refuse or gasoline. As you see from the table, the major source of CO is coming from Transportation.

Breathing CO affects the oxygen carrying capacity of the blood, because it binds with hemoglobin in the bloodstream to form carboxyhemoglobin (COHb). In fact CO has a greater affinity to bind with hemoglobin than oxygen; therefore this diminishes the carrying capacity of oxygen. CO can be harmful for either human or animals (2).

Nitrogen Dioxide (NO_2)

NO_2 is a reddish-brown gas made of nitrogen and oxygen. It is produced when nitric oxide (NO) combines with oxygen in the atmosphere. In addition to being a criteria pollutant, nitrogen dioxide is also a precursor for ozone and contributes to acid rain. NO which is needed for the formation of NO_2 is produced during high temperature combustion of fossil fuels in electric power generating facilities, industrial operations, automobiles and chemical processing plants.

Nitrogen dioxide can directly affect a human's health by causing acute bronchitis or pneumonia and by causing a lowered resistance to respiratory infections. It also has effect on plants to interfere with the chlorosis and make the leaves yellowish. Because of its color, it may interrupt human's visibility in polluted air (2).

Sulfur Dioxide (SO_2)

"Sulfur dioxide is a gaseous compound of Sulfur and Oxygen. The main sources are from burning of fossil fuels, including fuels used in vehicles, containing sulfur compounds. Sulfur dioxide can be transformed into other products such as fine particulate sulfates and sulfuric acid mist".

"The most obvious health effects are irritation and inflammation of body tissues that are contacted by the gas. It also constricts air passages making it difficult to breathe. The injury that SO_2 can cause on vegetation occurs between veins and on the margins and produces a bleached appearance. It can also reduce level of visibility due to sulfates which are a major component of fine particulate matters. It has being said that SO_2 is suspected to cause acid rain. Acid rain causes to decrease the pH of soil and natural waters" (2).

Particulate Matter ($PM_{2.5}$ and PM_{10})

Particulates are made of small particles of solid and liquid material. This term includes both solid particles and liquid droplets. Many manmade and natural sources emit PM directly or emit other pollutants that react in the atmosphere to form PM. Particles less than 2.5 micrometer in diameter are "fine" particulate matters, and particles with the diameter between 2.5 and 10 micrometer are referred to as "coarse".

The major sources of PMs are fuel burning, industrial operations, incinerators, agricultural tilling and motor vehicles. Both fine and coarse particles can accumulate in respiratory system and cause lots of harmful health effects. It can interfere with photosynthesis and plant growth by making a film on plant leaves. It also may cause degradation of property which can be costly for cleaning and maintaining. The same as SO_2 and NO_2, it will reduce visibility by scattering visible light (2).

Ozone (O_3)

Ozone is a colorless, odorless gas formed when nitrogen oxides (from fuel burning sources like automobiles, electric utilities and industrial boilers) and volatile organic compounds (from sources such as gasoline, paints and solvents) react in the presence of sunlight. These two categories of pollutants are also referred to as ozone precursors. The formation of ozone is dependent on the volume of air available for dilution, air temperature and the amount of sunlight (2).

Ozone can irritate the respiratory system, reduce lung function, and make breathing difficult. Children and elder people are even at the greater risk, because their respiratory systems are so sensitive. Ozone will accelerate the aging of many materials like making erosion in paints. This is a toxic gas; therefore it has many harmful effects on plants and trees. The most common symptom of ozone on leafy plants is small flecks visible on the upper leaf surface (2).

Lead (Pb)

Lead is in the fourth column of the periodic table of elements. Its atomic number is 82. Lead compounds can exist in the forms of gases or particles in the atmosphere. The major sources are leaded gasoline, lead-based paints and industrial processes. (2)

It has many harmful health effects on the nervous, kidney and cardiovascular systems. It may also cause severe reaction such as brain diseases. Because of reducing leaded gasoline and removal of lead from soldered cans, the lead emissions declined 78% between 1976 and 1980 and from 1988 to 1991 (2).

Hazardous Air Pollutants (HAPs)

Air pollutants that pose a threat to human health are called air toxics or hazardous air pollutants (HAPs). The risks are greatest for people living in polluted cities and environments. Hazardous air pollution increases the occurrence of cancer and other harmful health effects and also associates with widespread environmental harm. While emission of the criteria pollutants is steady and gradual, there is the possibility for hazardous air pollutants to be released in sudden and often catastrophic accidents. As mentioned before, one of these catastrophic accidents is the 1984 event at a pesticide factory in Bhopal, India, where cyanide gas released into the air and killed approximately 20,000 people and injured 120,000. Though, not as severe as the incident in Bhopal, there are hundreds of instances each year in the United States in which extremely hazardous substances are released into the air accidentally (2).

The air toxics program was established by the Clean Air Act Amendments of 1990 for pollution prevention in industry. A list of 188 toxic air pollutants has been created, along with a 10-year schedule for setting standards for all for pollution prevention in industry. Industries will be required to install the best control technologies that are achievable to meet the new standards. It is expected that this 10-year regulatory effort will reduce emissions of hazardous air pollutants by more than 1 million tons per year in the United States.

Approximately, 70% of these hazardous air pollutants are volatile organic compounds (VOCs). One source of VOCs emissions is a Water and Wastewater Treatment plant, but it may not be as high emission as other major sources. In most water and wastewater treatment plants, Thermal Oxidizers are used to remove many toxic gases from the air and water stream, where the air stream is heated to gas temperatures several hundred degrees Fahrenheit above “autoignition temperatures” of organic compounds that need to be oxidized. The fuel used to produce the necessary amount of heat is digester gas. However, it can be fueled with natural gas. The digester gas contains about 65 to 70 % CH_4 by volume, 25 to 30 % CO_2, and small amounts of N_2, H_2, H_2S, water vapor, and other gases. The two main gases, CH_4 and CO_2, are

Greenhouse Gases (GHGs); therefore, discharging digester gas is a significant contributor to global pollution. Using digester gas is more economical than natural gas, because natural gas prices now are four to five times more than 10 years ago. Digester gas is actually natural gas, just very "young natural gas".

Digester gas is a by-product of anaerobic digestion in wastewater treatment plants. Major application of anaerobic digestion is in the stabilization of concentrated sludge produced from the treatment of wastewater and in the treatment of some industrial wastes. Aerobic digestion needs to supply oxygen to the sludge. In anaerobic digestion, the sludge is fed into an air-free vessel; the digestion produces a gas which is mostly a mixture of methane and carbon dioxide (13, 14).

VOC emissions from wastewater treatment plants are possibly due to incomplete ignition of some toxic gases in the air stream and emissions from fueling of digester gas. Some of these harmful gases are briefly described below. The reason which these are more concerning than others in this study will be discussed later in Chapter IV:

1, 3 – Butadiene

"This is a simple conjugated diene with the formula C_4H_6 and the molecular weight is 54.09 g/mol. 1,3-Butadiene is a colorless gas with a mild gasoline-like odor. The odor threshold for 1,3-butadiene is 1.6 parts per million (ppm). The vapor pressure for 1,3-butadiene is 2100 mm Hg at 25 °C, and it has an octanol/water partition coefficient (log K_{ow}) of 1.99" (13).

"Human studies show that acute exposure to 1,3-butadiene by inhalation results in irritation of the eyes, nasal passages, throat, and lungs. Neurological effects, such as blurred vision, fatigue, headache, and vertigo, have also been reported at very high exposure levels. One epidemiological study reported that chronic (long-term) exposure to 1,3-butadiene via inhalation resulted in an increase in cardiovascular diseases, such as rheumatic and arteriosclerotic heart diseases, while other human studies have reported effects on the blood. Animal studies have reported effects on the respiratory and cardiovascular systems, blood, and liver from chronic inhalation exposure to 1,3-butadiene. EPA has established a Reference Concentration (RfC) for a chronic reference level of 0.002 milligrams per cubic meter (mg/m3) (0.9 ppb) for 1,3-butadiene based on reproductive effects in mice. The RfC is an exposure concentration at or below which adverse health effects are not likely to occur" (13).

Carbon Disulfide

"The chemical formula for carbon disulfide is CS_2, and its molecular weight is 76.14 g/mol. The pure carbon disulfide occurs as a colorless liquid that is not very soluble in water; impure carbon disulfide is yellowish. Carbon disulfide evaporates rapidly at room temperature and is flammable. It has a sweet, pleasant, chloroform-like odor, with an odor threshold of 0.05 mg/m^3. Commercial grades of carbon disulfide have a foul odor, smelling like rotten eggs. The vapor pressure for carbon disulfide is 352.6 mm Hg at 25 °C, and its log octanol/water partition coefficient (log K_{ow}) is 1.84 to 2.16" (14).

"Acute inhalation exposure of humans caused changes in breathing and some chest pains during an accidental release of carbon disulfide. Nausea, vomiting, dizziness, fatigue, headache, mood changes, lethargy, blurred vision, delirium, and convulsions have also been reported in humans acutely exposed by inhalation. Neurotoxic effects have been observed in chronic human and animal inhalation studies. Behavioral and neurophysiological changes, reduced nerve conduction velocity, peripheral neuropathy, and polyneuropathy have been observed in chronically exposed workers. The Reference Concentration for carbon disulfide is 0.7 milligrams per cubic meter (mg/m3) based on neurological effects in humans. The Reference Dose for carbon disulfide is 0.1 milligrams per kilogram body weight per day (mg/kg/d) based on fetal toxicity/malformations in rabbits" (14).

1, 4 – Dichlorobenzene

"The chemical formula for 1,4-dichlorobenzene is $C_6H_4Cl_2$ and the molecular weight is 147.02 g/mol. It is a white solid with a sweet taste and a strong odor. The odor threshold for 1,4-dichlorobenzene is 0.18 parts per million (ppm). The vapor pressure for 1,4-dichlorobenzene is 1.76 mm Hg at 25 °C, and it has a log octanol/water partition coefficient of 3.52" (15).

"Acute exposure to 1,4-dichlorobenzene via inhalation in humans results in irritation to the eyes, skin, and throat. Animal studies have reported effects on the blood, liver, and kidneys from oral exposure to 1,4-dichlorobenzene. Chronic exposure to 1,4-dichlorobenzene by inhalation in humans results in effects on the liver and skin. Animal studies have reported effects on the respiratory system, liver, and kidneys from inhalation exposure to 1,4-dichlorobenzene, while oral studies have reported effects on the blood, liver, and kidneys. The Reference Concentration for 1,4-dichlorobenzene is 0.8 milligrams per cubic meter (mg/m3) based on increased liver weights in rats. EPA has not established a Reference Dose for 1,4-dichlorobenzene" (15).

Methylene Chloride

"A common synonym for methylene chloride is dichloromethane. Methylene chloride is a colorless liquid with a sweetish odor. The chemical formula for methylene chloride is CH_2Cl_2, and the molecular weight is 84.93 g/mol. The vapor pressure for methylene chloride is 349 mm Hg at 20 °C, and it has an octanol/water coefficient (log K_{ow}) of 1.30. Methylene chloride has an odor threshold of 250 parts per million (ppm). Methylene chloride is slightly soluble in water and is nonflammable" (16).

"Case studies of methylene chloride poisoning during paint stripping operations have demonstrated that inhalation exposure to extremely high levels can be fatal to humans. The major effects from chronic inhalation exposure to methylene chloride in humans are effects on the CNS, such as headaches, dizziness, nausea, and memory loss. Animal studies indicate that the inhalation of methylene chloride causes effects on the liver, kidney, CNS, and cardiovascular system. EPA has calculated a provisional Reference Concentration of 3 milligrams per cubic meter (mg/m3) based on liver effects in rats. The Reference Dose for methylene chloride is 0.06 milligrams per kilogram body weight per day (mg/kg/d) based on liver toxicity in rats" (16).

Methyl Ethyl Ketone

"The chemical formula for methyl ethyl ketone is C_4H_8O and the molecular weight is 72.10 g/mol. Methyl ethyl ketone is a colorless volatile liquid that is soluble in water. The odor threshold for methyl ethyl ketone is 5.4 parts per million (ppm), with an acetone-like odor reported. The vapor pressure for methyl ethyl ketone is 95.1 mm Hg at 25 °C, and it has a log octanol/water partition coefficient (log K_{ow}) of 0.261. Methyl ethyl ketone is also referred to as 2-butanone" (17).

"Acute exposure of humans to high concentrations of methyl ethyl ketone produces irritation to the eyes, nose, and throat. Other effects reported from acute inhalation exposure in humans include central nervous system depression, headache, and nausea. Limited information is available on the chronic effects of methyl ethyl ketone in humans from inhalation exposure. One study reported nerve damage in individuals who sniffed a glue thinner containing methyl ethyl ketone and other chemicals. Slight neurological, liver, kidney, and respiratory effects have been reported in chronic inhalation studies of methyl ethyl ketone in animals. The Reference Concentration for methyl ethyl ketone is 1 milligram per cubic meter (mg/m3) based on decreased fetal birth weight in mice. The Reference Dose for methyl ethyl ketone is 0.6 milligrams per kilogram body weight per day (mg/kg/d) based on decreased fetal birth weight in rats" (17).

Natural Gas

Natural gas is an important source of energy to reduce pollution and having clean and healthy air. In addition to being a domestically abundant and secure source of energy, the use of natural gas also offers a number of environmental benefits over other fossil fuels. This section will discuss the environmental effects of natural gas, in terms of emissions and the environmental impact of the natural gas industry itself. (18)

Natural gas is the cleanest among all fossil fuels. Composed mainly of methane, the products of the combustion of natural gas are carbon dioxide and water vapor, the same compounds we exhale when we are breathing. Table IV shows the typical composition of natural gas. Coal and oil are composed of more complex molecules, with a higher carbon ratio and containing higher nitrogen and sulfur molecules. This means at combustion, coal and oil release higher levels of harmful gases, including a higher ratio of carbon emissions, nitrogen oxides, and sulfur dioxide. Coal and fuel oil also release ash particles into the atmosphere. (18)

Table IV - Typical Composition of Natural gas (18)

Compound	**Chemical Formula**	**Volume**
Methane	CH_4	70-90%
Ethane	C_2H_6	0-20%
Propane	C_3H_8	
Butane	C_4H_{10}	
Carbon Dioxide	CO_2	0-8%
Oxygen	O_2	0-0.2%
Nitrogen	N_2	0-5%
Hydrogen sulphide	H_2S	0-5%
Rare gases	A, He, Ne, Xe	trace

However, the combustion of natural gas releases very small amounts of sulfur dioxide and nitrogen oxides, no ash or particulate matter, and lower emissions of carbon dioxide and carbon monoxide. TABLE V shows each fossil fuel emission levels. (18)

Table V - Fossil Fuel Emission Levels (lb per 106 Btu of Energy Input)

Pollutant	**Natural gas**	**Oil**	**Coal**
Carbon Dioxide	117,000	164,000	208,000
Carbon Monoxide	40	33	208
Nitrogen Oxides	92	448	457
Sulfur Dioxide	1	1,122	2,591
Particulates	7	84	2,744
Mercury	0.000	0.007	0.016

(Source: Energy Information Administration, 1998)

The use of fossil fuels for energy causes a number of environmental problems. Natural gas can be used to help reduce the emissions of pollutants into the atmosphere. Burning natural gas in the place of other fossil fuels emits fewer harmful gases into the atmosphere. (18)

One issue that has arisen with regard to natural gas and the greenhouse gas (GHG) effect is the fact that methane, the main component of natural gas, is itself a very potent greenhouse gas. Methane has an ability to trap heat almost 21 times more effectively than carbon dioxide. According to the Energy Information Administration, although methane emissions account for only 1.1 % of total U.S. greenhouse gas emissions, they account for 8.5 % of the greenhouse gas emissions based on global warming potential. The sources for methane emissions in the United States include the waste management and operations industry, and the agricultural industry. (18)

"A major study performed by the EPA and the Gas Research Institute (GRI) in 1997 sought to discover whether the reduction in carbon dioxide emissions from increased natural gas use would be offset by a possible increased level of methane emissions. The study concluded that the reduction in emissions from increased natural gas use strongly outweighs the detrimental effects of increased methane emissions." (18)

"Acid rain is another environmental problem that affects much of the Eastern United States, damaging crops, forests, wildlife populations, and causing respiratory and other illnesses in humans. Acid rain is formed when sulfur dioxide and nitrogen oxides react with water vapor and other chemicals in the presence of sunlight to form various acidic compounds in the air. The principal source of acid rain causing pollutants, sulfur dioxide and nitrogen oxides, are coal-fired power plants. Since natural gas emits virtually no sulfur dioxide, and up to 80 % less nitrogen oxides than the combustion of coal, increased use of natural gas could provide for fewer acid rain causing emissions" (18).

"Natural gas can be used in the transportation sector to cut down on these high levels of pollution from gasoline and diesel powered cars, trucks, and buses. In fact, according to the EPA, compared to traditional vehicles, vehicles operating on compressed natural gas have reductions in carbon monoxide emissions of 90 to 97 %, and reductions in carbon dioxide emissions of 25 %. Nitrogen oxide emissions can be reduced by 35 to 60 %, and other non-methane hydrocarbon emissions could be reduced by as much as 50 to 75 %. In addition, because of the relatively simple makeup of natural gas in comparison to traditional vehicle fuels, there are fewer toxic and carcinogenic emissions from natural gas vehicles, and virtually no particulate emissions" (18).

Global Air Pollution

Air pollution cannot be necessarily limited to a local or regional scale. Atmospheric circulation causes pollution problems to get distributed around the world. Some air pollutants are potent to associate with climate changes of earth; therefore, international actions are needed to restrict their impacts (2).

The two types of compounds involved in global climate change are those that produce free halogen atoms by photochemical reaction which deplete the stratospheric ozone layer, and those that absorb energy in the near infrared region, which may ultimately produce global temperature change (Global Warming) (3). Global warming means the average surface temperature of the earth is increasing globally. Actually, the decade of the 1990s was the warmest decade ever recorded, and this trend of increasing seems to be continuing (2).

The first group mentioned above is comprised mostly of chlorofluorocarbons (CFC), hydrofluorocarbons (HFC), and perfluorocarbons (PFC). Control of these gas emissions involves control of leaks, as from refrigeration systems, and eliminating use of the substances. While chlorofluorocarbon aerosol propellants are useful and convenient, they are not necessary for most applications. For example, aerosol deodorant, cleaners, paint, and hairspray can be replaced by roll-on deodorant, wipe-on cleaners, rolled-on paint, hair mousse (10).

These gases are forms of Greenhouse Gases (GHGs). According to the definition in Section 202(a) of the Clean Air Act of the USEPA, there are six greenhouses gases: carbon dioxide, methane, nitrous oxide, HFC, PFC, and sulfur hexafluoride. These gases can result from human activities, which are known as anthropogenic greenhouse gases, and can be produced naturally and are known as natural greenhouse gases. These six GHGs have common physical properties with regard to the climate change problem: all are long-lived in the atmosphere; all can be well mixed globally regardless of where emitted; all trap heat from the sun; and all are directly emitted as greenhouse gases rather than being formed as greenhouse gas in the atmosphere after emission of precursor gas. Carbon dioxide is the dominant gas among all greenhouse gases.

Air Pollution Control

The need to minimize or control air pollution has been evident for several hundred years. Today, it is obvious that smoke can be more than just a temporary hurt; smoke and other air pollutants affect health and quality of life, esthetic sensibilities, and even climate on a global scale. In a modern industrial society, it is hard to avoid generating at least some waste products that will enter the atmosphere, in one way or another. All in all pollution control strategies, laws, and air quality standards are necessary; and logical principles of engineering and technology must be directed toward the development and use of pollution control equipment (2).

Air Sampling and Measurement

To evaluate air quality and design an efficient air pollution control system, emission rates must be determined from the sources and analyze the type and amounts of pollutants in the gas and surrounding air. Before such measurements can be done, appropriate samples must be collected. The quantification and evaluation of air quality involves accurate determination of pollutant concentrations, which are typically expressed as a ratio of the mass of the pollutant to the volume of air or gas in which it is found.

Measurement of mass is primarily made in an analytical laboratory, while determination of volume is usually measured in the field at the time of sampling. There exist hundreds of methods and types of instruments that can measure pollutant mass. Some instruments require a few milligrams of pollutant for accurate analysis, while others can detect and accurately measure very small amounts, even in the range of a few molecules. There are possibly also many methods and devices for measuring volume, velocity, flow rate. The choice of a technique for sampling and measuring the mass and volume depends on the properties of the sampled gas or air and the specification of the pollutants to be analyzed.

There are three kinds of air sampling: source sampling, ambient sampling, and indoor sampling (2).

Source Sampling

Source (or emission) sampling can be done at the location of a pollutant discharge, such as the exhaust gas from a chimney of any factory, ventilation system, or the tailpipe of an automobile. Source sampling is also termed “stack sampling” at power plant, wastewater treatment plant, or factories where the discharge comes from a chimney or smokestack (2).

Ambient Sampling

Ambient (or atmospheric) sampling is suitable for the measurement of outdoor air pollution levels. Samples are collected from air after pollutants from various sources have been completely dispersed and mixed together under natural conditions. Ambient sampling provides broad areas or background air quality data in urban or rural areas, and uses as a basis for assessing health effects, determining compliance with federal or state ambient air quality standards, and can predict the effects of proposed new sources of air pollution (2).

Indoor Sampling

Indoor air sampling is a kind of industrial and residential health sampling. Industrial hygiene air sampling is made in factories or other workplaces to protect the health of people who may be exposed to pollutants in the whole workday. Residential air sampling, on the other hand, provides data regarding the quality of indoor air in private homes to protect the health of residents (2).

CHAPTER III

SAMPLING PROCEDURE

To capture a valid sample at the RTO of the Morris Forman Wastewater Treatment Plant, first it was determined which sampling ports could provide a representative sample of atmospheric emissions. For safety reasons, ports were installed to allow sampling to occur at ground-level, avoiding, the need to use a ladder with the inherent safety risks. SilcoCan Canisters were used to store the samples to transport them easily to the laboratory and analyze them. Figure 6 shows the type of SilcoCan Canisters used.

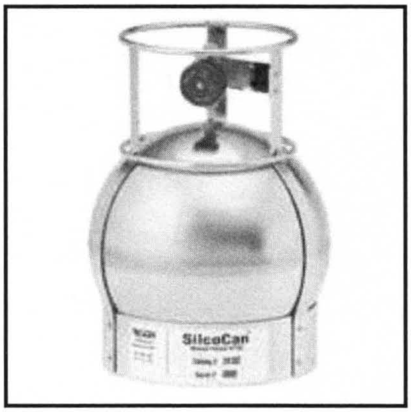

Figure 6 - SilcoCan Canister ("stable to 250 C, Volume of 6 L, and valve of ¼ inch")

It has the following features:

- High quality, metal-to-metal seal, 2/3-turn valve with stainless steel diaphragms.
- Various sizes to support a wide range of sampling needs.
- 2-port or 3-port valve available; 3-port valve includes -30" Hg/60psi vacuum/pressure gauge.

- Unsurpassed inertness, even for sulfur-containing or brominated compounds.

The white tube (1/4 inch internal diameter, Tygon tubing) was used to connect the canisters to the port of the sampling. Figure 7 shows how to set the sampling up.

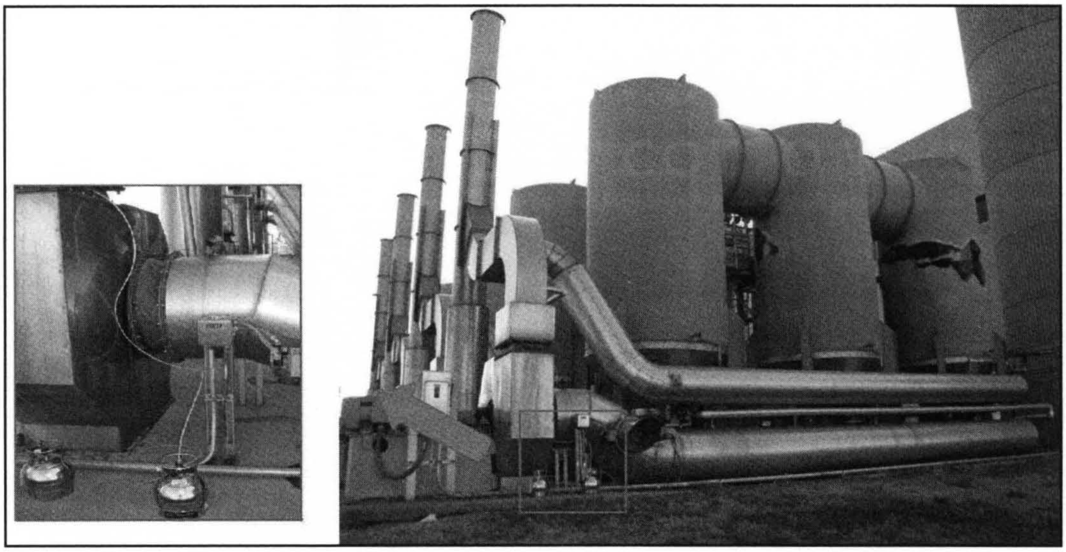

Figure 7 - Sampling set up

Two types of samples were retrieved: one under “Normal Condition” where the system was operated by digester gas, the second type of sample was captured when the system was operated by natural gas. In each case 15 to 20 minutes were allowed for sampling. In order to allow for removal of digester gas from the process, a 5 to 10 minute delay was allowed between the two sampling modes.

First a total of 12 samples were collected, six of which, were from digester gas and the other six were from natural gas operations on Train # 4 and # 1. These samples were taken over five days, including four consecutive days between December 14 to 18, 2009. Then because of some abnormality (like high concentrations of some chemicals in first and/or second events rather than other events, or some chemicals just showed up in one or two events) in this data, another six samples were captured to get a reliable result. Out of the secondary sampling events, the first two events were done on two different Trains. This means that due to some operational conflict in those days, digester gas samples were captured from Train # 1 and natural gas samples were captured from Train # 4. But for the last event, two samples were made using the same procedure as primary sampling (they were retrieved from Train # 4). Also for quality assurance, one field blank sample was captured on the first event of secondary sampling. Table VI shows the Sampling events information. See Appendix B for extended information on the samples chain of custody.

Table VI - Sampling events information

Sampling Date	Canister #	Pre-Sampling Pressure (mm Hg)	Post-Sampling Pressure (mm Hg)	Sampling Site	Analysis Date
12/04/09	6458	50	820	Natural gas, RTO Train # 4, MSD	12/11/09
	6455	50	820	Digester Gas, RTO Train # 4, MSD	12/11/09
12/14/09	2167	50	800	Natural gas, RTO Train # 4, MSD	12/16/09
	2168	50	800	Digester Gas, RTO Train # 4, MSD	01/04/10
12/15/09	2165	50	830	Natural gas, RTO Train # 4, MSD	01/04/10
	2166	50	820	Digester Gas, RTO Train # 4, MSD	01/04/10
12/16/09	2173	50	820	Natural gas, RTO Train # 4, MSD	01/04/10
	2172	50	830	Digester Gas, RTO Train # 4, MSD	01/04/10
12/17/09	2169	50	800	Natural gas, RTO Train # 4, MSD	01/04/10
	2171	50	800	Digester Gas, RTO Train # 4, MSD	01/04/10
12/18/09	2174	50	800	Natural gas, RTO Train # 4, MSD	01/04/10
	6445	50	800	Digester Gas, RTO Train # 4, MSD	01/04/10
02/26/10	6445	50	830	Natural gas, RTO Train # 4, MSD	03/23/10
	6437	50	760	Digester Gas, RTO Train # 1, MSD	03/23/10
	6458			Field Blank	03/23/10
03/05/10	6455	50	830	Natural gas, RTO Train # 4, MSD	03/23/10
	6443	50	810	Digester Gas, RTO Train # 1, MSD	03/23/10
03/12/10	6447	50	780	Natural gas, RTO Train # 4, MSD	03/23/10
	6449	50	790	Digester Gas, RTO Train # 4, MSD	03/23/10

ANALYSIS OF THE SAMPLES

After taking samples from the plant, they were transferred to the Air Quality Laboratory at Ernst Hall. They were analyzed with a Gas Chromatography-Mass Spectrometry (GC-MS) instrument (GC System 6890 series) shown Figure 8 and 9. As the name of GC/MS implies, it is actually two techniques that are combined to form a single method of analyzing mixtures of chemicals. Gas chromatography separates the components of a mixture, and mass spectrometry characterizes each of the components individually. By combining the two techniques, it is possible to both qualitatively and quantitatively evaluate a solution containing a number of chemicals.

"GC-MS can be applied in environmental analysis, fire investigation, explosives investigation drug detection, and identification of some unknown samples. Another important GC-MS application is to be used in airport security to detect substances in luggage or on human bodies. Also it can identify trace elements in materials that were previously thought to have disintegrated beyond identification" (21).

"The GC-MS has been widely heralded as a "gold standard" for forensic substance identification because it is used to perform a specific test. A specific test positively identifies the actual presence of a particular substance in a given sample. A non-specific test merely indicates that a substance falls into a category of substances. Although a non-specific test could statistically suggest the identity of the substance, this could lead to false positive identification" (21). Figure 9 shows the schematic of GC-MS works.

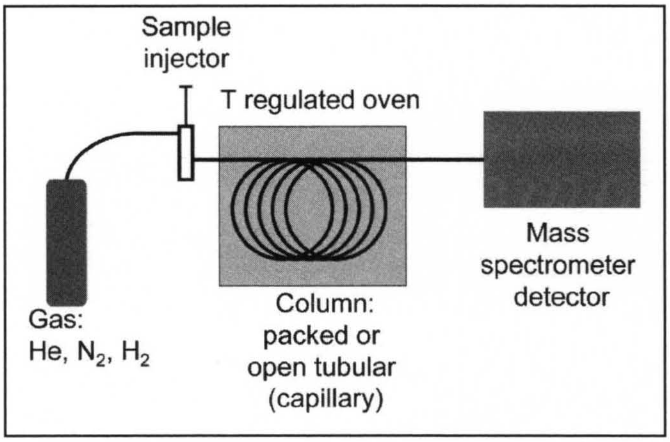

Figure 8 - The schematic view of GC-MS

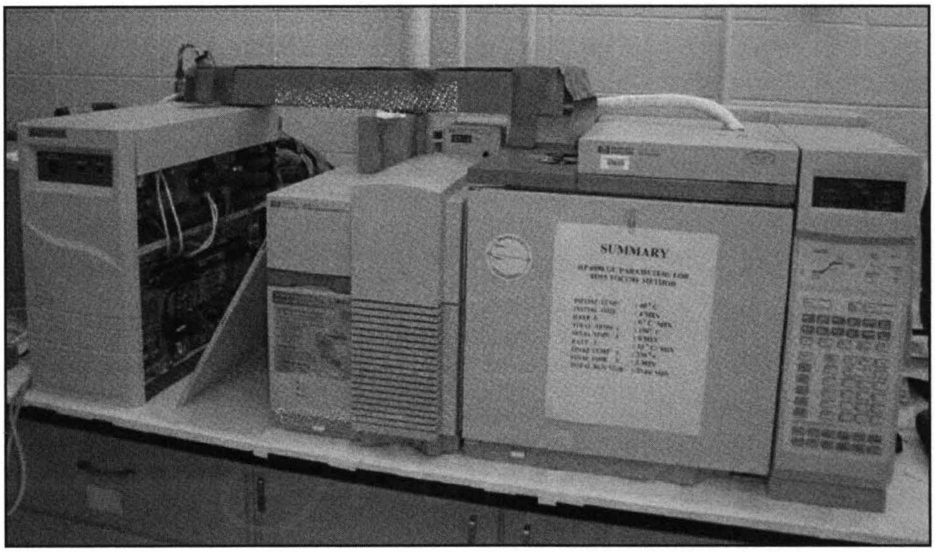

Figure 9 - GC System 6890 series

These series of instruments are very sensitive to highly polluted and molecular weight compounds; before any sampling, one sample was retrived to get the idea of how much dilution is needed for samples analysis. After that, it was decided that the samples need to be diluted 30 times with helium gas.

There are two methods for the determination of toxic volatile organic compounds (VOCs) in air samples. These two methods are Method TO-14A and Method TO-15. Method TO-15 is applicable to a subset of the 87 volatile organic compounds (VOCs) that are from the list of 189 hazardous air pollutants (HAPs) included in Title III of the Clean Air Amendments. By employing water management steps, this method reduces the loss of water-soluble VOCs. Because of this, the analysis list includes polar and non-polar VOCs. In general, Method TO-15 provides information on alternative water management systems that allow for the analysis of polar compounds, has a more complete quality control section, provides performance criteria for any monitoring technique employed, and provides guidance specifically directed at compound identification by mass spectrometry. Table VII shows each method's specification.

Table VII - Method TO-14A and Method TO-15 Specifications (Source: USEPA)

Method Specifications	TO-14A	TO-15
Non-polar VOCs (e.g., toluene, benzene)	x	x
Polar VOCs (e.g., methanol, alcohols, ketones)	-	x
GC/MS instrumentation	x	x
Sample collection by prepared canister (holding time = 30d)	x	x
Sample collection by sorbent tube	x	x
Water management techniques (avoid loss of polar compds)	-	x
Enhanced provisions for quality control	-	x
Method performance criteria	-	x
Selected Ion Monitoring (SIM)	-	x
Specific Cleaning procedures	-	x
Air sample concentrated onto solid sorbent trap	x	x
Use of other detectors for GC (e.g., GC/MD)	x	-
Detection Limit 0.2 – 25 ppbV	x	x

Method TO-15 was selected for this analysis because of the need for an expanded analysis list (especially polar compounds), the need for special canister considerations, and the need for specified quality control tools (method performance criteria for acceptance of data) (EPA, Report # 625/R-96-010b).

Analysis dates were mentioned in Table V. The data from GC-MS will be presented and the limitations on the accuracy of the data and how it may contribute to some of the variability will be explained later in Chapter IV.

CHAPTER IV

DATA AND RESULTS

The data from Gas Chromatography and Mass Spectrometry are in ppb. In order to compare with Inhalation Reference Concentration (RfC), data in both ppb and μg/m^3 are needed. Based on each chemical's molecular weight and Ideal gas constant, R, all concentrations were converted to μg/m^3. Based on the formula below, it can be converted to μg/m^3:

$$C_1 = \frac{C_2 * MW}{R}$$

Where

C_1 = Concentration of the compound (μg/m^3)

C_2 = Concentration of the compound (ppb)

MW = Molecular Weight

R = Ideal Gas Constant at 22 Deg. C = 24.205

For instance, the concentration of 1, 3 – Butadiene in the digester gas sample of Event # 3 is 36.42 ppb. By plugging in the numbers to the formula, the concentration is 81 μg/m^3.

Totally, 24 chemicals have been found in the samples. Table VIII and IX show the chemical's concentration in each sampling event. All units are μg/m^3.

Table VIII - Tabular form of data from Event 1 to Event 4 (All unit in μg/m^3).

COMPOUND	MW	DG 1	NG 1	DG 2	NG 2	DG 3	NG 3	DG 4	NG 4
1, 4 Difluorobenzene	114	19	19	19	19	19	19	19	19
Chlorobenzen-d5	112.56	19	19	19	19	19	19	19	19
Bromochloromethane	129.39	24	24	23	23	22	23	21	22
P-Bromofluorobenzene	174	28	28	28	30	31	29	29	29
Chloromethane	64.52	11	0	0	14	18	21	14	11
1, 3 - Butadiene	54.09	84	16	22	108	81	102	14	13
Acetone	58	354	357	215	660	553	850	500	615
Carbon Disulfide	76.14	14	21	6	18	17	10	14	14
Methyl Ethyl Ketone	72.1	304	73	46	151	135	206	120	135
Benzene	78.1	77	80	39	178	140	191	154	142
Toluene	100.19	16	18	11	57	37	66	45	45
1, 4 - Dichlorobenzene	147.01	45	22	0	0	0	0	0	0
Methylene Chloride	84.94	0	0	11	12	10	10	0	9
Naphthalene	128.16	0	0	12	32	23	10	16	35
Methyl Butyl Ketone	100.16	0	0	0	0	7	17	0	0
Xylene (m or p)	106.17	10	0	0	10	0	9	0	0
Chlorobenzene	112.56	0	0	0	0	0	6	0	0
Styrene	104.16	0	0	0	0	0	7	0	0
Freon 22	86.47	0	0	0	0	0	0	0	0
Methyl Methacrylate	100.12	0	0	0	0	0	0	0	0
Ethylbenzene	106.17	0	0	0	0	0	0	0	0
Hexane	86.18	0	0	0	0	0	0	0	0
O-Xylene	106.17	0	0	0	0	0	0	0	0
1,2,4-TrimethylBenzene	120.2	0	0	0	0	0	0	0	0

Table IX - Tabular form of data from Event 5 to Event 9 (All unit in μg/m^3).

COMPOUND	MW	DG 5	NG 5	DG 6	NG 6	DG 7	NG 7	DG 8	NG 8	DG 9	NG 9
1, 4 Difluorobenzene	114	19	19	19	19	19	19	19	19	19	19
Chlorobenzen-d5	112.56	19	19	19	19	19	19	19	19	19	19
Bromochloromethane	129.39	21	22	23	21	23	22	22	22	22	23
P-Bromofluorobenzene	174	30	30	27	29	29	30	32	30	32	31
Chloromethane	64.52	9	2	10	7	58	15	75	60	10	40
1, 3 - Butadiene	54.09	25	11	21	9	78	0	157	165	75	116
Acetone	58.08	425	313	348	354	961	639	1319	927	447	940
Carbon Disulfide	76.14	9	5	7	5	18	15	25	20	15	36
Methyl Ethyl Ketone	72.1	94	51	77	43	383	188	349	293	213	358
Benzene	78.1	122	50	98	45	220	176	296	270	191	355
Toluene	100.19	32	14	22	13	74	49	122	83	67	146
1, 4 - Dichlorobenzene	147.01	0	0	0	0	31	17	41	37	51	53
Methylene Chloride	84.94	0	9	11	0	15	0	12	16	11	13
Naphthalene	128.16	41	36	10	23	6	12	0	15	22	34
Methyl Butyl Ketone	100.16	0	0	0	0	9	0	15	12	0	14
Xylene (m or p)	106.17	0	0	0	0	0	0	0	0	0	0
Chlorobenzene	112.56	0	0	0	0	10	8	19	11	11	25
Styrene	104.16	0	0	0	0	0	0	12	8	9	14
Freon 22	86.47	0	0	0	0	0	37	0	0	0	0
Methyl Methacrylate	100.12	0	0	0	0	6	0	10	0	0	0
Ethylbenzene	106.17	0	0	0	0	5	0	8	5	0	10
Hexane	86.18	0	0	0	0	0	0	4	0	0	0
O-Xylene	106.17	0	0	0	0	0	0	8	0	0	6
1,2,4-TrimethylBenzene	120.2	0	0	0	0	0	0	0	0	0	8

Discussion

In the RTO, any volatile organics have been treated during the process and what is sampled at the outlet seems safe. From the tables above, it can be observed tha some chemicals like Xylene only have been in a few sampling events, and some others (with regard to their RfC value) like Naphthalene, have a low concentration that are of no concern for health issues because they don't have a considerable risk to health. Because of that, these chemicals can be neglected. The chemicals which were not neglected are:

1. 1, 3 – Butadiene;
2. Carbon Disulfide;
3. 1, 4 – Dichlorobenzene;
4. Methylene Chloride;
5. Methyl Ethyl Ketone.

The physical and chemical properties of these hydrocarbons have been described briefly in chapter II. Based on U.S. EPA researches, these chemicals have the Inhalation Reference Concentrations (RfC) (shown in Table X), the concentrations which are likely to be without risk of deleterious non-cancer effects during a lifetime. The average concentration of nine events, for both digester gas and natural gas samples, for all chemicals were calculated except for 1, 4 – Dichlorobenzene and Methylene Chloride. For 1, 4 – Dichlorobenzene, the average of four events, which it showed up in the samples, was calculated; and for Methylene Chloride, the average of eight events was calculated.

The Detection Limits and the Confidence Interval (95% Confidence Level) of these five chemicals are shown in the Table X. Detection Limit is the lowest quantity of a substance that can be distinguished from the absence of that substance:

Table X - RfC, Average concentration and MQL for five chemicals

Chemical	**RfC** (Source: EPA) ($\mu g/m^3$)	**Avg concentration** ($\mu g/m^3$)		**95 % Confidence Interval**		**Detection Limit** ($\mu g/m^3$)
		NG	**DG**	**NG**	**DG**	
1, 3 - Butadiene	2	60	62	19 - 101	32 - 92	0.23
Carbon Disulfide	700	16	14	13 - 19	10 - 18	0.33
1, 4 - Dichlorobenzene	800	32	42	21 - 43	37 - 47	0.63
Methylene Chloride	3000	9	9	5 - 13	7 - 11	0.36
Methyl Ethyl Ketone	1000	17	19	96 - 236	109 - 273	0.29

Observation

As can be observed from the table above, except for 1, 3 – Butadiene, all other hydrocarbon concentrations are below the RfC values. The graphs of concentration in each event for these five chemicals are presented in Figure 10 to 14. As they show, in the last two or three events the concentrations are high among all sampling events; it is possibly because of operational problems in those days or different weather condition.

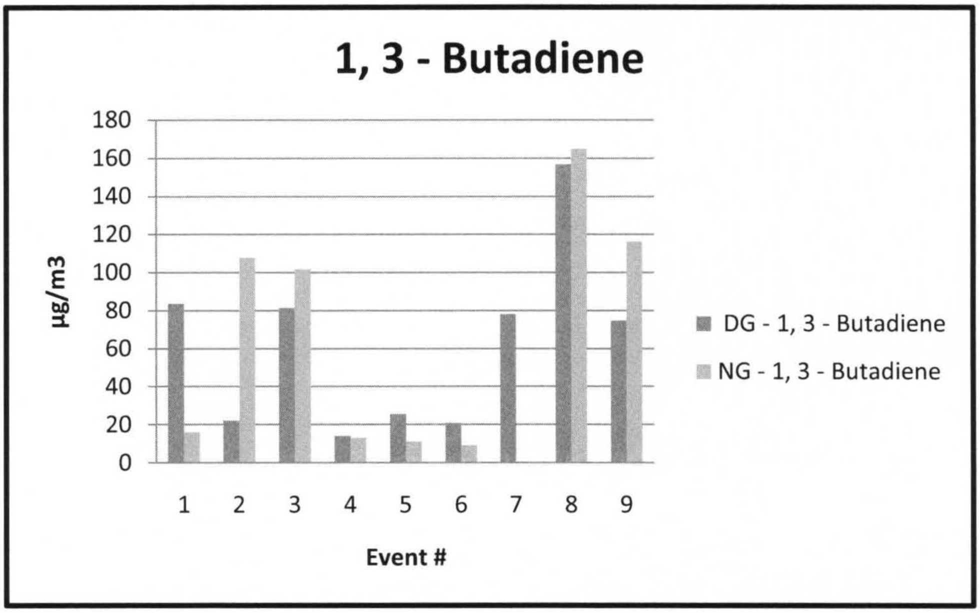

Figure 10 - Graph of concentrations for 1,3 – Butadiene

MQL = 0.23 µg/m3, RfC = 2 µg/m3

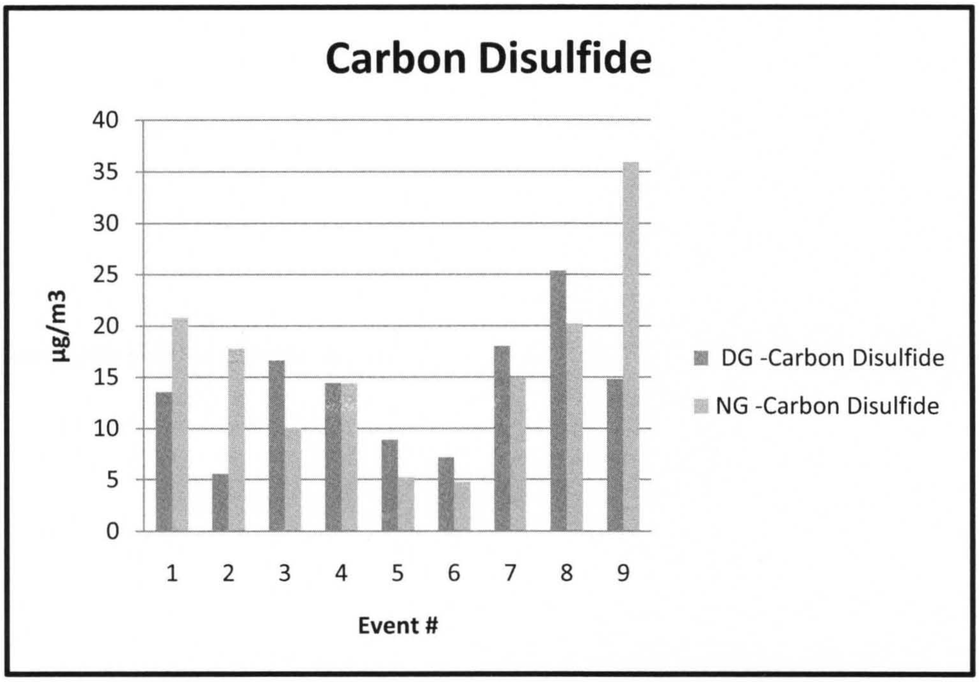

Figure 11 - Graph of concentrations for Carbon Disulfide

MQL = 0.33 µg/m3, RfC = 700 µg/m3

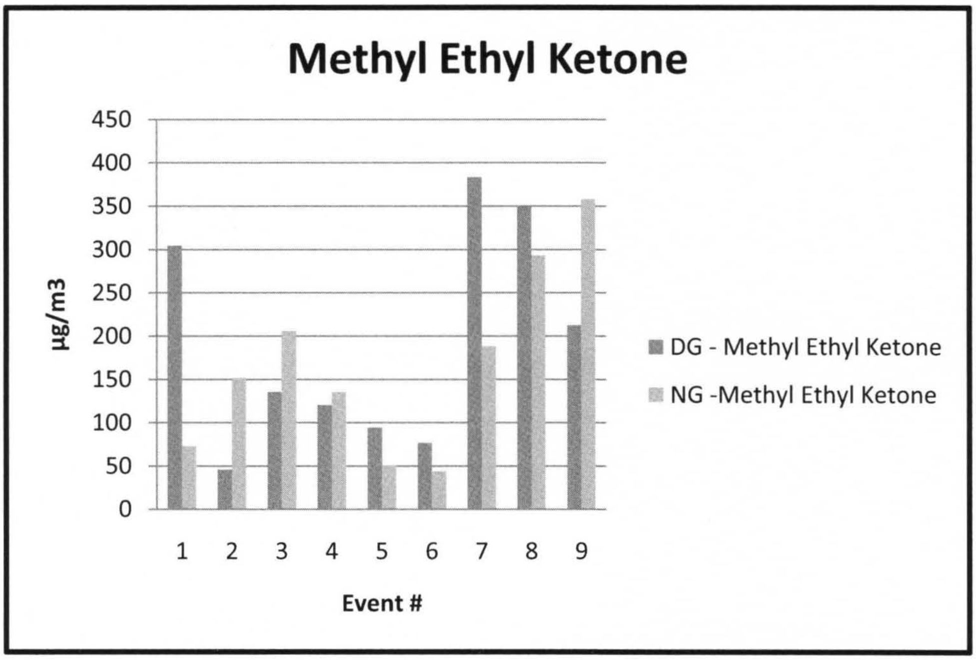

Figure 12 - Graph of concentrations for Methyl Ethyl Ketone

MQL = 0.29 µg/m3, RfC = 1000 µg/m3

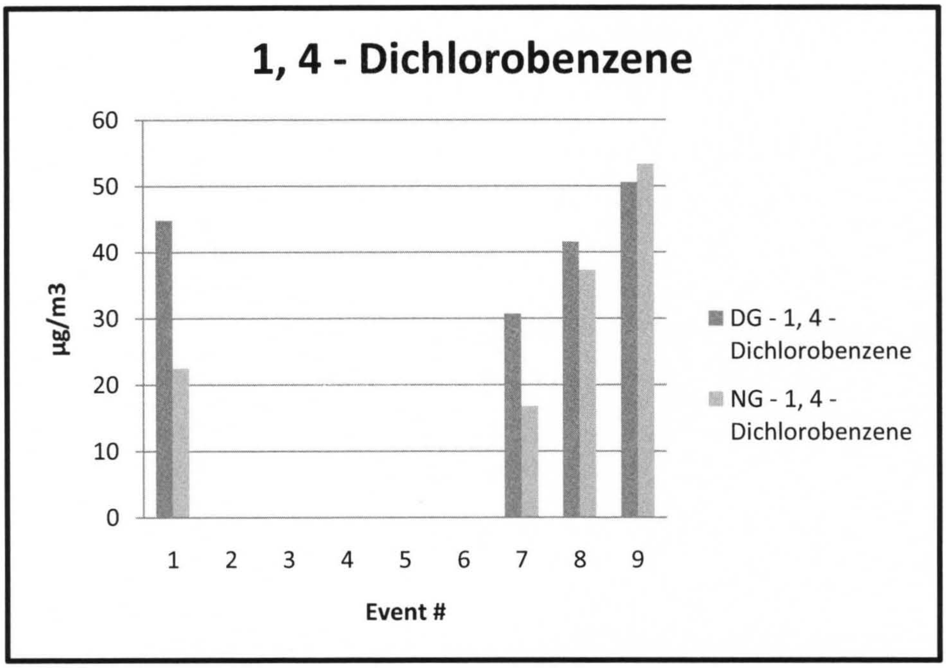

Figure 13 - Graph of concentrations for 1,4 – Dichlorobenzene

MQL = 0.63 µg/m3, RfC = 800 µg/m3

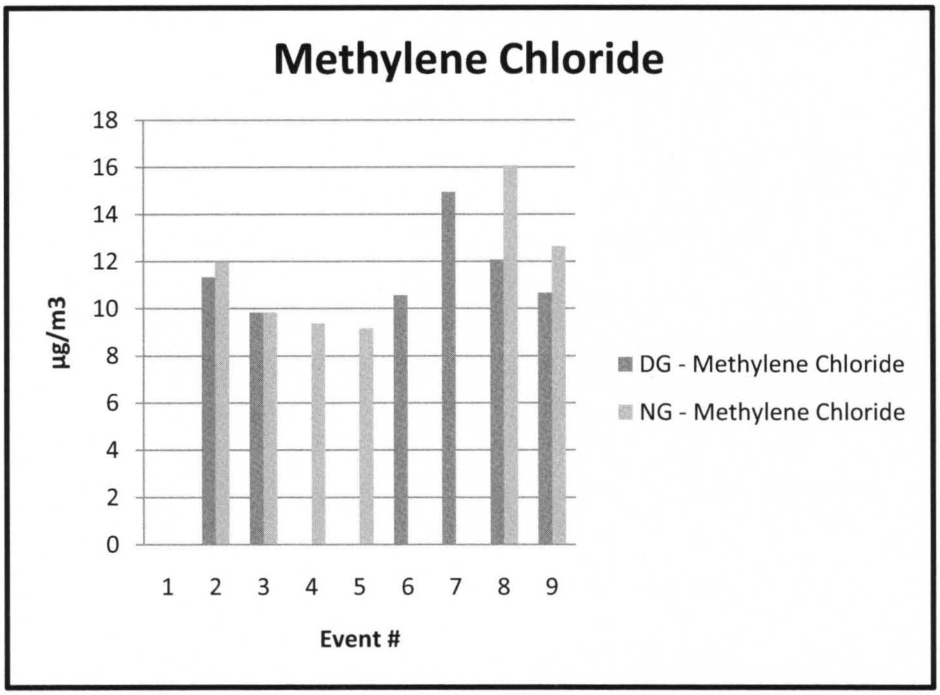

Figure 14 - Graph of concentrations for Methylene Chloride

MQL = 0.36 µg/m3, RfC = 3000 µg/m3

As mentioned before and can be observed from these graphs, the concentrations of these five chemicals are high in last the two to three events. And 1,4 – Dichlorobenzene only showed up in four events. Also the concentrations of these five chemicals in Events 4, 5, and 6 are lower than in other events. Such variability can be observed from these graphs and caused by some limitations in sampling and analysis procedures. These limitations can be:

1. 10 to 15 minutes time for purging the regenerative thermal oxidizer to change the mode from digester gas to natural gas feeding,
2. Having some residual solids and semisolids on the canister valve after sampling in Events 7, 8, and 9. Effort was made to avoid carryover of these semi-solids into the analysis; but within ppb concentrations, it is hard to avoid perfectly.
3. Measuring the samples once, more measurements make more accuracy,
4. Measurement of samples based on 1:30 dilution factor,
5. Accuracy of TO-15 methodology for measurement which is + or – 25% (EPA approved),
6. Possibility of the existence of some VOC residue in the tube used for the connection of the sampling port to canister valve,
7. Possibility of the existence of some VOC residue in the canisters remained after cleaning them for reuse for subsequent events,
8. Sampling in one season of the year; sampling in different weather conditions may be more accurate,
9. Sampling from one port at the outlet of gases. Sampling from different ports leads to have more accuracy.

It should be pointed out that based on the typical composition of natural gas which is shown in Table IV (Chapter II, Page 23), theoretically after the combustion of natural gas, the typical gases which should be at the outlet of RTO are water vapor, carbon dioxide, and carbon monoxide. Therefore, the gases, which were found in the natural gas samples in this study, might result from the residuals of digester gas burning at the combustion chamber of the RTO. In order to address this issue, it may be necessary to allot more than 10 minutes for purging the residual gases at the RTO.

CHAPTER V

CONCLUSIONS

Based on the current study, the result showed there is not much difference between natural gas emission and digester gas emission (as shown in Table X, Chapter IV, and Page 37). In the same table, it was showed that all chemicals concentrations are below RfC value except for 1, 3 – Butadiene.

Use of digester gas instead of natural gas proves to be an economical move without causing any harmful emission. Digester gas as a by-product of water and wastewater treatment is an economical source of energy that can be utilized to greatly reduce operating costs for wastewater treatment facilities. And there is no need to dispose this of by-product. This possible source of energy should not be wasted.

CHAPTER VI

RECOMMENDATION

To further validate the result obtained in this study, further research similar to current research is recommended. In addition to the limitations and observations mentioned in Chapter IV, it is recommended to try to sample from various water and wastewater treatment plants, send the captured samples to different laboratories for analysis, use a better tube for connection of canisters to the sampling port, and use different types of canisters for sampling.

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APPENDIX A – SAMPLE CHAIN OF CUSTODY

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID # 6437

Sampler ID # ———

Circle Sample Type: 24 Hr [✓ Grab] Other:

Sampling Event # and Date: 12/2/09

Sampling Location: MSD TRAIN #2 (Natural Gas)

Pre-Sampling Information

Date/Time Prepared: 6/4/07 4:45Pm By: MG/Jm

Composite Cleaning File: C0604-15.D

Instrument Blank File:

Pressure of Canister: -29.2 in Hg 40 mm Hg

Field Data

Setup By: MG/Jm Collected By: MG/Jm

Start Date/Time: Stop Date/Time:

Initial Pressure: in Hg Final Pressure: in ~~mm~~ Hg

Post-Sampling Information

Date/Time Analyzed: 12/2/09 3:15Pm By: J

GC/MS Sample File: 1130-17.D

Sequence File: 11302009

Pressure of Canister: in Hg mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1				*Set up for sampling*
2	Jm	John Mulage	12/2/09	*Lab analysis*
3				

Notes:

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 6458

Sampler ID #: —

Circle Sample Type: 24 Hr [✓ Grab] 15 min Other:

Sampling Event # and Date: #1, 12/04/09

Sampling Location: MSD, Natural Gas Train# 4

Pre-Sampling Information

Date/Time Prepared: 6/4/07 4:17pm By: J

Composite Cleaning File: C0604-11.D

Instrument Blank File:

Pressure of Canister: -29.2 in Hg 30 mm Hg

Field Data

Setup By: M.G Collected By: M.G

Start Date/Time: 8:30 AM Stop Date/Time: 8:45 AM

Initial Pressure: in Hg Final Pressure: ~~mm~~ in Hg

Post-Sampling Information

Date/Time Analyzed: 12/11/09 3:12Pm By: J

GC/MS Sample File: ~~Snapshot~~ 1210-11.D

Sequence File: Snapshot 1210209

Pressure of Canister: in Hg 820 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M.G		12/04/09	*Set up for sampling*
2	Jim		12/4/09	*Lab analysis*
3				

Notes: 1st dilution= Used 3X dil protocol 14.9→44.7 Psia w/zero N
2nd dilution= Used 50 cc of sample instead of 500 cc = 10X dil
Total dilution = 30 (3X10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 6455

Circle Sample Type: 24 Hr [✓ Grab] 15 Min Other:

Sampler ID #: —

Sampling Event # and Date: #1, 12/04/09

Sampling Location: MSD DIGESTER GAS TRAIN #4

Pre-Sampling Information

Date/Time Prepared: 11/12/08 4 PM By: J

Composite Cleaning File: C1110-14.D

Instrument Blank File: —

Pressure of Canister: -29 in Hg 52 mm Hg

Field Data

Setup By: M.G Collected By: M.G

Start Date/Time: 9:15 AM Stop Date/Time: 9: 30 AM

Initial Pressure: in Hg Final Pressure: in ~~mm~~ Hg

Post-Sampling Information

Date/Time Analyzed: 12/10/09 4:01 PM By: J

GC/MS Sample File: 1210-17.D

Sequence File: 12102009

Pressure of Canister: in Hg 820 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M·G		12/04/09	*Set up for sampling*
2	John M.		12/4/09	*Lab analysis*
3				

Notes: 1st dilution: Used 3x dil protocol 14.8 → 44.4 psia w/ zero N.
2nd dilution: Used 50 cc of sample instead of 500 cc = 10 X dil
Total dilution = 30 (3X10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Natural gas

Canister ID #: 2167

Circle Sample Type: 24 Hr [✓ Grab] Other: 20 min

Sampler ID #: —

Sampling Event # and Date: #2 – 12/14/2009

Sampling Location: MSD – train #4

Pre-Sampling Information

Date/Time Prepared: 12/9/09 4:30P By: J

Composite Cleaning File: ~

Instrument Blank File:

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: M Collected By: M

Start Date/Time: 1:10 PM Stop Date/Time: 1:30 PM

Initial Pressure: in Hg Final Pressure: in ~~mm~~ Hg

Post-Sampling Information

Date/Time Analyzed: 12/16/09 11:45Am By: J

GC/MS Sample File: 1216-04.D

Sequence File: 12162009

Pressure of Canister: in Hg 800 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	MG		12/14/09	*Set up for sampling*
2	Jon		12/14/09	*Lab analysis*
3				

Notes: 1st dilution = Used 3x dil protocol 14.5 - 43.5 psia w/zero N_2
2nd dilution = Used 50 cc of sample instead of 500 cc = 10x dil
Total dilution = 30 (3x10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 2168

Sampler ID #: —

Circle Sample Type: 24 Hr [✓ Grab] Other: Digester gas

Sampling Event # and Date: #2 – 12/14/2009

Sampling Location: MSD – train #4

Pre-Sampling Information

Date/Time Prepared: 12/9/09 4:30pm By: JM

Composite Cleaning File:

Instrument Blank File:

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: M Collected By: M

Start Date/Time: 1:40 PM Stop Date/Time: 1:55 PM

Initial Pressure: in Hg Final Pressure: in ~~mm~~ Hg

Post-Sampling Information

Date/Time Analyzed: By:

GC/MS Sample File:

Sequence File:

Pressure of Canister: in Hg 800 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M.G		12/14/09	*Set up for sampling*
2	J.M	John Metzgar	12/14/09	*Lab analysis*
3				

Notes: 1st dilution = Used 3x dil protocol 14.5 → 43.5 psia w/ zero N_2
2nd dilution = Used 50 cc of sample instead of 500 cc = 10 X dil
Total dilution = 30 (3x10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Natural gas

Canister ID #: 2165

Circle Sample Type: 24 Hr [✓ Grab] Other: 15 min

Sampler ID #: —

Sampling Event # and Date: #3 – 12/15/09

Sampling Location:

Pre-Sampling Information

Date/Time Prepared: 12/9/09 4:30pm By: JM

Composite Cleaning File: —

Instrument Blank File: —

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: M.G Collected By: M.G

Start Date/Time: 2:00 PM Stop Date/Time: 2:15 PM

Initial Pressure: in Hg Final Pressure: in Hg

Post-Sampling Information

Date/Time Analyzed: By:

GC/MS Sample File:

Sequence File:

Pressure of Canister: in Hg 830 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M.G			*Set up for sampling*
2	JM	John Metzger	12/15/09 3:30pm	*Lab analysis*
3				

Notes: 1st dilution = Used 3x dil protocol 14.5 → 43.6 psia w/ zero N_2
2nd dilution = Used 50 cc of sample instead of 500 cc = 10 x dil
Total dilution = 30 (3x10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Digester gas

Canister ID #: 2166

Sampler ID #: —

Circle Sample Type: 24 Hr [✓ Grab] 15 Min Other:

Sampling Event # and Date: #3 – 12/15/2009

Sampling Location: MSD – train #4

Pre-Sampling Information

Date/Time Prepared: 12/9/09 4:30pm By: JM

Composite Cleaning File:

Instrument Blank File:

Pressure of Canister: – 29 in Hg 58 mm Hg

Field Data

Setup By: M.G Collected By: M.G

Start Date/Time: 1:30 PM Stop Date/Time: 1:45 PM

Initial Pressure: in Hg Final Pressure: in ~~mm~~ Hg

Post-Sampling Information

Date/Time Analyzed: By:

GC/MS Sample File:

Sequence File:

Pressure of Canister: in Hg 820 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M.G		12/15/09	*Set up for sampling*
2	J.M	John Metzger	12/15/09 3:30pm	*Lab analysis*
3				

Notes: 1st dilution = Used 3x dil protocol 14.5 → 43.6 Psia w/ zero N_2
2nd dilution = Used 50 cc of sample instead of 500 cc = 10 x dil
Total dilution = 30 (3x10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 2173

Circle Sample Type: 24 Hr [✓ Grab] Other: Natural gas 15 min

Sampler ID #:

Sampling Event # and Date: # 4 — 12/16/09

Sampling Location: MSD – train # 4

Pre-Sampling Information

Date/Time Prepared: 12/14/09 2:15p By: J

Composite Cleaning File:

Instrument Blank File:

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: M.G Collected By: M G

Start Date/Time: 1:40 PM Stop Date/Time: 1:55 PM

Initial Pressure: in Hg Final Pressure: in ~~mm~~ Hg

Post-Sampling Information

Date/Time Analyzed: 1/4/10 12:26p By: J

GC/MS Sample File: 0104-04.D

Sequence File: 01042010

Pressure of Canister: in Hg 820 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M.G		12/16/09	*Set up for sampling*
2	J. M	John Melaxas	12/16/09	*Lab analysis*
3				

Notes: 1st dilution = Used 3x dil protocol 14.7 → 44.1 Psia w/zero N_2
2nd dilution = Used 50 cc of sample instead of 500 cc = 10 x dil
Total dilution = 30 (3x10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Digester gas

Canister ID #: 2172

Circle Sample Type: 24 Hr [✓ Grab] Other: 18 Min

Sampler ID #: —

Sampling Event # and Date: #4 – 12/16/09

Sampling Location: MSD — train #4

Pre-Sampling Information

Date/Time Prepared: 12/14/09 1:15pm By: J

Composite Cleaning File:

Instrument Blank File:

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: MG Collected By: M.G

Start Date/Time: 1:10 PM Stop Date/Time: 1:28 PM

Initial Pressure: in Hg Final Pressure: ~~mm~~ in Hg

Post-Sampling Information

Date/Time Analyzed: 1/4/10 1:17pm By: Jn

GC/MS Sample File: 0104-05.D

Sequence File: 01042010

Pressure of Canister: in Hg 830 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M G		12/16/09	*Set up for sampling*
2	J. n	John	12/16/09	*Lab analysis*
3				

Notes: 1st dilution: Used 3x dilution protocol 14.8 → 44.4 psia w/ zero N_2
2nd dilution: Used 50 cc of sample instead of 500 cc = 10x dil
Total dilution = 30 (3x10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID # 2169

Sampler ID # —

Circle Sample Type: 24 Hr [✓ Grab] Other: Natural gas 15 Min

Sampling Event # and Date: #5 – 12/17/09

Sampling Location: MSD – train #4

Pre-Sampling Information

Date/Time Prepared: 12/15/09 1pm By: JM

Composite Cleaning File:

Instrument Blank File:

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: M.G Collected By: M.G

Start Date/Time: 2:01 PM Stop Date/Time: 2:16 PM

Initial Pressure: in Hg Final Pressure: in Hg

Post-Sampling Information

Date/Time Analyzed: 01/04/10 2:01 P By: J

GC/MS Sample File: 0104-06.D

Sequence File: 01042010

Pressure of Canister: in Hg 800 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M.G		12/17/09	*Set up for sampling*
2	JM	John Meloan	12/17/09	*Lab analysis*
3				

Notes: 1st dilution = Used 3x dilution protocol 14.5 → 43.5 psia w/ zero N_2
2nd dilution: Used 50 cc of sample instead of 500 cc = 10 X dil
Total dilution = 30 (3 X 10

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Digester
gas
15 Min

Canister ID #: 2171
Circle Sample Type: 24 Hr [✓ Grab] Other:
Sampler ID #: —

Sampling Event # and Date: #5 – MSD train #4 – 12/17/09

Sampling Location: MSD train #4

Pre-Sampling Information
Date/Time Prepared: 12/15/09 By: JM
Composite Cleaning File:
Instrument Blank File:
Pressure of Canister: -29 in Hg 10 mm Hg

Field Data
Setup By: M.G 1:20 PM Collected By: M.G
Start Date/Time: 1:20 PM Stop Date/Time: 1:35 PM
Initial Pressure: in Hg Final Pressure: in ~~mm~~ Hg

Post-Sampling Information
Date/Time Analyzed: 1/4/10 2:49 Pm By: J
GC/MS Sample File: 0104-07.D
Sequence File: 01042010
Pressure of Canister: in Hg 800 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M G		12/17/2009	*Set up for sampling*
2	J.M	John Metaxa	12/17/09	*Lab analysis*
3				

Notes: 1st dilution = Used 3X dilution protocol 14.7 → 44.1 Psia w/zero N_2
2nd dilution = Used 50 cc of sample instead of 500 cc = 10 X dilution
Total dilution = 30 (3x10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 2174
Circle Sample Type: 24 Hr [✓ Grab] Other: Natural gas 15 Min
Sampler ID #:

Sampling Event # and Date: #6 – 12/18/09
Sampling Location: MSD – train #4

Pre-Sampling Information
Date/Time Prepared: 12/14/09 2:15 pm By: J
Composite Cleaning File: –
Instrument Blank File: –
Pressure of Canister: –29 in Hg 30 mm Hg

Field Data
Setup By: M.G Collected By: M.G
Start Date/Time: 1:25 PM Stop Date/Time: 1:40 PM
Initial Pressure: in Hg Final Pressure: ~~mm~~ in Hg

Post-Sampling Information
Date/Time Analyzed: 1/4/10 3:43 pm By: J
GC/MS Sample File: 0104-08.D
Sequence File: 01042010
Pressure of Canister: in Hg 800 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M.G		12/18/09	*Set up for sampling*
2	Jn		12/18/09	*Lab analysis*
3				

Notes: 1st dilution = used 3x dilution protocol 14.9 → 44.7 Psia w/zero N_2
2nd dilution = used 50 cc of sample instead of 500 cc = 10 X dilution
Total dilution = 30 (3x10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 6445

Sampler ID #:

Circle Sample Type: 24 Hr [✓ Grab] Other: Digester gas 17 min

Sampling Event # and Date: #6 — 12/18/09

Sampling Location: MSD — train #4

Pre-Sampling Information

Date/Time Prepared: 6/4/07 4:12 pm By: Z

Composite Cleaning File: C0604-15.D

Instrument Blank File: ✓

Pressure of Canister: -29.1 in Hg 50 mm Hg

Field Data

Setup By: M.G Collected By: M.G

Start Date/Time: 12:58 PM Stop Date/Time: 1:15 PM

Initial Pressure: in Hg Final Pressure: in Hg

Post-Sampling Information

Date/Time Analyzed: 1/4/10 4:31 pm By: J

GC/MS Sample File: 0104-09.D

Sequence File: 01042010

Pressure of Canister: in Hg 800 mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	M.G		12/18/09	*Set up for sampling*
2	Jm	John Meloyan	12/18/09	*Lab analysis*
3				

Notes: 1st dilution : Used 3X dil protocol 14.5 → 43.5 psia w/ N_2
2nd dilution : used 50 cc of sample instead of 500 cc = 10X dil
Total dilution = 30 (3X10)

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 6458

Circle Sample Type: **24 Hr** **Grab** **Other:** FB (Field blank)

Sampler ID #:

Sampling Event # and Date: 2/26/10

Sampling Location:

Pre-Sampling Information

Date/Time Prepared: 1/15/10 11:30A By: Jn

Composite Cleaning File: C0114-02.D

Instrument Blank File:

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: Collected By:

Start Date/Time: Stop Date/Time:

Initial Pressure: in Hg Final Pressure: in Hg

Post-Sampling Information

Date/Time Analyzed: 3/23/10 11:05 Am By: J

GC/MS Sample File: 0323-03.D

Sequence File: 03232010

Pressure of Canister: in Hg mm Hg

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1				*Set up for sampling*
2	Jn	John [illegible]	3/1/10 12:15P	*Lab analysis*
3				

Notes: Pressurized to 660 mmHg with Zero N_2

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 6445
Sampler ID #:
Circle Sample Type: 24 Hr [✓ Grab] Other:

15 min
train #4
Just on
natural
gas today

Sampling Event # and Date: Event 7 — 02/26/10
Sampling Location: MSD — train # 4

Pre-Sampling Information
Date/Time Prepared: 1/19/10 11:30 Am By: J
Composite Cleaning File: C0114-02.D
Instrument Blank File: —
Pressure of Canister: -25 in Hg 170 mm Hg

Field Data
Setup By: M.G Collected By: M.G
Start Date/Time: 10:18 Stop Date/Time: 10:33
Initial Pressure: in Hg Final Pressure: in Hg

Post-Sampling Information
Date/Time Analyzed: 3/23/10 11:50 Am By: J
GC/MS Sample File: 0323-04.D
Sequence File: 03232010
Pressure of Canister: in Hg 830 mm Hg 3/24/10 12 Nm

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	[illegible]	[illegible]	02/26/10	*Set up for sampling*
2	Jn	John [illegible]	3/1/10 12:15 Pm	*Lab analysis*
3				

Notes:

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 6437

Sampler ID #:

Circle Sample Type: 24 Hr [✓ Grab] Other: 15 min Digester gas train # 1

Sampling Event # and Date: #7 - 02/26/10

Sampling Location: MSD - train # 1

Pre-Sampling Information

Date/Time Prepared: 1/19/10 11:30A By: J

Composite Cleaning File: C0114-02.D

Instrument Blank File: —

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: M.G Collected By: M.G

Start Date/Time: 10:37 Stop Date/Time: 10:52

Initial Pressure: in Hg Final Pressure: in Hg

Post-Sampling Information

Date/Time Analyzed: 3/23/10 12:39P By: J

GC/MS Sample File: 0323-05.D

Sequence File: 03232010

Pressure of Canister: in Hg 760 mm Hg 3/10/10 11:50A

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	Mahyar Ghorbanian		02/26/10	*Set up for sampling*
2	J	John Metaxa	3/1/10 12:15P	*Lab analysis*
3				

Notes:

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Natural gas
15 min

Canister ID #: 6455
Sampler ID #:
Circle Sample Type: 24 Hr [✓ Grab] Other:

Sampling Event # and Date: #8 — 03/05/10
Sampling Location: MSD – Train #4

Pre-Sampling Information
Date/Time Prepared: 1/19/10 11:30 Am By: [illegible]
Composite Cleaning File: C0114-02.D
Instrument Blank File:
Pressure of Canister: -29 in Hg 50 mm Hg

Field Data
Setup By: M·G Collected By: M·G
Start Date/Time: 10:30 AM Stop Date/Time: 10:45 AM
Initial Pressure: in Hg Final Pressure: in Hg

Post-Sampling Information
Date/Time Analyzed: 3 23 10 1:27 Pm By: [illegible]
GC/MS Sample File: 0323-06.D
Sequence File: 03232010
Pressure of Canister: in Hg 830 mm Hg

3/22/10
12:25 P

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	[illegible]		03/05/10	*Set up for sampling*
2	Jim		3/[illegible]/10	*Lab analysis*
3				

Notes:

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 6443

Circle Sample Type: 24 Hr [✓ Grab] Other:

Digester gas
15 Min

Sampler ID #:

Sampling Event # and Date: #8 - MSD Train # 1 — 03/05/10

Sampling Location: MSD - Train # 1

Pre-Sampling Information

Date/Time Prepared: 1/9/09 2:45 Pm By: J

Composite Cleaning File: C0108-14.D

Instrument Blank File: —

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: M.G Collected By: M.G

Start Date/Time: 10:48 AM Stop Date/Time: 11:03

Initial Pressure: in Hg Final Pressure: in Hg

Post-Sampling Information

Date/Time Analyzed: 3/23/10 2:41p By: J

GC/MS Sample File: 0323-07.D

Sequence File: 03232010

Pressure of Canister: in Hg 810 mm Hg 3/22/10 12:20pm

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	Mahyar [illegible]		03/05/10	*Set up for sampling*
2	J M	John [illegible]	3/12/10	*Lab analysis*
3				

Notes:

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID # 6447

Circle Sample Type: 24 Hr [✓ Grab] Other: Natural gas

Sampler ID #

Sampling Event # and Date: 9 — 03/12/10

Sampling Location: MSD — Train #4

Pre-Sampling Information

Date/Time Prepared: 1/9/09 2:45p By: J

Composite Cleaning File: C0108-14.D

Instrument Blank File: —

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: M.G Collected By: M.G

Start Date/Time: 10:55 AM Stop Date/Time: 11:10 AM

Initial Pressure: in Hg Final Pressure: in Hg

Post-Sampling Information

Date/Time Analyzed: 3/23/10 3:02pm By: J

GC/MS Sample File: 0323-08.D

Sequence File: 03232010

Pressure of Canister: in Hg 780 mm Hg 3/24/10 12:15p

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	Mahyar Ghorbanian		03/12/10	*Set up for sampling*
2	J	John Metaxas	3/12/10	*Lab analysis*
3				

Notes:

Air Toxics Sample Chain of Custody

University of Louisville Air Quality Laboratory
Ernst Hall room 202, Univ. of Louisville, Louisville KY 40292
Phone 502-852-2734

Canister ID #: 6449

Circle Sample Type: 24 Hr [✓ Grab] Other: Digester gas 15 Min

Sampler ID #:

Sampling Event # and Date: #9 — 03/12/10

Sampling Location: MSD — Train #4

Pre-Sampling Information

Date/Time Prepared: 1/9/09 2:45pm By: J

Composite Cleaning File: C0109-14.D

Instrument Blank File: —

Pressure of Canister: -29 in Hg 50 mm Hg

Field Data

Setup By: M G Collected By: M G

Start Date/Time: 10:30AM Stop Date/Time: 10:45AM

Initial Pressure: in Hg ~~Final~~ Pressure: in ~~mm~~ Hg

Post-Sampling Information

Date/Time Analyzed: 3/23/10 3:49pm By: Jm

GC/MS Sample File: 0323-09.D

Sequence File: 03232010

Pressure of Canister: in Hg 790 mm Hg 3/22/10 2:22 pm

Chain of Custody

	Recipient(Print)	Signature	Date/Time	Reason for transfer
1	Mahyar Ghobanian		03/12/10	*Set up for sampling*
2	Jm	John Metaxas	3/12/10	*Lab analysis*
3				

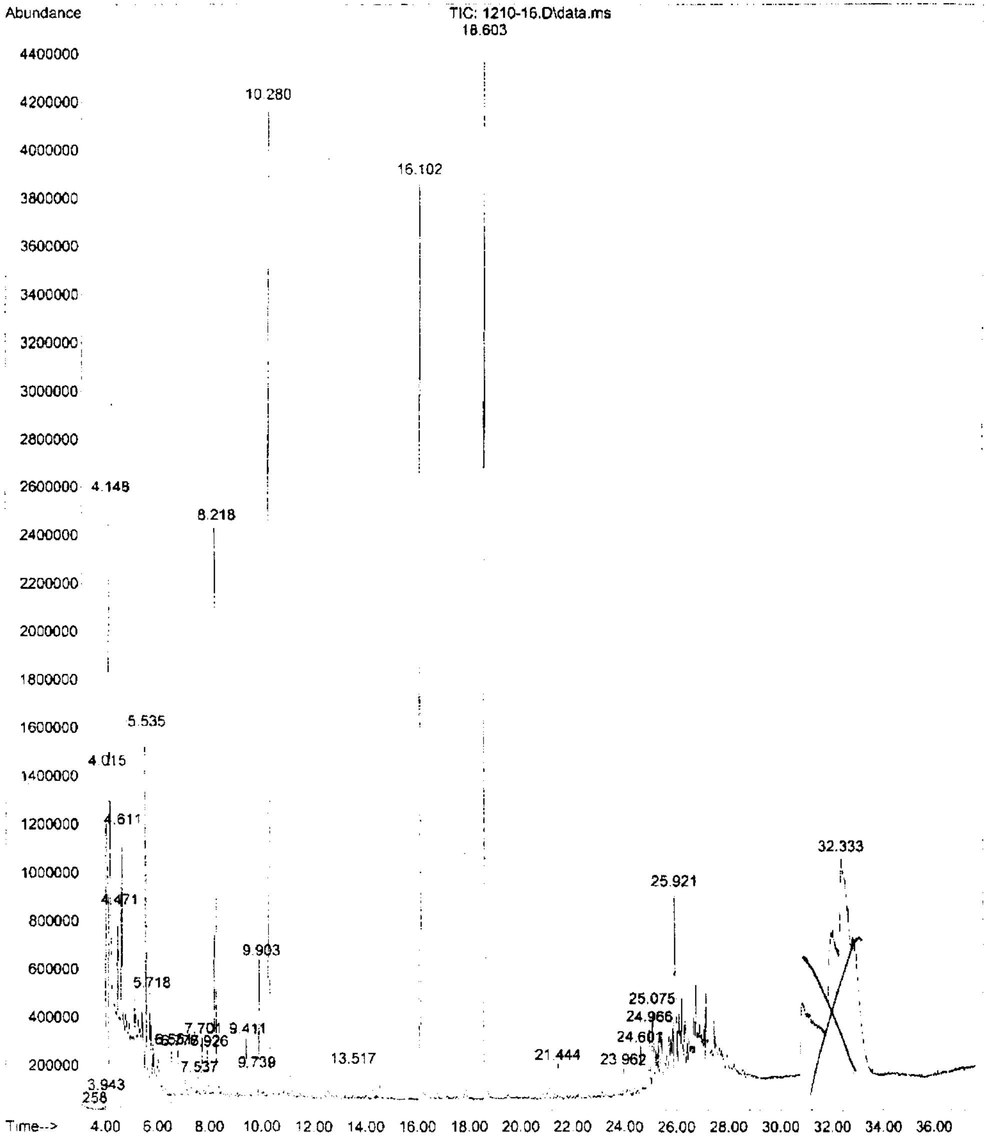
Notes:

APPENDIX B – CHROMATOGRAPHS AND QUANTITATION REPORTS FROM GC/MS MEASUREMENTS

#1

```
File        :C:\msdchem\1\DATA\12102009\Snapshot\1210-16.D
Operator    : JM
Acquired    : 11 Dec 2009   3:12 pm using AcqMethod TO15PPBB.M
Instrument  :    5973A MSD
Sample Name: 100cc IS,50cc,AS15,6458,TO15.mpt
Misc Info   : MSD,Natural Gas, Train #4, 35-300amu @4.64min
Vial Number: 17
```

Collected 12/4/09



```
                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\12102009\Snapshot\
Data File : 1210-16.D
Acq On    : 11 Dec 2009   3:12 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,6458,TO15.mpt
Misc      : MSD,Natural Gas, Train #4, 35-300amu @4.64min
ALS Vial  : 17   Sample Multiplier: 30

Quant Time: Dec 14 10:18:22 2009
Quant Method : C:\msdchem\1\METHODS\T015ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Fri Dec 11 10:00:41 2009
Response via : Continuing Cal File: C:\msdchem\1\DATA\12102009\A1210-13.D

 Internal Standards               R.T. QIon  Response  Conc Units Dev(Min)
-------------------------------------------------------------------------
  1) 1,4-Difluorobenzene         10.280  114  3815999     4.12 ppbv    0.00
 53) Chlorobenzene-d5            16.102   82  1731503     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane           8.218  128   830837     4.39 ppbv    0.00
 64) p-Bromofluorobenzene        18.603  174  1653193     3.89 ppbv    0.00

 Target Compounds                                                   Qvalue
  2) Freon 22 (CLF2Methane)       0.000   67        0     N.D.
  3) Freon 12 (Cl2F2Methane)      0.000   85        0     N.D.
  4) Chloromethane                0.000   50        0     N.D.
  5) Freon 114 (Cl2F4Ethane)      0.000   85        0     N.D.
  6) Vinyl Chloride               0.000   62        0     N.D.
  7) 1,3- Butadiene               4.641   54    36359m    7.11 ppbv
  8) Bromomethane                 0.000   94        0     N.D.
  9) Chloroethane                 0.000   64        0     N.D.
 10) Acetone                      5.535   58   609338m  148.63 ppbv
 11) Freon 11 (Cl3Fmethane)       0.000  101        0     N.D.
 12) Acrylonitrile                0.000   53        0     N.D.
 13) 1,1-Dichloroethene           0.000   96        0     N.D.
 14) Methylene Chloride           0.000   84        0     N.D.
 15) Methyl Acetate               0.000   43        0     N.D.
 16) Freon 113 (Cl3F3Ethane)      0.000  101        0     N.D.
 17) Carbon Disulfide             6.551   76   153810m    6.62 ppbv
 18) Trans-1,2-Dichlorothene      0.000   96        0     N.D.
 19) 1,1-Dichloroethane           0.000   63        0     N.D.
 20) Methyl T-Butyl Ether (...    0.000   73        0     N.D.
 21) Methyl Ethyl Ketone(2-...    7.707   43   381837    24.47 ppbv       98
 22) Chloroprene(2-Cl-1,3-B...    0.000   88        0     N.D.
 23) cis-1,2-Dichloroethene       0.000   96        0     N.D.
 25) Hexane                       0.000   57        0     N.D.
 26) Chloroform                   0.000   83        0     N.D.
 27) 2,2-Dichloropropane          0.000   77        0     N.D.
 28) Dibromofluoromethane (...    0.000  111        0     N.D.
 29) 1,2- Dichloroethane          0.000   62        0     N.D.
 30) 1,1,1-Trichloroethane        0.000   97        0     N.D.
 31) 1,1- Dichloropropene         0.000   75        0     N.D.
 32) Benzene                      9.909   78   616704    24.67 ppbv       99
 33) Carbon Tetrachloride         0.000  117        0     N.D.
 34) Cyclohexane                  0.000   84        0     N.D.
 35) Dibromomethane               0.000  174        0     N.D.
 36) 1,2-Dichloropropane          0.000   63        0     N.D.
 37) Ethyl Acrylate               0.000   55        0     N.D.
 38) Bromodichloromethane         0.000   83        0     N.D.
 39) Trichloroethene              0.000  132        0     N.D.
 40) Methyl Methacrylate          0.000   69        0     N.D.
 41) cis-1,3-Dichloropropene      0.000   75        0     N.D.
 42) Methyl Isobutyl Ketone       0.000   58        0     N.D.
 43) Methyl Cyclohexane           0.000   98        0     N.D.
 44) trans-1,3-Dichloropropene    0.000   75        0     N.D.
```

```
 45) 1,1,2-Trichloroethane       0.000    97        0      N.D.
 46) Toluene-d8  (SMC)           0.000    98        0      N.D.
 47) Toluene                    13.517    91   127993     4.27 ppbv        96
 48) 1,3-Dichloropropane         0.000    76        0      N.D.
 49) Methyl Butyl Ketone(2-...   0.000    43        0      N.D.
 50) Dibromochloromethane        0.000   129        0      N.D.
 51) 1,2- Dibromoethane          0.000   107        0      N.D.
 52) Tetrachloroethene           0.000   166        0      N.D.
 54) 1,1,1,2 - Tetrachloroe...   0.000   131        0      N.D.
 55) Chlorobenzene               0.000   112        0      N.D.
 56) Ethylbenzene                0.000    91        0      N.D.
 57) (m and /or p) Xylene        0.000    91        0      N.D.
 58) Bromoform                   0.000   173        0      N.D.
 59) Butyl Acrylate              0.000    55        0      N.D.
 60) Styrene                     0.000   104        0      N.D.
 61) 1,1,2,2-Tetrachloroethane   0.000    83        0      N.D.
 62) o-Xylene (1,2-Dimethyl...   0.000    91        0      N.D.
 63) 1,2,3-Trichloropropane      0.000   110        0      N.D.
 65) Isopropylbenzene            0.000   105        0      N.D.
 66) Bromobenzene                0.000   156        0      N.D.
 67) o-Chlorotoluene             0.000   126        0      N.D.
 68) n-Propylbenzene             0.000   120        0      N.D.
 69) p-Chlorotoluene             0.000   126        0      N.D.
 70) 1,3,5-Trimethylbenzene      0.000   105        0      N.D.
 71) tert-Butylbenzene           0.000   134        0      N.D.
 72) 1,2,4-Trimethylbenzene      0.000   105        0      N.D.
 73) 1,3-Dichlorobenzene         0.000   146        0      N.D.
 74) 1,4-Dichlorobenzene        21.438   146    97498m    3.70 ppbv
 75) sec-Butylbenzene            0.000   105        0      N.D.
 76) p-Isopropyltoluene          0.000   119        0      N.D.
 77) 1,2-Dichlorobenzene         0.000   146        0      N.D.
 78) n-Butylbenzene              0.000    91        0      N.D.
 79) 1,2-Dibromo-3-chloropr...   0.000   157        0      N.D.
 80) 1,2,4-Trichlorobenzene      0.000   180        0      N.D.
 81) Naphthalene                 0.000   128        0      N.D.
 82) 1,2,3-Trichlorobenzene      0.000   180        0      N.D.
 83) Hexachlorobutadiene         0.000   225        0      N.D.
--------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 13:45:27 2010
```

#1

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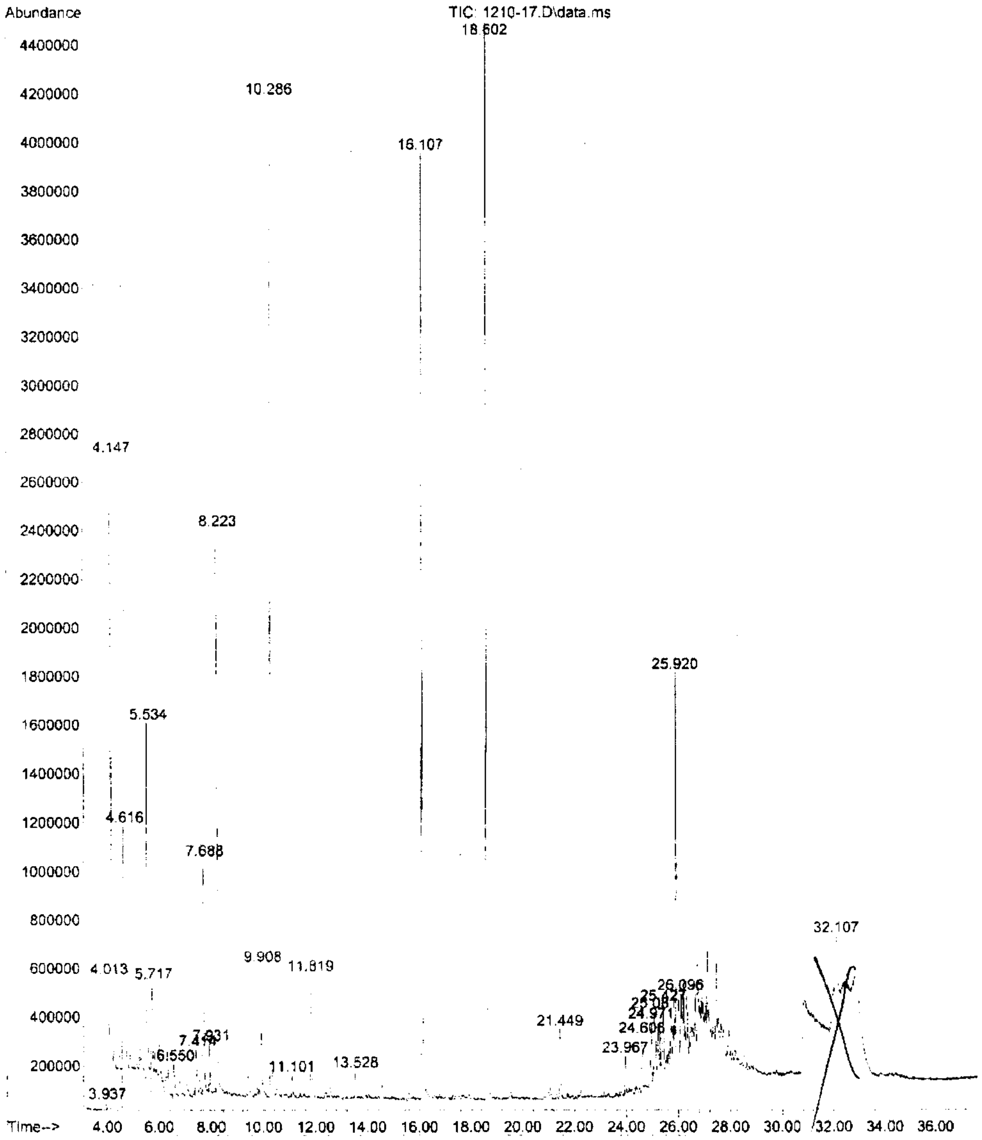
File        :C:\msdchem\1\DATA\12102009\1210-17.D
Operator    : JM
Acquired    : 11 Dec 2009   4:01 pm using AcqMethod TO15PPB8.M
Instrument  :   5973A MSD
Sample Name: 100cc IS,50cc,AS16,6455,TO15.mpt
Misc Info   : MSD,Digester Gas,Train #4 35-300amu @4.64min
Vial Number: 18
```

Collected 12/4/09



```
                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\12102009\
Data File : 1210-17.D
Acq On    : 11 Dec 2009    4:01 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS16,6455,TO15.mpt
Misc      : MSD,Digester Gas,Train #4 35-300amu @4.64min
ALS Vial  : 18   Sample Multiplier: 30

Quant Time: Jan 07 13:11:22 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Fri Dec 11 10:00:41 2009
Response via : Continuing Cal File: C:\msdchem\1\DATA\12102009\A1210-13.D

 Internal Standards                R.T. QIon  Response  Conc Units Dev(Min)
-----------------------------------------------------------------------------
  1) 1,4-Difluorobenzene         10.286  114  3836463     4.12 ppbv    0.00
 53) Chlorobenzene-d5            16.107   82  1749266     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane           8.223  128   846786     4.45 ppbv    0.00
 64) p-Bromofluorobenzene        18.608  174  1693281     3.94 ppbv    0.00

 Target Compounds                                                    Qvalue
  2) Freon 22 (CLF2Methane)       0.000   67        0      N.D.
  3) Freon 12 (Cl2F2Methane)      0.000   85        0      N.D. d
  4) Chloromethane                4.354   50    22452     4.28 ppbv       95
  5) Freon 114 (Cl2F4Ethane)      0.000   85        0      N.D.
  6) Vinyl Chloride               0.000   62        0      N.D.
  7) 1,3- Butadiene               4.640   54   192462m   37.45 ppbv
  8) Bromomethane                 0.000   94        0      N.D.
  9) Chloroethane                 0.000   64        0      N.D.
 10) Acetone                      5.528   58   607853   147.48 ppbv       95
 11) Freon 11 (Cl3Fmethane)       0.000  101        0      N.D.
 12) Acrylonitrile                0.000   53        0      N.D. d
 13) 1,1-Dichloroethene           0.000   96        0      N.D.
 14) Methylene Chloride           0.000   84        0      N.D. d
 15) Methyl Acetate               0.000   43        0      N.D. d
 16) Freon 113 (Cl3F3Ethane)      0.000  101        0      N.D.
 17) Carbon Disulfide             6.550   76   100479m    4.30 ppbv
 18) Trans-1,2-Dichlorothene      0.000   96        0      N.D.
 19) 1,1-Dichloroethane           0.000   63        0      N.D.
 20) Methyl T-Butyl Ether (...    0.000   73        0      N.D.
 21) Methyl Ethyl Ketone(2-...    7.688   43  1602835   102.18 ppbv      100
 22) Chloroprene(2-Cl-1,3-B...    0.000   88        0      N.D.
 23) cis-1,2-Dichloroethene       0.000   96        0      N.D.
 25) Hexane                       0.000   57        0      N.D.
 26) Chloroform                   0.000   83        0      N.D. d
 27) 2,2-Dichloropropane          0.000   77        0      N.D.
 28) Dibromofluoromethane (...    0.000  111        0      N.D.
 29) 1,2- Dichloroethane          0.000   62        0      N.D.
 30) 1,1,1-Trichloroethane        0.000   97        0      N.D.
 31) 1,1- Dichloropropene         0.000   75        0      N.D.
 32) Benzene                      9.908   78   598726    23.82 ppbv       99
 33) Carbon Tetrachloride         0.000  117        0      N.D.
 34) Cyclohexane                  0.000   84        0      N.D. d
 35) Dibromomethane               0.000  174        0      N.D.
 36) 1,2-Dichloropropane          0.000   63        0      N.D.
 37) Ethyl Acrylate               0.000   55        0      N.D.
 38) Bromodichloromethane         0.000   83        0      N.D.
 39) Trichloroethene              0.000  132        0      N.D.
 40) Methyl Methacrylate          0.000   69        0      N.D.
 41) cis-1,3-Dichloropropene      0.000   75        0      N.D.
 42) Methyl Isobutyl Ketone       0.000   58        0      N.D.
 43) Methyl Cyclohexane           0.000   98        0      N.D.
 44) trans-1,3-Dichloropropene    0.000   75        0      N.D.
```

```
 45) 1,1,2-Trichloroethane       0.000    97        0       N.D.
 46) Toluene-d8  (SMC)           0.000    98        0       N.D.
 47) Toluene                    13.528    91   118820     3.94 ppbv       96
 48) 1,3-Dichloropropane         0.000    76        0       N.D.
 49) Methyl Butyl Ketone(2-...   0.000    43        0       N.D. d
 50) Dibromochloromethane        0.000   129        0       N.D.
 51) 1,2- Dibromoethane          0.000   107        0       N.D.
 52) Tetrachloroethene           0.000   166        0       N.D.
 54) 1,1,1,2 - Tetrachloroe...   0.000   131        0       N.D.
 55) Chlorobenzene               0.000   112        0       N.D.
 56) Ethylbenzene                0.000    91        0       N.D. d
 57) (m and /or p) Xylene        0.000    91        0       N.D. d
 58) Bromoform                   0.000   173        0       N.D.
 59) Butyl Acrylate              0.000    55        0       N.D. d
 60) Styrene                     0.000   104        0       N.D. d
 61) 1,1,2,2-Tetrachloroethane   0.000    83        0       N.D.
 62) o-Xylene (1,2-Dimethyl...   0.000    91        0       N.D. d
 63) 1,2,3-Trichloropropane      0.000   110        0       N.D.
 65) Isopropylbenzene            0.000   105        0       N.D.
 66) Bromobenzene                0.000   156        0       N.D.
 67) o-Chlorotoluene             0.000   126        0       N.D.
 68) n-Propylbenzene             0.000   120        0       N.D.
 69) p-Chlorotoluene             0.000   126        0       N.D.
 70) 1,3,5-Trimethylbenzene      0.000   105        0       N.D.
 71) tert-Butylbenzene           0.000   134        0       N.D.
 72) 1,2,4-Trimethylbenzene      0.000   105        0       N.D.
 73) 1,3-Dichlorobenzene         0.000   146        0       N.D.
 74) 1,4-Dichlorobenzene        21.449   146   196139     7.37 ppbv       98
 75) sec-Butylbenzene            0.000   105        0       N.D.
 76) p-Isopropyltoluene          0.000   119        0       N.D. d
 77) 1,2-Dichlorobenzene         0.000   146        0       N.D.
 78) n-Butylbenzene              0.000    91        0       N.D.
 79) 1,2-Dibromo-3-chloropr...   0.000   157        0       N.D.
 80) 1,2,4-Trichlorobenzene      0.000   180        0       N.D.
 81) Naphthalene                 0.000   128        0       N.D. d
 82) 1,2,3-Trichlorobenzene      0.000   180        0       N.D. d
 83) Hexachlorobutadiene         0.000   225        0       N.D.
 ------------------------------------------------------------------------

 (#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 13:11:57 2010
```

#2

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File        :C:\msdchem\1\DATA\12162009\1216-05.D
Operator    : JM
Acquired    : 16 Dec 2009    1:11 pm using AcqMethod TO15PPB8.M
Instrument  :    5973A MSD
Sample Name: 100cc IS,50cc,AS15,2167,TO15.mpt
Misc Info   : MSD,NatGas,121409, Train #4,35-300amu @4.64mi
Vial Number: 5
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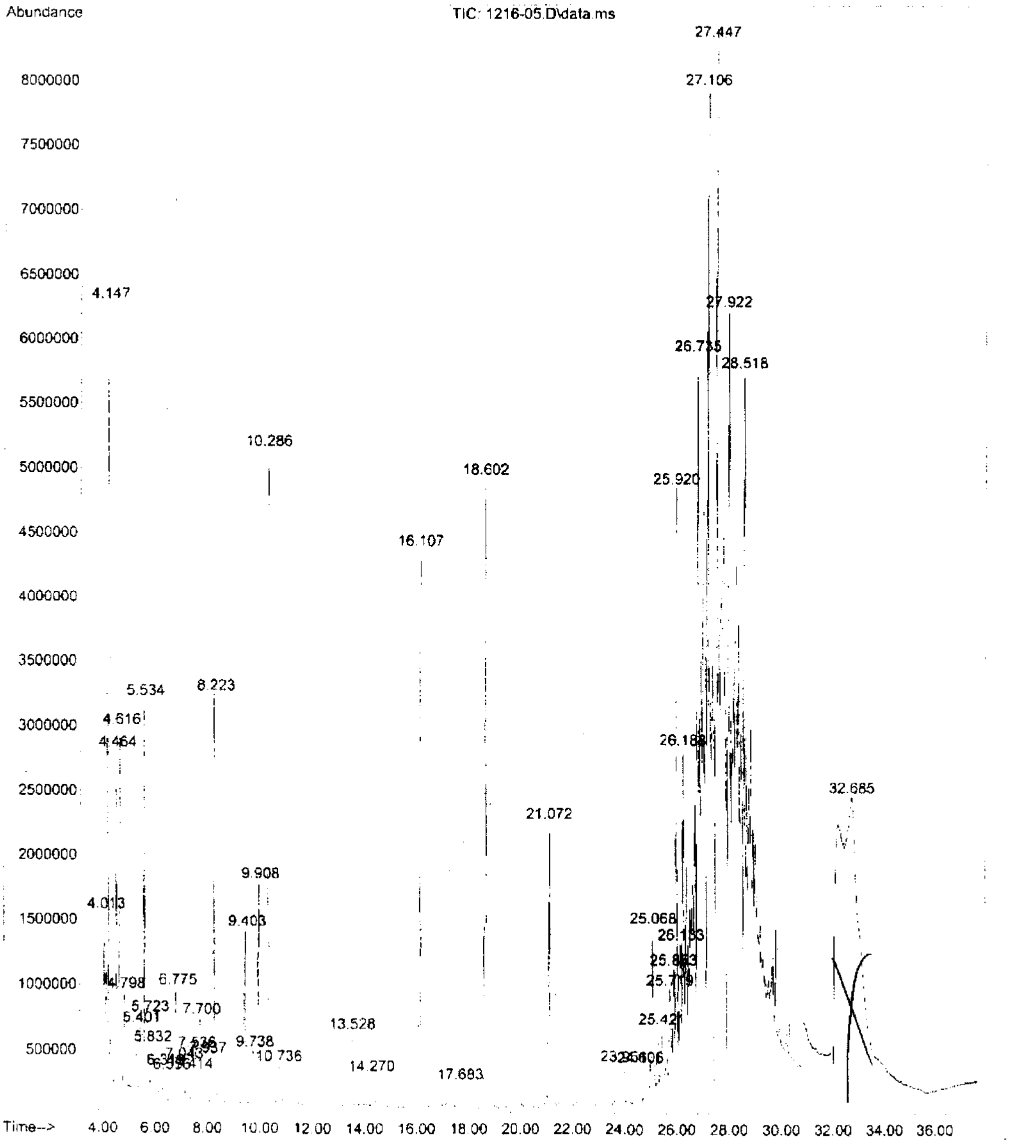

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                    Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\DATA\12162009\
Data File : 1216-05.D
Acq On    : 16 Dec 2009   1:11 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,2167,TO15.mpt
Misc      : MSD,NatGas,121409, Train #4,35-300amu @4.64mi
ALS Vial  : 5   Sample Multiplier: 30

Quant Time: Jan 07 11:10:32 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Mon Jan 04 13:09:57 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\12162009\A1216-02.D

 Internal Standards                R.T.  QIon  Response  Conc Units Dev(Min)
-----------------------------------------------------------------------------
   1) 1,4-Difluorobenzene        10.286  114  5259120     4.12 ppbv    0.00
  53) Chlorobenzene-d5           16.107   82  2010843     4.16 ppbv    0.00

 System Monitoring Compounds
  24) Bromochloromethane          8.223  128  1198926     4.36 ppbv    0.00
  64) p-Bromofluorobenzene       18.602  174  2009652     4.21 ppbv    0.00

 Target Compounds                                                  Qvalue
   2) Freon 22 (CLF2Methane)      0.000   67        0       N.D. d
   3) Freon 12 (Cl2F2Methane)     0.000   85        0       N.D. d
   4) Chloromethane               4.348   50    41230     5.18 ppbv       93
   5) Freon 114 (Cl2F4Ethane)     0.000   85        0       N.D. d
   6) Vinyl Chloride              0.000   62        0       N.D.
   7) 1,3- Butadiene              4.646   54   365455m   48.21 ppbv
   8) Bromomethane                0.000   94        0       N.D. d
   9) Chloroethane                0.000   64        0       N.D.
  10) Acetone                     5.534   58  1615537m  274.95 ppbv
  11) Freon 11 (Cl3Fmethane)      0.000  101        0       N.D. d
  12) Acrylonitrile               0.000   53        0       N.D. d
  13) 1,1-Dichloroethene          0.000   96        0       N.D.
  14) Methylene Chloride          6.246   84    42726     3.41 ppbv       94
  15) Methyl Acetate              0.000   43        0       N.D. d
  16) Freon 113 (Cl3F3Ethane)     0.000  101        0       N.D. d
  17) Carbon Disulfide            6.556   76   198017m    5.65 ppbv
  18) Trans-1,2-Dichlorothene     0.000   96        0       N.D.
  19) 1,1-Dichloroethane          0.000   63        0       N.D. d
  20) Methyl T-Butyl Ether (...   0.000   73        0       N.D. d
  21) Methyl Ethyl Ketone(2-...   7.700   43  1149427    50.86 ppbv       98
  22) Chloroprene(2-Cl-1,3-B...   0.000   88        0       N.D.
  23) cis-1,2-Dichloroethene      0.000   96        0       N.D.
  25) Hexane                      0.000   57        0       N.D. d
  26) Chloroform                  0.000   83        0       N.D. d
  27) 2,2-Dichloropropane         0.000   77        0       N.D. d
  28) Dibromofluoromethane (...   0.000  111        0       N.D.
  29) 1,2- Dichloroethane         0.000   62        0       N.D.
  30) 1,1,1-Trichloroethane       0.000   97        0       N.D. d
  31) 1,1- Dichloropropene        0.000   75        0       N.D. d
  32) Benzene                     9.908   78  1990146    55.06 ppbv      100
  33) Carbon Tetrachloride        0.000  117        0       N.D. d
  34) Cyclohexane                 0.000   84        0       N.D. d
  35) Dibromomethane              0.000  174        0       N.D. d
  36) 1,2-Dichloropropane         0.000   63        0       N.D.
  37) Ethyl Acrylate              0.000   55        0       N.D.
  38) Bromodichloromethane        0.000   83        0       N.D. d
  39) Trichloroethene             0.000  132        0       N.D.
  40) Methyl Methacrylate         0.000   69        0       N.D.
  41) cis-1,3-Dichloropropene     0.000   75        0       N.D.
  42) Methyl Isobutyl Ketone      0.000   58        0       N.D.
  43) Methyl Cyclohexane          0.000   98        0       N.D.
  44) trans-1,3-Dichloropropene   0.000   75        0       N.D.
```

```
 45) 1,1,2-Trichloroethane        0.000   97        0      N.D.
 46) Toluene-d8  (SMC)            0.000   98        0      N.D.
 47) Toluene                     13.522   91   574081    13.84 ppbv      98
 48) 1,3-Dichloropropane          0.000   76        0      N.D. d
 49) Methyl Butyl Ketone(2-...    0.000   43        0      N.D. d
 50) Dibromochloromethane         0.000  129        0      N.D. d
 51) 1,2- Dibromoethane           0.000  107        0      N.D.
 52) Tetrachloroethene            0.000  166        0      N.D.
 54) 1,1,1,2 - Tetrachloroe...    0.000  131        0      N.D. d
 55) Chlorobenzene                0.000  112        0      N.D. d
 56) Ethylbenzene                 0.000   91        0      N.D. d
 57) (m and /or p) Xylene        17.044   91    81810     2.26 ppbv      95
 58) Bromoform                    0.000  173        0      N.D. d
 59) Butyl Acrylate               0.000   55        0      N.D. d
 60) Styrene                      0.000  104        0      N.D. d
 61) 1,1,2,2-Tetrachloroethane    0.000   83        0      N.D. d
 62) o-Xylene (1,2-Dimethyl...    0.000   91        0      N.D. d
 63) 1,2,3-Trichloropropane       0.000  110        0      N.D.
 65) Isopropylbenzene             0.000  105        0      N.D. d
 66) Bromobenzene                 0.000  156        0      N.D.
 67) o-Chlorotoluene              0.000  126        0      N.D.
 68) n-Propylbenzene              0.000  120        0      N.D.
 69) p-Chlorotoluene              0.000  126        0      N.D.
 70) 1,3,5-Trimethylbenzene       0.000  105        0      N.D. d
 71) tert-Butylbenzene            0.000  134        0      N.D. d
 72) 1,2,4-Trimethylbenzene       0.000  105        0      N.D. d
 73) 1,3-Dichlorobenzene          0.000  146        0      N.D. d
 74) 1,4-Dichlorobenzene          0.000  146        0      N.D. d
 75) sec-Butylbenzene             0.000  105        0      N.D. d
 76) p-Isopropyltoluene           0.000  119        0      N.D. d
 77) 1,2-Dichlorobenzene          0.000  146        0      N.D. d
 78) n-Butylbenzene               0.000   91        0      N.D. d
 79) 1,2-Dibromo-3-chloropr...    0.000  157        0      N.D.
 80) 1,2,4-Trichlorobenzene       0.000  180        0      N.D. d
 81) Naphthalene                 25.744  128   161937     5.98 ppbv      97
 82) 1,2,3-Trichlorobenzene       0.000  180        0      N.D. d
 83) Hexachlorobutadiene          0.000  225        0      N.D. d
--------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 11:10:39 2010
```

#2

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File         :C:\msdchem\1\DATA\12162009\1216-06.D
Operator     : JM
Acquired     : 16 Dec 2009   1:59 pm using AcqMethod TO15PPB8.M
Instrument :    5973A MSD
Sample Name: 100cc IS,50cc,AS16,2168,TO15.mpt
Misc Info  : MSD,Dig Gas,121409,Train #4,35-300amu @4.64mi
Vial Number: 6
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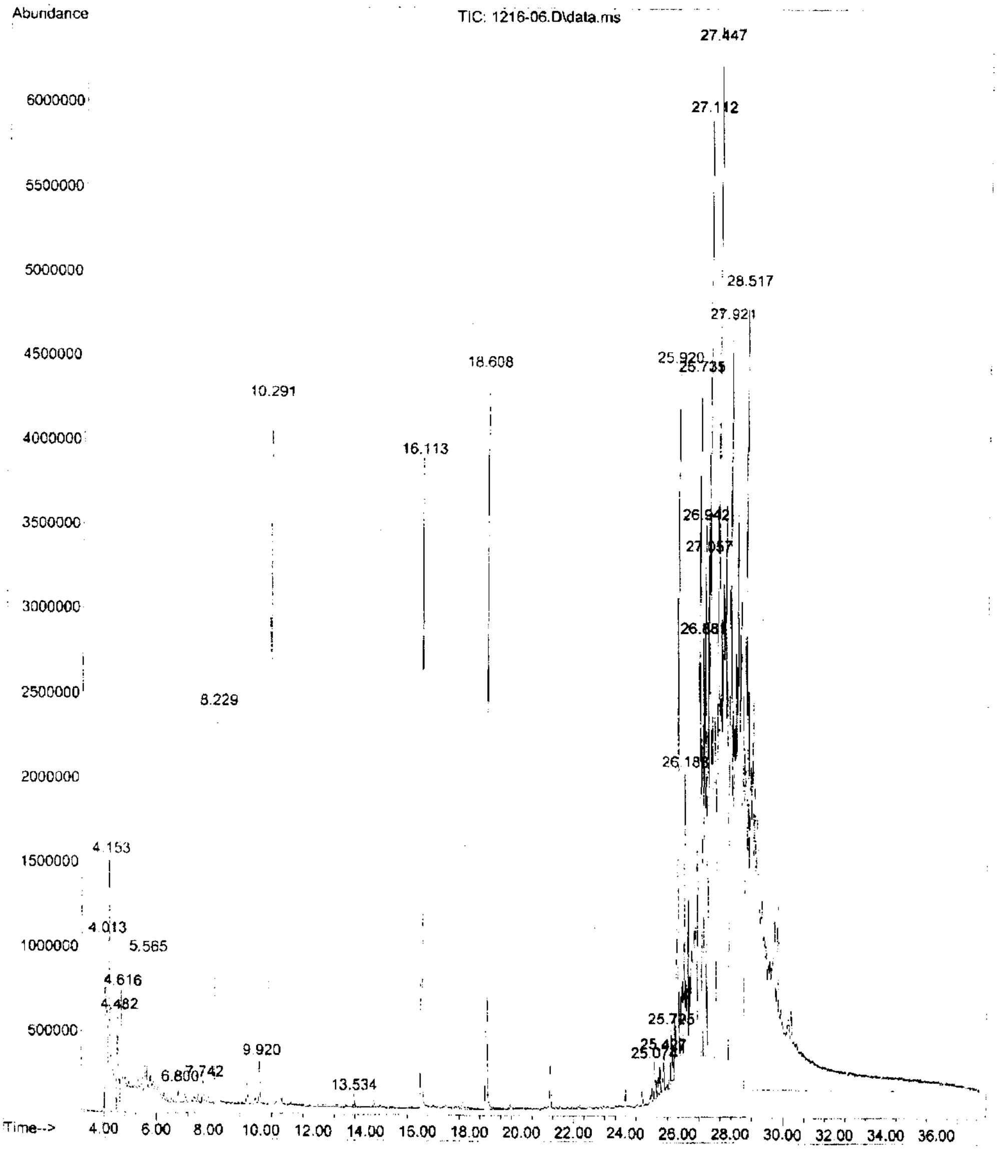

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                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\12162009\
Data File : 1216-06.D
Acq On    : 16 Dec 2009   1:59 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS16,2168,TO15.mpt
Misc      : MSD,Dig Gas,121409,Train #4,35-300amu @4.64mi
ALS Vial  : 6   Sample Multiplier: 30

Quant Time: Jan 07 11:00:02 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Fri Dec 11 10:00:41 2009
Response via : Continuing Cal File: C:\msdchem\1\DATA\12162009\A1216-02.D

 Internal Standards               R.T. QIon  Response  Conc Units Dev(Min)
-----------------------------------------------------------------------------
  1) 1,4-Difluorobenzene         10.291  114  4037904     4.12 ppbv    0.00
 53) Chlorobenzene-d5            16.113   82  1714366     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane           8.229  128   877811     4.38 ppbv    0.00
 64) p-Bromofluorobenzene        18.608  174  1656759     3.93 ppbv    0.00

 Target Compounds                                                   Qvalue
  2) Freon 22 (CLF2Methane)       0.000   67        0       N.D. d
  3) Freon 12 (Cl2F2Methane)      0.000   85        0       N.D. d
  4) Chloromethane                0.000   50        0       N.D. d
  5) Freon 114 (Cl2F4Ethane)      0.000   85        0       N.D.
  6) Vinyl Chloride               0.000   62        0       N.D.
  7) 1,3- Butadiene               4.646   54    53185m    9.83 ppbv
  8) Bromomethane                 0.000   94        0       N.D.
  9) Chloroethane                 0.000   64        0       N.D.
 10) Acetone                      5.565   58   388430m   89.54 ppbv
 11) Freon 11 (Cl3Fmethane)       0.000  101        0       N.D.
 12) Acrylonitrile                0.000   53        0       N.D. d
 13) 1,1-Dichloroethene           0.000   96        0       N.D.
 14) Methylene Chloride           6.258   84    27736m    3.23 ppbv
 15) Methyl Acetate               0.000   43        0       N.D.
 16) Freon 113 (Cl3F3Ethane)      0.000  101        0       N.D.
 17) Carbon Disulfide             6.562   76    43228m    1.76 ppbv
 18) Trans-1,2-Dichlorothene      0.000   96        0       N.D.
 19) 1,1-Dichloroethane           0.000   63        0       N.D.
 20) Methyl T-Butyl Ether (...    0.000   73        0       N.D.
 21) Methyl Ethyl Ketone(2-...    7.742   43   253392    15.35 ppbv       98
 22) Chloroprene(2-Cl-1,3-B...    0.000   88        0       N.D.
 23) cis-1,2-Dichloroethene       0.000   96        0       N.D.
 25) Hexane                       0.000   57        0       N.D.
 26) Chloroform                   0.000   83        0       N.D. d
 27) 2,2-Dichloropropane          0.000   77        0       N.D.
 28) Dibromofluoromethane (...    0.000  111        0       N.D.
 29) 1,2- Dichloroethane          0.000   62        0       N.D.
 30) 1,1,1-Trichloroethane        0.000   97        0       N.D.
 31) 1,1- Dichloropropene         0.000   75        0       N.D.
 32) Benzene                      9.914   78   321165    12.14 ppbv       98
 33) Carbon Tetrachloride         0.000  117        0       N.D.
 34) Cyclohexane                  0.000   84        0       N.D. d
 35) Dibromomethane               0.000  174        0       N.D.
 36) 1,2-Dichloropropane          0.000   63        0       N.D.
 37) Ethyl Acrylate               0.000   55        0       N.D.
 38) Bromodichloromethane         0.000   83        0       N.D.
 39) Trichloroethene              0.000  132        0       N.D.
 40) Methyl Methacrylate          0.000   69        0       N.D.
 41) cis-1,3-Dichloropropene      0.000   75        0       N.D.
 42) Methyl Isobutyl Ketone       0.000   58        0       N.D.
 43) Methyl Cyclohexane           0.000   98        0       N.D.
 44) trans-1,3-Dichloropropene    0.000   75        0       N.D.
```

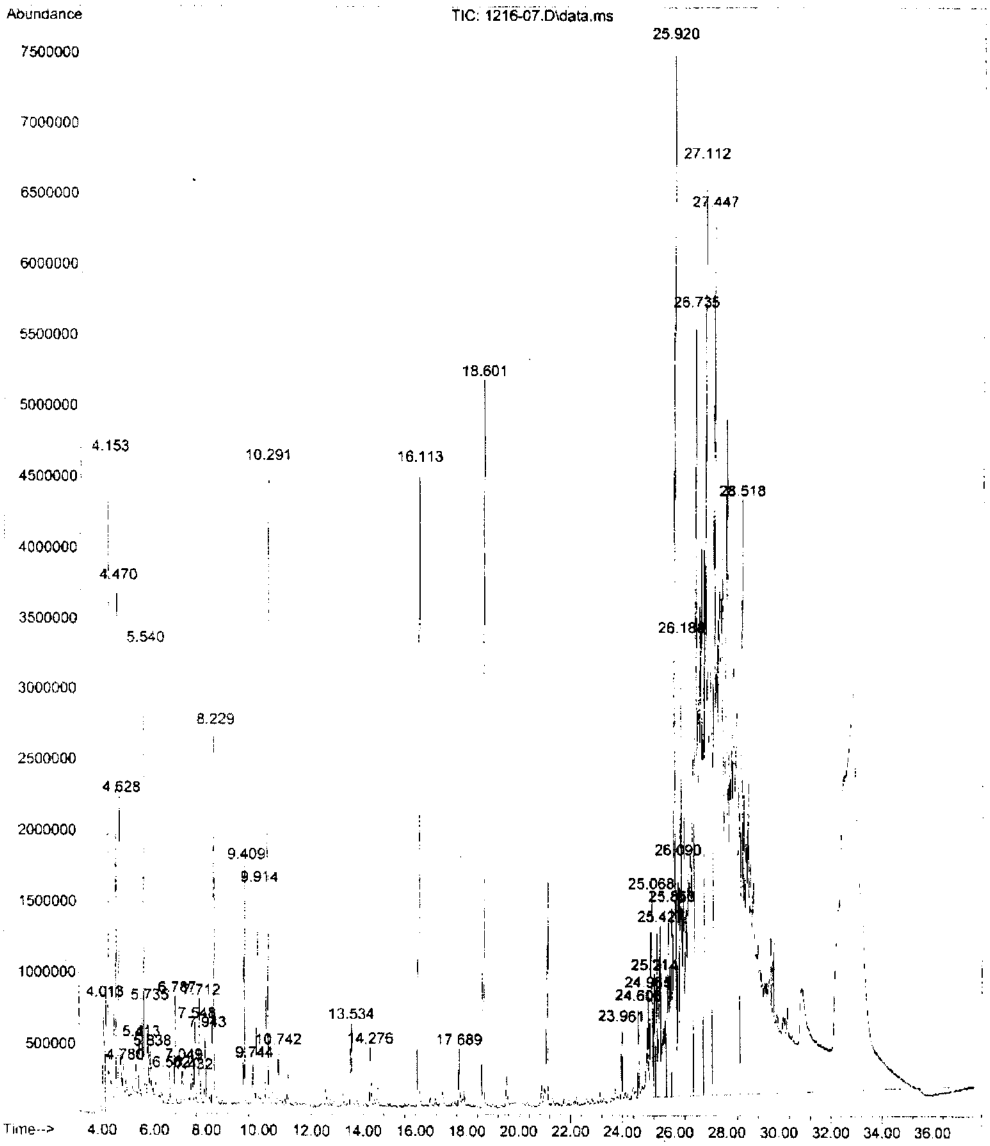
```
 45) 1,1,2-Trichloroethane        0.000    97          0        N.D.
 46) Toluene-d8  (SMC)            0.000    98          0        N.D.
 47) Toluene                     13.534    91      85598      2.70 ppbv        99
 48) 1,3-Dichloropropane          0.000    76          0        N.D.
 49) Methyl Butyl Ketone(2-...    0.000    43          0        N.D. d
 50) Dibromochloromethane         0.000   129          0        N.D.
 51) 1,2- Dibromoethane           0.000   107          0        N.D.
 52) Tetrachloroethene            0.000   166          0        N.D.
 54) 1,1,1,2 - Tetrachloroe...    0.000   131          0        N.D.
 55) Chlorobenzene                0.000   112          0        N.D. d
 56) Ethylbenzene                 0.000    91          0        N.D. d
 57) (m and /or p) Xylene         0.000    91          0        N.D. d
 58) Bromoform                    0.000   173          0        N.D.
 59) Butyl Acrylate               0.000    55          0        N.D. d
 60) Styrene                      0.000   104          0        N.D. d
 61) 1,1,2,2-Tetrachloroethane    0.000    83          0        N.D.
 62) o-Xylene (1,2-Dimethyl...    0.000    91          0        N.D. d
 63) 1,2,3-Trichloropropane       0.000   110          0        N.D.
 65) Isopropylbenzene             0.000   105          0        N.D.
 66) Bromobenzene                 0.000   156          0        N.D.
 67) o-Chlorotoluene              0.000   126          0        N.D.
 68) n-Propylbenzene              0.000   120          0        N.D.
 69) p-Chlorotoluene              0.000   126          0        N.D.
 70) 1,3,5-Trimethylbenzene       0.000   105          0        N.D.
 71) tert-Butylbenzene            0.000   134          0        N.D.
 72) 1,2,4-Trimethylbenzene       0.000   105          0        N.D. d
 73) 1,3-Dichlorobenzene          0.000   146          0        N.D.
 74) 1,4-Dichlorobenzene          0.000   146          0        N.D. d
 75) sec-Butylbenzene             0.000   105          0        N.D.
 76) p-Isopropyltoluene           0.000   119          0        N.D. d
 77) 1,2-Dichlorobenzene          0.000   146          0        N.D.
 78) n-Butylbenzene               0.000    91          0        N.D. d
 79) 1,2-Dibromo-3-chloropr...    0.000   157          0        N.D.
 80) 1,2,4-Trichlorobenzene       0.000   180          0        N.D.
 81) Naphthalene                 25.743   128      86520      2.24 ppbv        92
 82) 1,2,3-Trichlorobenzene       0.000   180          0        N.D. d
 83) Hexachlorobutadiene          0.000   225          0        N.D.
-----------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 11:00:11 2010
```

#3

```
File       :C:\msdchem\1\DATA\12162009\1216-07.D
Operator   : JM
Acquired   : 16 Dec 2009   2:55 pm using AcqMethod TO15PPB8.M
Instrument :    5973A MSD
Sample Name: 100cc IS,50cc,AS15,2165,TO15.mpt
Misc Info  : MSD,NatGas,121509, Train #4,35-300amu @4.64mi
Vial Number: 7
```



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                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\12162009\
Data File : 1216-07.D
Acq On    : 16 Dec 2009   2:55 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,2165,TO15.mpt
Misc      : MSD,NatGas.121509, Train #4,35-300amu @4.64mi
ALS Vial  : 7   Sample Multiplier: 30

Quant Time: Jan 07 10:49:10 2010
Quant Method : C:\msdchem\1\METHODS\T015ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Fri Dec 11 10:00:41 2009
Response via : Continuing Cal File: C:\msdchem\1\DATA\12162009\A1216-02.D

 Internal Standards               R.T. QIon  Response  Conc Units Dev(Min)
-------------------------------------------------------------------------
  1) 1,4-Difluorobenzene         10.298  114  4579337     4.12 ppbv    0.01
 53) Chlorobenzene-d5            16.113   82  2109400     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane           8.235  128   963705     4.24 ppbv    0.01
 64) p-Bromofluorobenzene        18.601  174  2102353     4.06 ppbv    0.00

 Target Compounds                                                   Qvalue
  2) Freon 22 (CLF2Methane)       0.000   67        0      N.D. d
  3) Freon 12 (Cl2F2Methane)      0.000   85        0      N.D. d
  4) Chloromethane                4.360   50    49669     7.93 ppbv      96
  5) Freon 114 (Cl2F4Ethane)      0.000   85        0      N.D. d
  6) Vinyl Chloride               0.000   62        0      N.D.
  7) 1,3- Butadiene               4.658   54   278833m   45.46 ppbv
  8) Bromomethane                 0.000   94        0      N.D.
  9) Chloroethane                 0.000   64        0      N.D.
 10) Acetone                      5.540   58  1742866m  354.26 ppbv
 11) Freon 11 (Cl3Fmethane)       0.000  101        0      N.D. d
 12) Acrylonitrile                0.000   53        0      N.D. d
 13) 1,1-Dichloroethene           0.000   96        0      N.D.
 14) Methylene Chloride           6.258   84    31089     3.19 ppbv      93
 15) Methyl Acetate               0.000   43        0      N.D. d
 16) Freon 113 (Cl3F3Ethane)      0.000  101        0      N.D. d
 17) Carbon Disulfide             6.562   76   190349     6.82 ppbv      98
 18) Trans-1,2-Dichlorothene      0.000   96        0      N.D.
 19) 1,1-Dichloroethane           0.000   63        0      N.D.
 20) Methyl T-Butyl Ether (...    0.000   73        0      N.D. d
 21) Methyl Ethyl Ketone(2-...    7.712   43  1292433    69.03 ppbv      96
 22) Chloroprene(2-Cl-1,3-B...    0.000   88        0      N.D.
 23) cis-1,2-Dichloroethene       0.000   96        0      N.D.
 25) Hexane                       0.000   57        0      N.D. d
 26) Chloroform                   0.000   83        0      N.D. d
 27) 2,2-Dichloropropane          0.000   77        0      N.D. d
 28) Dibromofluoromethane (...    0.000  111        0      N.D.
 29) 1,2- Dichloroethane          0.000   62        0      N.D.
 30) 1,1,1-Trichloroethane        0.000   97        0      N.D. d
 31) 1,1- Dichloropropene         0.000   75        0      N.D.
 32) Benzene                      9.920   78  1771934    59.07 ppbv      99
 33) Carbon Tetrachloride         0.000  117        0      N.D. d
 34) Cyclohexane                  0.000   84        0      N.D. d
 35) Dibromomethane               0.000  174        0      N.D.
 36) 1,2-Dichloropropane          0.000   63        0      N.D.
 37) Ethyl Acrylate               0.000   55        0      N.D.
 38) Bromodichloromethane         0.000   83        0      N.D. d
 39) Trichloroethene              0.000  132        0      N.D.
 40) Methyl Methacrylate          0.000   69        0      N.D.
 41) cis-1,3-Dichloropropene      0.000   75        0      N.D.
 42) Methyl Isobutyl Ketone       0.000   58        0      N.D.
 43) Methyl Cyclohexane           0.000   98        0      N.D.
 44) trans-1,3-Dichloropropene    0.000   75        0      N.D.
```

```
 45) 1,1,2-Trichloroethane         0.000    97         0      N.D.
 46) Toluene-d8  (SMC)             0.000    98         0      N.D.
 47) Toluene                      13.534    91    569724     15.83 ppbv        99
 48) 1,3-Dichloropropane           0.000    76         0      N.D. d
 49) Methyl Butyl Ketone(2-...    14.033    43    36458m      1.96 ppbv
 50) Dibromochloromethane          0.000   129         0      N.D. d
 51) 1,2- Dibromoethane            0.000   107         0      N.D. d
 52) Tetrachloroethene             0.000   166         0      N.D. d
 54) 1,1,1,2 - Tetrachloroe...     0.000   131         0      N.D. d
 55) Chlorobenzene                16.180   112    36260m      1.20 ppbv
 56) Ethylbenzene                  0.000    91         0      N.D. d
 57) (m and /or p) Xylene         17.044    91    78573m      2.13 ppbv
 58) Bromoform                     0.000   173         0      N.D. d
 59) Butyl Acrylate                0.000    55         0      N.D. d
 60) Styrene                      17.665   104    49622m      1.74 ppbv
 61) 1,1,2,2-Tetrachloroethane     0.000    83         0      N.D. d
 62) o-Xylene (1,2-Dimethyl...     0.000    91         0      N.D. d
 63) 1,2,3-Trichloropropane        0.000   110         0      N.D.
 65) Isopropylbenzene              0.000   105         0      N.D. d
 66) Bromobenzene                  0.000   156         0      N.D.
 67) o-Chlorotoluene               0.000   126         0      N.D.
 68) n-Propylbenzene               0.000   120         0      N.D.
 69) p-Chlorotoluene               0.000   126         0      N.D.
 70) 1,3,5-Trimethylbenzene        0.000   105         0      N.D. d
 71) tert-Butylbenzene             0.000   134         0      N.D. d
 72) 1,2,4-Trimethylbenzene        0.000   105         0      N.D. d
 73) 1,3-Dichlorobenzene           0.000   146         0      N.D. d
 74) 1,4-Dichlorobenzene           0.000   146         0      N.D. d
 75) sec-Butylbenzene              0.000   105         0      N.D. d
 76) p-Isopropyltoluene            0.000   119         0      N.D. d
 77) 1,2-Dichlorobenzene           0.000   146         0      N.D. d
 78) n-Butylbenzene                0.000    91         0      N.D. d
 79) 1,2-Dibromo-3-chloropr...     0.000   157         0      N.D.
 80) 1,2,4-Trichlorobenzene        0.000   180         0      N.D. d
 81) Naphthalene                  25.743   128    196811      4.15 ppbv       100
 82) 1,2,3-Trichlorobenzene        0.000   180         0      N.D. d
 83) Hexachlorobutadiene           0.000   225         0      N.D. d
--------------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 10:49:21 2010
```

#3

```
File       :C:\msdchem\1\DATA\12162009\1216-08.D
Operator   : JM
Acquired   : 16 Dec 2009   3:43 pm using AcqMethod TO15PPB8.M
Instrument :    5973A MSD
Sample Name: 100cc IS,50cc,AS16,2166,TO15.mpt
Misc Info  : MSD,Dig Gas,121509,Train #4,35-300amu @4.64mi
Vial Number: 8
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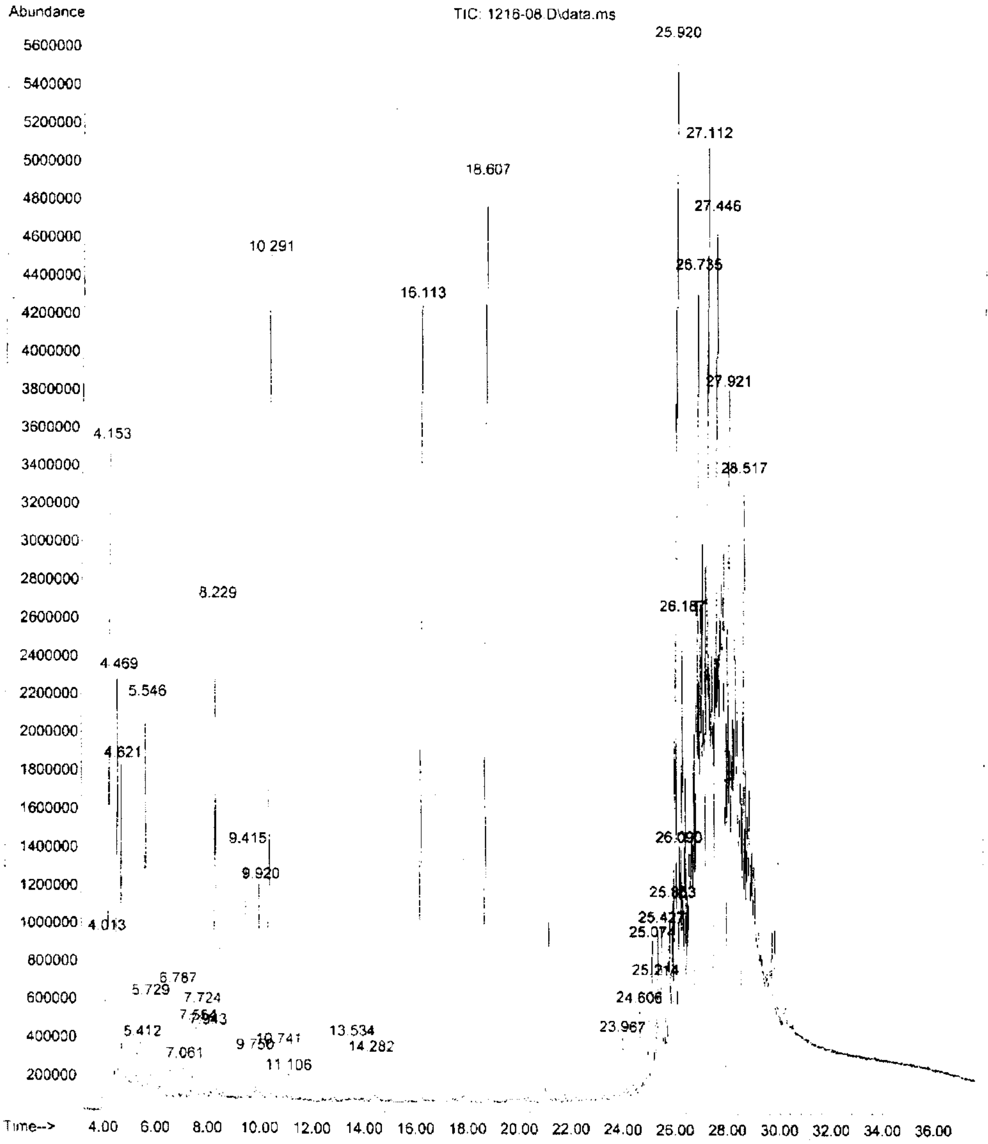

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                  Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\12162009\
Data File : 1216-08.D
Acq On    : 16 Dec 2009   3:43 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS16,2166,TO15.mpt
Misc      : MSD,Dig Gas,121509,Train #4,35-300amu @4.64mi
ALS Vial  : 8   Sample Multiplier: 30

Quant Time: Jan 07 10:33:31 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Mon Jan 04 13:09:57 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\12162009\A1216-02.D

 Internal Standards                R.T.  QIon  Response  Conc Units Dev(Min)
------------------------------------------------------------------------------
  1) 1,4-Difluorobenzene          10.291  114  4374419     4.12 ppbv    0.00
 53) Chlorobenzene-d5             16.113   82  1900218     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane            8.229  128   947808     4.14 ppbv    0.00
 64) p-Bromofluorobenzene         18.607  174  1923446     4.26 ppbv    0.00

 Target Compounds                                                   Qvalue
  2) Freon 22 (CLF2Methane)        0.000   67        0      N.D.
  3) Freon 12 (Cl2F2Methane)       0.000   85        0      N.D. d
  4) Chloromethane                 4.360   50    44707     6.76 ppbv       99
  5) Freon 114 (Cl2F4Ethane)       0.000   85        0      N.D.
  6) Vinyl Chloride                0.000   62        0      N.D.
  7) 1,3- Butadiene                4.652   54   229639m   36.42 ppbv
  8) Bromomethane                  0.000   94        0      N.D.
  9) Chloroethane                  0.000   64        0      N.D.
 10) Acetone                       5.546   58  1125526m  230.30 ppbv
 11) Freon 11 (Cl3Fmethane)        0.000  101        0      N.D.
 12) Acrylonitrile                 0.000   53        0      N.D. d
 13) 1,1-Dichloroethene            0.000   96        0      N.D.
 14) Methylene Chloride            6.264   84    29253     2.80 ppbv       94
 15) Methyl Acetate                0.000   43        0      N.D.
 16) Freon 113 (Cl3F3Ethane)       0.000  101        0      N.D.
 17) Carbon Disulfide              6.562   76   154094     5.28 ppbv       99
 18) Trans-1,2-Dichlorothene       0.000   96        0      N.D.
 19) 1,1-Dichloroethane            0.000   63        0      N.D.
 20) Methyl T-Butyl Ether (...     0.000   73        0      N.D. d
 21) Methyl Ethyl Ketone(2-...     7.724   43   854327    45.45 ppbv      100
 22) Chloroprene(2-Cl-1,3-B...     0.000   88        0      N.D.
 23) cis-1,2-Dichloroethene        0.000   96        0      N.D.
 25) Hexane                        0.000   57        0      N.D. d
 26) Chloroform                    0.000   83        0      N.D. d
 27) 2,2-Dichloropropane           0.000   77        0      N.D.
 28) Dibromofluoromethane (...     0.000  111        0      N.D.
 29) 1,2- Dichloroethane           0.000   62        0      N.D.
 30) 1,1,1-Trichloroethane         0.000   97        0      N.D.
 31) 1,1- Dichloropropene          0.000   75        0      N.D.
 32) Benzene                       9.920   78  1307169    43.48 ppbv      100
 33) Carbon Tetrachloride          0.000  117        0      N.D.
 34) Cyclohexane                   0.000   84        0      N.D. d
 35) Dibromomethane                0.000  174        0      N.D.
 36) 1,2-Dichloropropane           0.000   63        0      N.D.
 37) Ethyl Acrylate                0.000   55        0      N.D.
 38) Bromodichloromethane          0.000   83        0      N.D.
 39) Trichloroethene               0.000  132        0      N.D.
 40) Methyl Methacrylate           0.000   69        0      N.D.
 41) cis-1,3-Dichloropropene       0.000   75        0      N.D.
 42) Methyl Isobutyl Ketone        0.000   58        0      N.D.
 43) Methyl Cyclohexane            0.000   98        0      N.D.
 44) trans-1,3-Dichloropropene     0.000   75        0      N.D.
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-------------------------------------------------------------------------------
 45) 1,1,2-Trichloroethane          0.000    97         0      N.D.
 46) Toluene-d8  (SMC)              0.000    98         0      N.D.
 47) Toluene                       13.534    91    308845    8.95 ppbv       98
 48) 1,3-Dichloropropane            0.000    76         0      N.D.
 49) Methyl Butyl Ketone(2-...     14.045    43     27600    1.73 ppbv       81
 50) Dibromochloromethane           0.000   129         0      N.D.
 51) 1,2- Dibromoethane             0.000   107         0      N.D.
 52) Tetrachloroethene              0.000   166         0      N.D.
 54) 1,1,1,2 - Tetrachloroe...      0.000   131         0      N.D.
 55) Chlorobenzene                  0.000   112         0      N.D. d
 56) Ethylbenzene                   0.000    91         0      N.D. d
 57) (m and /or p) Xylene           0.000    91         0      N.D. d
 58) Bromoform                      0.000   173         0      N.D.
 59) Butyl Acrylate                 0.000    55         0      N.D. d
 60) Styrene                        0.000   104         0      N.D. d
 61) 1,1,2,2-Tetrachloroethane      0.000    83         0      N.D.
 62) o-Xylene (1,2-Dimethyl...      0.000    91         0      N.D. d
 63) 1,2,3-Trichloropropane         0.000   110         0      N.D.
 65) Isopropylbenzene               0.000   105         0      N.D. d
 66) Bromobenzene                   0.000   156         0      N.D.
 67) o-Chlorotoluene                0.000   126         0      N.D.
 68) n-Propylbenzene                0.000   120         0      N.D.
 69) p-Chlorotoluene                0.000   126         0      N.D.
 70) 1,3,5-Trimethylbenzene         0.000   105         0      N.D. d
 71) tert-Butylbenzene              0.000   134         0      N.D. d
 72) 1,2,4-Trimethylbenzene         0.000   105         0      N.D. d
 73) 1,3-Dichlorobenzene            0.000   146         0      N.D.
 74) 1,4-Dichlorobenzene            0.000   146         0      N.D. d
 75) sec-Butylbenzene               0.000   105         0      N.D.
 76) p-Isopropyltoluene             0.000   119         0      N.D. d
 77) 1,2-Dichlorobenzene            0.000   146         0      N.D.
 78) n-Butylbenzene                 0.000    91         0      N.D. d
 79) 1,2-Dibromo-3-chloropr...      0.000   157         0      N.D.
 80) 1,2,4-Trichlorobenzene         0.000   180         0      N.D. d
 81) Naphthalene                   25.743   128    113058    4.42 ppbv       97
 82) 1,2,3-Trichlorobenzene         0.000   180         0      N.D. d
 83) Hexachlorobutadiene            0.000   225         0      N.D.
-------------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 10:33:41 2010
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                    Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\DATA\01042010\
Data File : 0104-04.D
Acq On    :  4 Jan 2010  12:26 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,2173,TO15.mpt
Misc      : MSD,NatGas,121609, Train #4,35-300amu @4.64mi
ALS Vial  : 4   Sample Multiplier: 30

Quant Time: Jan 07 12:06:12 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Thu Jan 07 11:31:33 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\01042010\A0104-02.D

 Internal Standards                R.T. QIon  Response  Conc Units Dev(Min)
-----------------------------------------------------------------------------
  1) 1,4-Difluorobenzene          10.274  114  3565232     4.12 ppbv    0.00
 53) Chlorobenzene-d5             16.096   82  1606249     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane            8.212  128   790913     4.10 ppbv    0.00
 64) p-Bromofluorobenzene         18.596  174  1481470     4.05 ppbv    0.00

 Target Compounds                                                    Qvalue
  2) Freon 22 (CLF2Methane)        0.000   67        0      N.D.
  3) Freon 12 (Cl2F2Methane)       0.000   85        0      N.D.
  4) Chloromethane                 4.336   50    23718m    3.96 ppbv
  5) Freon 114 (Cl2F4Ethane)       0.000   85        0      N.D.
  6) Vinyl Chloride                0.000   62        0      N.D.
  7) 1,3- Butadiene                4.598   54    34180m    5.73 ppbv
  8) Bromomethane                  0.000   94        0      N.D.
  9) Chloroethane                  0.000   64        0      N.D.
 10) Acetone                       5.517   58  1125959m  256.11 ppbv
 11) Freon 11 (Cl3Fmethane)        0.000  101        0      N.D.
 12) Acrylonitrile                 0.000   53        0      N.D. d
 13) 1,1-Dichloroethene            0.000   96        0      N.D.
 14) Methylene Chloride            6.228   84    24278m    2.67 ppbv
 15) Methyl Acetate                0.000   43        0      N.D. d
 16) Freon 113 (Cl3F3Ethane)       0.000  101        0      N.D.
 17) Carbon Disulfide              6.539   76   119154m    4.57 ppbv
 18) Trans-1,2-Dichlorothene       0.000   96        0      N.D.
 19) 1,1-Dichloroethane            0.000   63        0      N.D.
 20) Methyl T-Butyl Ether (...     0.000   73        0      N.D.
 21) Methyl Ethyl Ketone(2-...     7.682   43   767407    45.31 ppbv       99
 22) Chloroprene(2-Cl-1,3-B...     0.000   88        0      N.D.
 23) cis-1,2-Dichloroethene        0.000   96        0      N.D.
 25) Hexane                        0.000   57        0      N.D.
 26) Chloroform                    0.000   83        0      N.D.
 27) 2,2-Dichloropropane           0.000   77        0      N.D.
 28) Dibromofluoromethane (...     0.000  111        0      N.D.
 29) 1,2- Dichloroethane           0.000   62        0      N.D.
 30) 1,1,1-Trichloroethane         0.000   97        0      N.D.
 31) 1,1- Dichloropropene          0.000   75        0      N.D.
 32) Benzene                       9.903   78  1141446    44.03 ppbv       99
 33) Carbon Tetrachloride          0.000  117        0      N.D.
 34) Cyclohexane                   0.000   84        0      N.D. d
 35) Dibromomethane                0.000  174        0      N.D.
 36) 1,2-Dichloropropane           0.000   63        0      N.D.
 37) Ethyl Acrylate                0.000   55        0      N.D.
 38) Bromodichloromethane          0.000   83        0      N.D.
 39) Trichloroethene               0.000  132        0      N.D.
 40) Methyl Methacrylate           0.000   69        0      N.D.
 41) cis-1,3-Dichloropropene       0.000   75        0      N.D.
 42) Methyl Isobutyl Ketone        0.000   58        0      N.D.
 43) Methyl Cyclohexane            0.000   98        0      N.D.
 44) trans-1,3-Dichloropropene     0.000   75        0      N.D.
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------------------------------------------------------------------------------------
45) 1,1,2-Trichloroethane        0.000    97         0      N.D.
46) Toluene-d8  (SMC)            0.000    98         0      N.D.
47) Toluene                     13.516    91    322606    10.84 ppbv        96
48) 1,3-Dichloropropane          0.000    76         0      N.D.
49) Methyl Butyl Ketone(2-...   13.991    43     21714     1.56 ppbv #      28
50) Dibromochloromethane         0.000   129         0      N.D.
51) 1,2- Dibromoethane           0.000   107         0      N.D.
52) Tetrachloroethene            0.000   166         0      N.D.
54) 1,1,1,2 - Tetrachloroe...    0.000   131         0      N.D.
55) Chlorobenzene                0.000   112         0      N.D. d
56) Ethylbenzene                 0.000    91         0      N.D. d
57) (m and /or p) Xylene         0.000    91         0      N.D. d
58) Bromoform                    0.000   173         0      N.D.
59) Butyl Acrylate               0.000    55         0      N.D. d
60) Styrene                      0.000   104         0      N.D.
61) 1,1,2,2-Tetrachloroethane    0.000    83         0      N.D.
62) o-Xylene (1,2-Dimethyl...    0.000    91         0      N.D. d
63) 1,2,3-Trichloropropane       0.000   110         0      N.D.
65) Isopropylbenzene             0.000   105         0      N.D.
66) Bromobenzene                 0.000   156         0      N.D.
67) o-Chlorotoluene              0.000   126         0      N.D.
68) n-Propylbenzene              0.000   120         0      N.D.
69) p-Chlorotoluene              0.000   126         0      N.D.
70) 1,3,5-Trimethylbenzene       0.000   105         0      N.D.
71) tert-Butylbenzene            0.000   134         0      N.D.
72) 1,2,4-Trimethylbenzene       0.000   105         0      N.D. d
73) 1,3-Dichlorobenzene          0.000   146         0      N.D.
74) 1,4-Dichlorobenzene          0.000   146         0      N.D. d
75) sec-Butylbenzene             0.000   105         0      N.D.
76) p-Isopropyltoluene           0.000   119         0      N.D. d
77) 1,2-Dichlorobenzene          0.000   146         0      N.D.
78) n-Butylbenzene               0.000    91         0      N.D. d
79) 1,2-Dibromo-3-chloropr...    0.000   157         0      N.D.
80) 1,2,4-Trichlorobenzene       0.000   180         0      N.D. d
81) Naphthalene                 25.732   128    128123     6.63 ppbv        97
82) 1,2,3-Trichlorobenzene       0.000   180         0      N.D. d
83) Hexachlorobutadiene          0.000   225         0      N.D.
------------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 12:06:36 2010
```
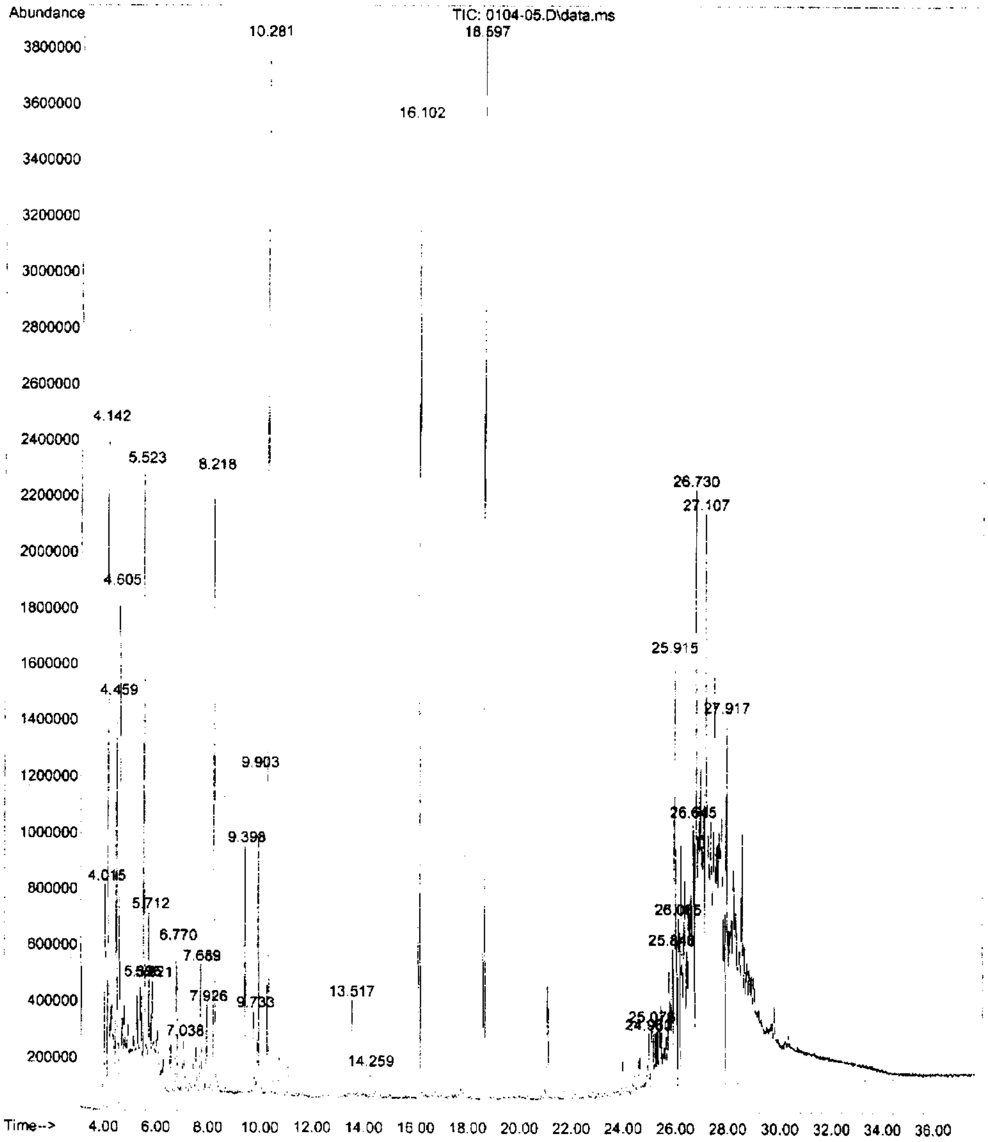

#4

```
File       :C:\msdchem\1\DATA\01042010\0104-05.D
Operator   : JM
Acquired   :  4 Jan 2010   1:13 pm using AcqMethod TO15PPB8.M
Instrument :   5973A MSD
Sample Name: 100cc IS,50cc,AS16,2172,TO15.mpt
Misc Info  : MSD,Dig Gas,121609,Train #4,35-300amu @4.64mi
Vial Number: 5
```



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                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\01042010\
Data File : 0104-05.D
Acq On    :  4 Jan 2010   1:13 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS16,2172,TO15.mpt
Misc      : MSD,Dig Gas,121609,Train #4,35-300amu @4.64mi
ALS Vial  : 5   Sample Multiplier: 30

Quant Time: Jan 07 12:31:54 2010
Quant Method : C:\msdchem\1\METHODS\T015ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Thu Jan 07 11:31:33 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\01042010\A0104-02.D

 Internal Standards                  R.T. QIon  Response  Conc Units Dev(Min)
 ------------------------------------------------------------------------------
   1) 1,4-Difluorobenzene          10.281  114  3690482     4.12 ppbv    0.00
  53) Chlorobenzene-d5             16.102   82  1624073     4.16 ppbv    0.00

 System Monitoring Compounds
  24) Bromochloromethane            8.218  128   791606     3.96 ppbv    0.01
  64) p-Bromofluorobenzene         18.597  174  1492476     4.04 ppbv    0.00

 Target Compounds                                                     Qvalue
   2) Freon 22 (CLF2Methane)        0.000   67        0      N.D.
   3) Freon 12 (Cl2F2Methane)       0.000   85        0      N.D.
   4) Chloromethane                 4.343   50    33096m    5.34 ppbv
   5) Freon 114 (Cl2F4Ethane)       0.000   85        0      N.D.
   6) Vinyl Chloride                0.000   62        0      N.D.
   7) 1,3- Butadiene                4.605   54    38218m    6.19 ppbv
   8) Bromomethane                  0.000   94        0      N.D.
   9) Chloroethane                  0.000   64        0      N.D.
  10) Acetone                       5.523   58   948189m  208.36 ppbv
  11) Freon 11 (Cl3Fmethane)        0.000  101        0      N.D.
  12) Acrylonitrile                 0.000   53        0      N.D. d
  13) 1,1-Dichloroethene            0.000   96        0      N.D.
  14) Methylene Chloride            0.000   84        0      N.D. d
  15) Methyl Acetate                0.000   43        0      N.D. d
  16) Freon 113 (Cl3F3Ethane)       0.000  101        0      N.D.
  17) Carbon Disulfide              6.545   76   123715m    4.58 ppbv
  18) Trans-1,2-Dichlorothene       0.000   96        0      N.D.
  19) 1,1-Dichloroethane            0.000   63        0      N.D.
  20) Methyl T-Butyl Ether (...     0.000   73        0      N.D.
  21) Methyl Ethyl Ketone(2-...     7.689   43   706539    40.30 ppbv       99
  22) Chloroprene(2-Cl-1,3-B...     0.000   88        0      N.D.
  23) cis-1,2-Dichloroethene        0.000   96        0      N.D.
  25) Hexane                        0.000   57        0      N.D.
  26) Chloroform                    0.000   83        0      N.D.
  27) 2,2-Dichloropropane           0.000   77        0      N.D.
  28) Dibromofluoromethane (...     0.000  111        0      N.D.
  29) 1,2- Dichloroethane           0.000   62        0      N.D.
  30) 1,1,1-Trichloroethane         0.000   97        0      N.D.
  31) 1,1- Dichloropropene          0.000   75        0      N.D.
  32) Benzene                       9.903   78  1279848    47.70 ppbv       99
  33) Carbon Tetrachloride          0.000  117        0      N.D.
  34) Cyclohexane                   0.000   84        0      N.D. d
  35) Dibromomethane                0.000  174        0      N.D.
  36) 1,2-Dichloropropane           0.000   63        0      N.D.
  37) Ethyl Acrylate                0.000   55        0      N.D.
  38) Bromodichloromethane          0.000   83        0      N.D.
  39) Trichloroethene               0.000  132        0      N.D.
  40) Methyl Methacrylate           0.000   69        0      N.D.
  41) cis-1,3-Dichloropropene       0.000   75        0      N.D.
  42) Methyl Isobutyl Ketone        0.000   58        0      N.D.
  43) Methyl Cyclohexane            0.000   98        0      N.D.
  44) trans-1,3-Dichloropropene     0.000   75        0      N.D.
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---------------------------------------------------------------------------
45) 1,1,2-Trichloroethane          0.000    97        0      N.D.
46) Toluene-d8  (SMC)              0.000    98        0      N.D.
47) Toluene                       13.523    91   337069    10.94 ppbv      100
48) 1,3-Dichloropropane            0.000    76        0      N.D.
49) Methyl Butyl Ketone(2-...      0.000    43        0      N.D.
50) Dibromochloromethane           0.000   129        0      N.D.
51) 1,2- Dibromoethane             0.000   107        0      N.D.
52) Tetrachloroethene              0.000   166        0      N.D.
54) 1,1,1,2 - Tetrachloroe...      0.000   131        0      N.D.
55) Chlorobenzene                  0.000   112        0      N.D.
56) Ethylbenzene                   0.000    91        0      N.D. d
57) (m and /or p) Xylene           0.000    91        0      N.D. d
58) Bromoform                      0.000   173        0      N.D.
59) Butyl Acrylate                 0.000    55        0      N.D.
60) Styrene                        0.000   104        0      N.D.
61) 1,1,2,2-Tetrachloroethane      0.000    83        0      N.D.
62) o-Xylene (1,2-Dimethyl...      0.000    91        0      N.D.
63) 1,2,3-Trichloropropane         0.000   110        0      N.D.
65) Isopropylbenzene               0.000   105        0      N.D.
66) Bromobenzene                   0.000   156        0      N.D.
67) o-Chlorotoluene                0.000   126        0      N.D.
68) n-Propylbenzene                0.000   120        0      N.D.
69) p-Chlorotoluene                0.000   126        0      N.D.
70) 1,3,5-Trimethylbenzene         0.000   105        0      N.D.
71) tert-Butylbenzene              0.000   134        0      N.D.
72) 1,2,4-Trimethylbenzene         0.000   105        0      N.D.
73) 1,3-Dichlorobenzene            0.000   146        0      N.D.
74) 1,4-Dichlorobenzene            0.000   146        0      N.D.
75) sec-Butylbenzene               0.000   105        0      N.D.
76) p-Isopropyltoluene             0.000   119        0      N.D.
77) 1,2-Dichlorobenzene            0.000   146        0      N.D.
78) n-Butylbenzene                 0.000    91        0      N.D.
79) 1,2-Dibromo-3-chloropr...      0.000   157        0      N.D.
80) 1,2,4-Trichlorobenzene         0.000   180        0      N.D.
81) Naphthalene                   25.733   128    59810m     3.06 ppbv
82) 1,2,3-Trichlorobenzene         0.000   180        0      N.D.
83) Hexachlorobutadiene            0.000   225        0      N.D.
---------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 12:32:04 2010
```

#5

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File        :C:\msdchem\1\DATA\01042010\0104-06.D
Operator    : JM
Acquired    :  4 Jan 2010    2:01 pm using AcqMethod TO15PPB8.M
Instrument  :   5973A MSD
Sample Name: 100cc IS,50cc,AS15,2169,TO15.mpt
Misc Info   : MSD,NatGas,121709, Train #4,35-300amu @4.64mi
Vial Number: 6
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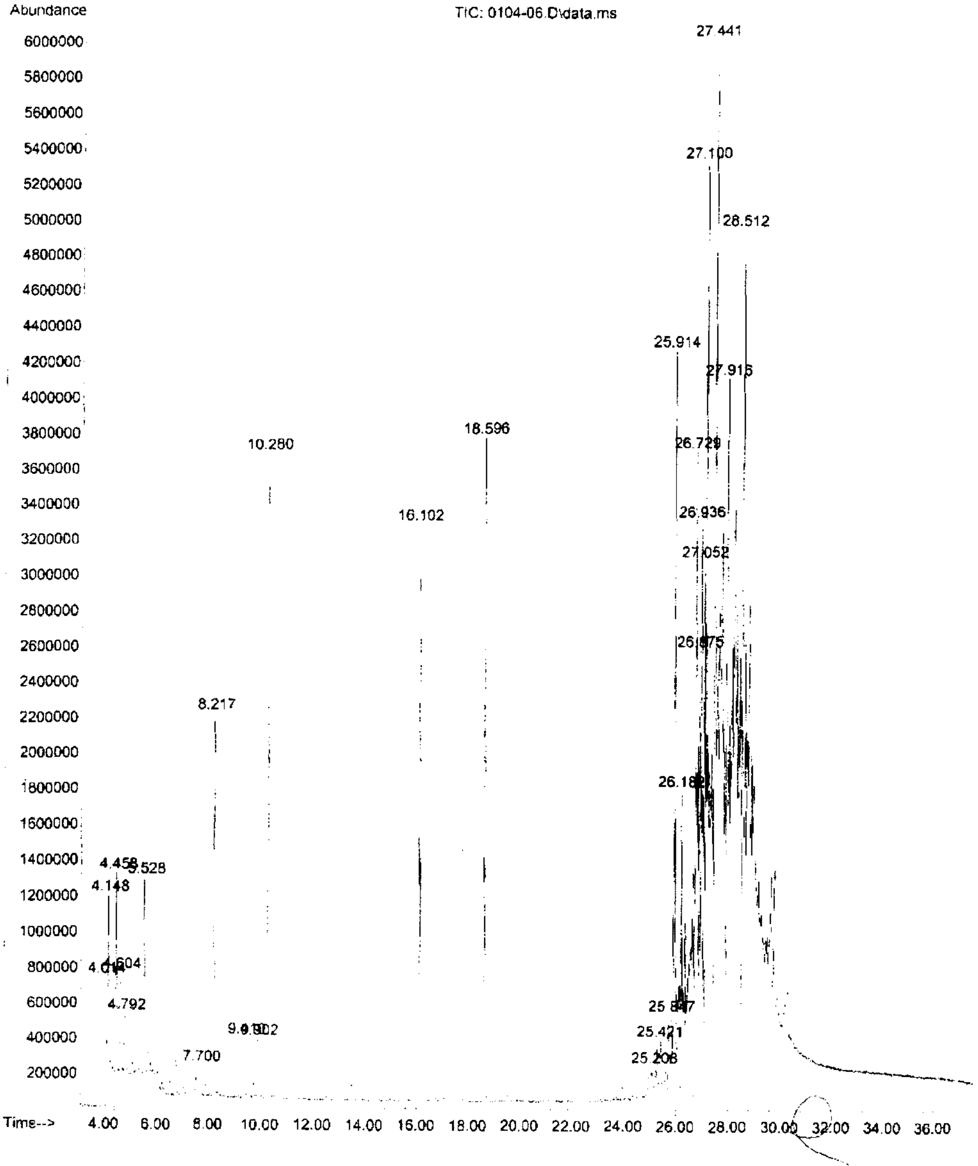

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                    Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\DATA\01042010\
Data File : 0104-06.D
Acq On    :  4 Jan 2010   2:01 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,2169,TO15.mpt
Misc      : MSD,NatGas,121709, Train #4,35-300amu @4.64mi
ALS Vial  : 6   Sample Multiplier: 30

Quant Time: Jan 07 12:26:35 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Thu Jan 07 11:31:33 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\01042010\A0104-02.D

 Internal Standards              R.T. QIon  Response  Conc Units Dev(Min)
 ------------------------------------------------------------------------
   1) 1,4-Difluorobenzene       10.280  114  3441780     4.12 ppbv    0.00
  53) Chlorobenzene-d5          16.102   82  1494442     4.16 ppbv    0.00

 System Monitoring Compounds
  24) Bromochloromethane         8.217  128   769225     4.13 ppbv    0.01
  64) p-Bromofluorobenzene      18.596  174  1397469     4.11 ppbv    0.00

 Target Compounds                                                  Qvalue
   2) Freon 22 (CLF2Methane)     0.000   67        0     N.D.
   3) Freon 12 (Cl2F2Methane)    0.000   85        0     N.D.
   4) Chloromethane              4.342   50    4611m    0.80 ppbv
   5) Freon 114 (Cl2F4Ethane)    0.000   85        0     N.D.
   6) Vinyl Chloride             0.000   62        0     N.D.
   7) 1,3- Butadiene             4.640   54   28339m    4.92 ppbv
   8) Bromomethane               0.000   94        0     N.D.
   9) Chloroethane               0.000   64        0     N.D.
  10) Acetone                    5.528   58  553224m  130.35 ppbv
  11) Freon 11 (Cl3Fmethane)     0.000  101        0     N.D.
  12) Acrylonitrile              0.000   53        0     N.D.
  13) 1,1-Dichloroethene         0.000   96        0     N.D.
  14) Methylene Chloride         6.234   84   22895m    2.61 ppbv
  15) Methyl Acetate             0.000   43        0     N.D.
  16) Freon 113 (Cl3F3Ethane)    0.000  101        0     N.D.
  17) Carbon Disulfide           6.544   76   41212m    1.64 ppbv
  18) Trans-1,2-Dichlorothene    0.000   96        0     N.D.
  19) 1,1-Dichloroethane         0.000   63        0     N.D.
  20) Methyl T-Butyl Ether (...  0.000   73        0     N.D.
  21) Methyl Ethyl Ketone(2-...  7.700   43   279236   17.08 ppbv        98
  22) Chloroprene(2-Cl-1,3-B...  0.000   88        0     N.D.
  23) cis-1,2-Dichloroethene     0.000   96        0     N.D.
  25) Hexane                     0.000   57        0     N.D.
  26) Chloroform                 0.000   83        0     N.D.
  27) 2,2-Dichloropropane        0.000   77        0     N.D.
  28) Dibromofluoromethane (...  0.000  111        0     N.D.
  29) 1,2- Dichloroethane        0.000   62        0     N.D.
  30) 1,1,1-Trichloroethane      0.000   97        0     N.D.
  31) 1,1- Dichloropropene       0.000   75        0     N.D.
  32) Benzene                    9.909   78   386198   15.43 ppbv        99
  33) Carbon Tetrachloride       0.000  117        0     N.D.
  34) Cyclohexane                0.000   84        0     N.D. d
  35) Dibromomethane             0.000  174        0     N.D.
  36) 1,2-Dichloropropane        0.000   63        0     N.D.
  37) Ethyl Acrylate             0.000   55        0     N.D.
  38) Bromodichloromethane       0.000   83        0     N.D.
  39) Trichloroethene            0.000  132        0     N.D.
  40) Methyl Methacrylate        0.000   69        0     N.D.
  41) cis-1,3-Dichloropropene    0.000   75        0     N.D.
  42) Methyl Isobutyl Ketone     0.000   58        0     N.D.
  43) Methyl Cyclohexane         0.000   98        0     N.D.
  44) trans-1,3-Dichloropropene  0.000   75        0     N.D.
```

```
 45) 1,1,2-Trichloroethane       0.000   97         0       N.D.
 46) Toluene-d8  (SMC)           0.000   98         0       N.D.
 47) Toluene                    13.522   91     99933     3.48 ppbv       99
 48) 1,3-Dichloropropane         0.000   76         0       N.D.
 49) Methyl Butyl Ketone(2-...   0.000   43         0       N.D.
 50) Dibromochloromethane        0.000  129         0       N.D.
 51) 1,2- Dibromoethane          0.000  107         0       N.D.
 52) Tetrachloroethene           0.000  166         0       N.D.
 54) 1,1,1,2 - Tetrachloroe...   0.000  131         0       N.D.
 55) Chlorobenzene               0.000  112         0       N.D. d
 56) Ethylbenzene                0.000   91         0       N.D.
 57) (m and /or p) Xylene        0.000   91         0       N.D. d
 58) Bromoform                   0.000  173         0       N.D.
 59) Butyl Acrylate              0.000   55         0       N.D.
 60) Styrene                     0.000  104         0       N.D.
 61) 1,1,2,2-Tetrachloroethane   0.000   83         0       N.D.
 62) o-Xylene (1,2-Dimethyl...   0.000   91         0       N.D.
 63) 1,2,3-Trichloropropane      0.000  110         0       N.D.
 65) Isopropylbenzene            0.000  105         0       N.D.
 66) Bromobenzene                0.000  156         0       N.D.
 67) o-Chlorotoluene             0.000  126         0       N.D.
 68) n-Propylbenzene             0.000  120         0       N.D.
 69) p-Chlorotoluene             0.000  126         0       N.D.
 70) 1,3,5-Trimethylbenzene      0.000  105         0       N.D.
 71) tert-Butylbenzene           0.000  134         0       N.D.
 72) 1,2,4-Trimethylbenzene      0.000  105         0       N.D.
 73) 1,3-Dichlorobenzene         0.000  146         0       N.D.
 74) 1,4-Dichlorobenzene         0.000  146         0       N.D.
 75) sec-Butylbenzene            0.000  105         0       N.D.
 76) p-Isopropyltoluene          0.000  119         0       N.D.
 77) 1,2-Dichlorobenzene         0.000  146         0       N.D.
 78) n-Butylbenzene              0.000   91         0       N.D.
 79) 1,2-Dibromo-3-chloropr...   0.000  157         0       N.D.
 80) 1,2,4-Trichlorobenzene      0.000  180         0       N.D.
 81) Naphthalene                25.732  128    121897     6.78 ppbv       98
 82) 1,2,3-Trichlorobenzene      0.000  180         0       N.D.
 83) Hexachlorobutadiene         0.000  225         0       N.D.
--------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 12:26:53 2010
```

#5

```
File        :C:\msdchem\1\DATA\01042010\0104-07.D
Operator    : JM
Acquired    :  4 Jan 2010   2:49 pm using AcqMethod TO15PPB8.M
Instrument  :   5973A MSD
Sample Name: 100cc IS,50cc,AS16,2171,TO15.mpt
Misc Info   : MSD,Dig Gas,121709,Train #4,35-300amu @4.64mi
Vial Number: 7
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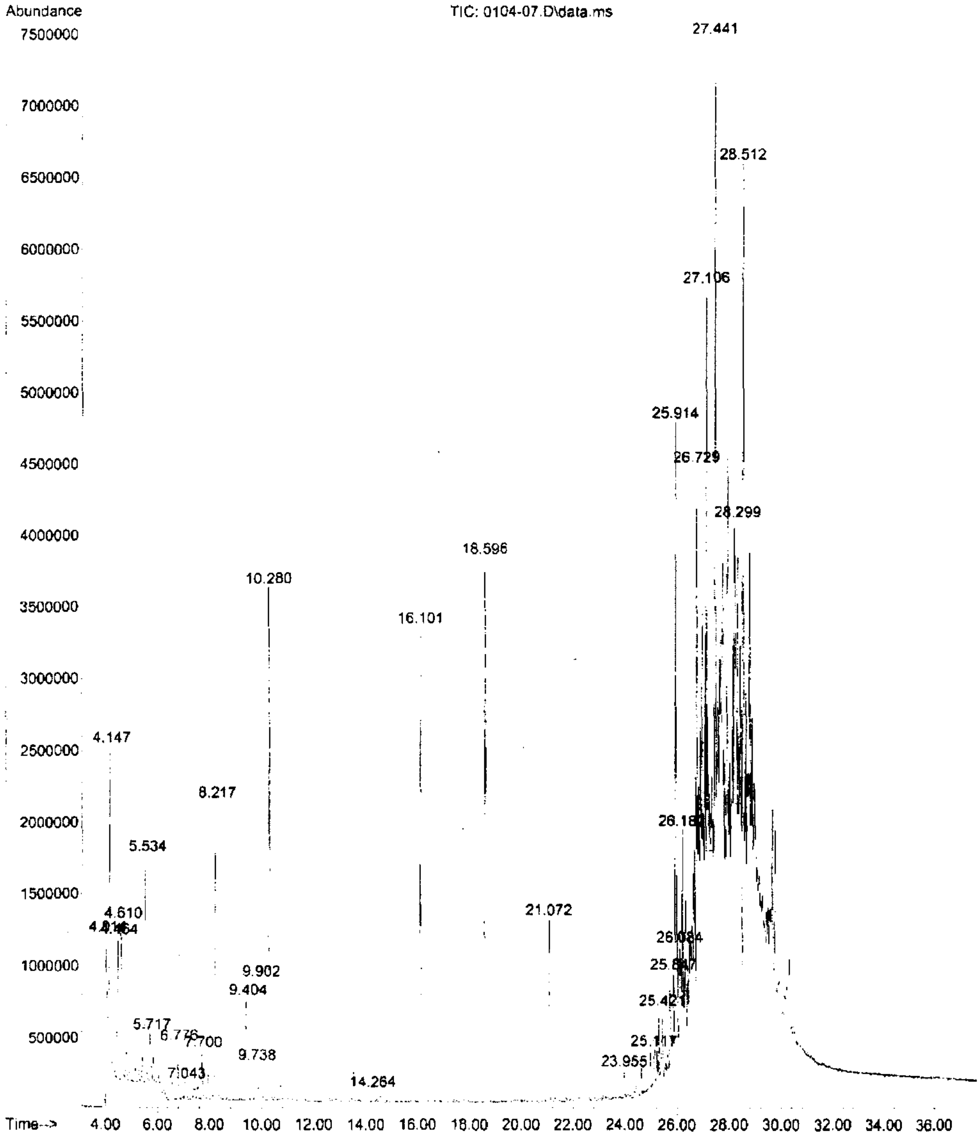

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                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\01042010\
Data File : 0104-07.D
Acq On    :  4 Jan 2010   2:49 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS16,2171,TO15.mpt
Misc      : MSD,Dig Gas,121709,Train #4,35-300amu @4.64mi
ALS Vial  : 7   Sample Multiplier: 30

Quant Time: Jan 07 12:37:28 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Thu Jan 07 11:31:33 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\01042010\A0104-02.D

 Internal Standards                   R.T. QIon  Response  Conc Units Dev(Min)
-------------------------------------------------------------------------------
  1) 1,4-Difluorobenzene             10.280  114  3460041     4.12 ppbv    0.00
 53) Chlorobenzene-d5                16.101   82  1523878     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane               8.217  128   739906     3.95 ppbv    0.01
 64) p-Bromofluorobenzene            18.596  174  1440938     4.15 ppbv    0.00

 Target Compounds                                                       Qvalue
  2) Freon 22 (CLF2Methane)           0.000   67         0      N.D.
  3) Freon 12 (Cl2F2Methane)          0.000   85         0      N.D. d
  4) Chloromethane                    4.348   50     20583     3.54 ppbv      96
  5) Freon 114 (Cl2F4Ethane)          0.000   85         0      N.D.
  6) Vinyl Chloride                   0.000   62         0      N.D.
  7) 1,3- Butadiene                   4.640   54    65584m   11.33 ppbv
  8) Bromomethane                     0.000   94         0      N.D.
  9) Chloroethane                     0.000   64         0      N.D.
 10) Acetone                          5.534   58   756058m  177.20 ppbv
 11) Freon 11 (Cl3Fmethane)           0.000  101         0      N.D.
 12) Acrylonitrile                    0.000   53         0      N.D. d
 13) 1,1-Dichloroethene               0.000   96         0      N.D.
 14) Methylene Chloride               0.000   84         0      N.D. d
 15) Methyl Acetate                   0.000   43         0      N.D.
 16) Freon 113 (Cl3F3Ethane)          0.000  101         0      N.D.
 17) Carbon Disulfide                 6.550   76    71368m    2.82 ppbv
 18) Trans-1,2-Dichlorothene          0.000   96         0      N.D.
 19) 1,1-Dichloroethane               0.000   63         0      N.D.
 20) Methyl T-Butyl Ether (...        0.000   73         0      N.D.
 21) Methyl Ethyl Ketone(2-...        7.700   43    520248   31.65 ppbv      99
 22) Chloroprene(2-Cl-1,3-B...        0.000   88         0      N.D.
 23) cis-1,2-Dichloroethene           0.000   96         0      N.D.
 25) Hexane                           0.000   57         0      N.D.
 26) Chloroform                       0.000   83         0      N.D. d
 27) 2,2-Dichloropropane              0.000   77         0      N.D.
 28) Dibromofluoromethane (...        0.000  111         0      N.D.
 29) 1,2- Dichloroethane              0.000   62         0      N.D.
 30) 1,1,1-Trichloroethane            0.000   97         0      N.D.
 31) 1,1- Dichloropropene             0.000   75         0      N.D.
 32) Benzene                          9.902   78    948056   37.68 ppbv      99
 33) Carbon Tetrachloride             0.000  117         0      N.D.
 34) Cyclohexane                      0.000   84         0      N.D. d
 35) Dibromomethane                   0.000  174         0      N.D.
 36) 1,2-Dichloropropane              0.000   63         0      N.D.
 37) Ethyl Acrylate                   0.000   55         0      N.D.
 38) Bromodichloromethane             0.000   83         0      N.D.
 39) Trichloroethene                  0.000  132         0      N.D.
 40) Methyl Methacrylate              0.000   69         0      N.D.
 41) cis-1,3-Dichloropropene          0.000   75         0      N.D.
 42) Methyl Isobutyl Ketone           0.000   58         0      N.D.
 43) Methyl Cyclohexane               0.000   98         0      N.D.
 44) trans-1,3-Dichloropropene        0.000   75         0      N.D.
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-    -----   -------------------   ---------       ---- ----     ------
   45) 1,1,2-Trichloroethane         0.000    97          0        N.D.
   46) Toluene-d8  (SMC)             0.000    98          0        N.D.
   47) Toluene                      13.522    91     221623      7.67 ppbv        93
   48) 1,3-Dichloropropane           0.000    76          0        N.D.
   49) Methyl Butyl Ketone(2-...     0.000    43          0        N.D. d
   50) Dibromochloromethane          0.000   129          0        N.D.
   51) 1,2- Dibromoethane            0.000   107          0        N.D.
   52) Tetrachloroethene             0.000   166          0        N.D.
   54) 1,1,1,2 - Tetrachloroe...     0.000   131          0        N.D.
   55) Chlorobenzene                 0.000   112          0        N.D. d
   56) Ethylbenzene                  0.000    91          0        N.D. d
   57) (m and /or p) Xylene          0.000    91          0        N.D. d
   58) Bromoform                     0.000   173          0        N.D.
   59) Butyl Acrylate                0.000    55          0        N.D. d
   60) Styrene                       0.000   104          0        N.D. d
   61) 1,1,2,2-Tetrachloroethane     0.000    83          0        N.D.
   62) o-Xylene (1,2-Dimethyl...     0.000    91          0        N.D. d
   63) 1,2,3-Trichloropropane        0.000   110          0        N.D.
   65) Isopropylbenzene              0.000   105          0        N.D.
   66) Bromobenzene                  0.000   156          0        N.D.
   67) o-Chlorotoluene               0.000   126          0        N.D.
   68) n-Propylbenzene               0.000   120          0        N.D.
   69) p-Chlorotoluene               0.000   126          0        N.D.
   70) 1,3,5-Trimethylbenzene        0.000   105          0        N.D.
   71) tert-Butylbenzene             0.000   134          0        N.D. d
   72) 1,2,4-Trimethylbenzene        0.000   105          0        N.D. d
   73) 1,3-Dichlorobenzene           0.000   146          0        N.D.
   74) 1,4-Dichlorobenzene           0.000   146          0        N.D. d
   75) sec-Butylbenzene              0.000   105          0        N.D.
   76) p-Isopropyltoluene            0.000   119          0        N.D. d
   77) 1,2-Dichlorobenzene           0.000   146          0        N.D.
   78) n-Butylbenzene                0.000    91          0        N.D. d
   79) 1,2-Dibromo-3-chloropr...     0.000   157          0        N.D.
   80) 1,2,4-Trichlorobenzene        0.000   180          0        N.D. d
   81) Naphthalene                  25.732   128     140775      7.67 ppbv        98
   82) 1,2,3-Trichlorobenzene        0.000   180          0        N.D. d
   83) Hexachlorobutadiene           0.000   225          0        N.D.
--------------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 12:37:37 2010
```
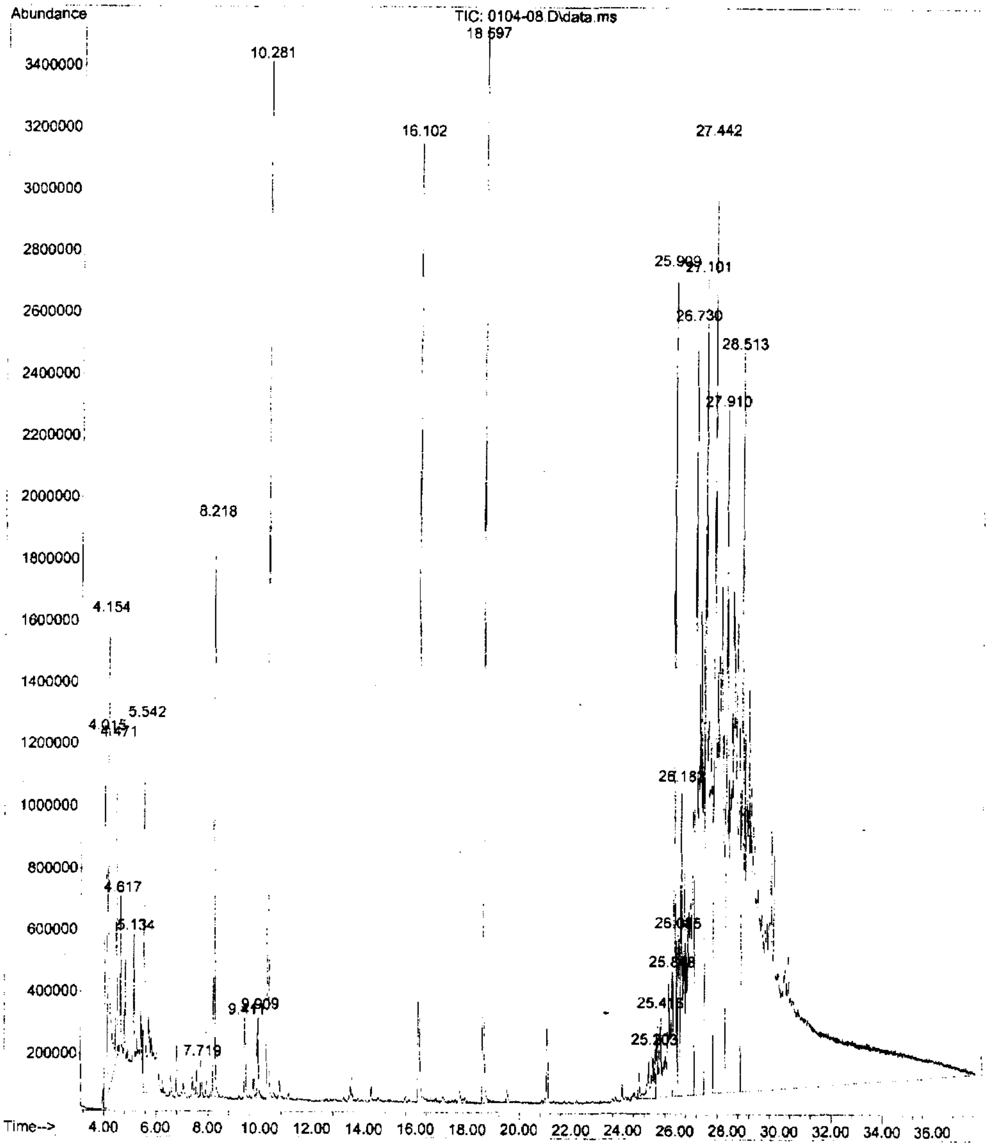

#6

```
File        :C:\msdchem\1\DATA\01042010\0104-08.D
Operator    : JM
Acquired    :  4 Jan 2010   3:43 pm using AcqMethod TO15PPB8.M
Instrument  :   5973A MSD
Sample Name: 100cc IS,50cc,AS15,2174,TO15.mpt
Misc Info   : MSD,NatGas,121809, Train #4,35-300amu @4.64mi
Vial Number: 8
```



```
                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\01042010\
Data File : 0104-08.D
Acq On    :  4 Jan 2010   3:43 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,2174,TO15.mpt
Misc      : MSD,NatGas,121809, Train #4,35-300amu @4.64mi
ALS Vial  : 8   Sample Multiplier: 30

Quant Time: Jan 07 12:44:11 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Thu Jan 07 11:31:33 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\01042010\A0104-02.D

 Internal Standards                R.T. QIon  Response  Conc Units Dev(Min)
-----------------------------------------------------------------------------
  1) 1,4-Difluorobenzene          10.281  114  3191569     4.12 ppbv    0.00
 53) Chlorobenzene-d5             16.102   82  1405323     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane            8.218  128   672534     3.89 ppbv    0.01
 64) p-Bromofluorobenzene         18.597  174  1286566     4.02 ppbv    0.00

 Target Compounds                                                     Qvalue
  2) Freon 22 (CLF2Methane)        0.000   67        0      N.D. d
  3) Freon 12 (Cl2F2Methane)       0.000   85        0      N.D. d
  4) Chloromethane                 4.349   50    13899m    2.59 ppbv
  5) Freon 114 (Cl2F4Ethane)       0.000   85        0      N.D.
  6) Vinyl Chloride                0.000   62        0      N.D.
  7) 1,3- Butadiene                4.647   54    21707m    4.07 ppbv
  8) Bromomethane                  0.000   94        0      N.D.
  9) Chloroethane                  0.000   64        0      N.D.
 10) Acetone                       5.542   58   580622m  147.53 ppbv
 11) Freon 11 (Cl3Fmethane)        0.000  101        0      N.D.
 12) Acrylonitrile                 0.000   53        0      N.D. d
 13) 1,1-Dichloroethene            0.000   96        0      N.D.
 14) Methylene Chloride            0.000   84        0      N.D. d
 15) Methyl Acetate                0.000   43        0      N.D.
 16) Freon 113 (Cl3F3Ethane)       0.000  101        0      N.D.
 17) Carbon Disulfide              6.551   76    34999m    1.50 ppbv
 18) Trans-1,2-Dichlorothene       0.000   96        0      N.D.
 19) 1,1-Dichloroethane            0.000   63        0      N.D.
 20) Methyl T-Butyl Ether (...     0.000   73        0      N.D.
 21) Methyl Ethyl Ketone(2-...     7.719   43   221020    14.58 ppbv       99
 22) Chloroprene(2-Cl-1,3-B...     0.000   88        0      N.D.
 23) cis-1,2-Dichloroethene        0.000   96        0      N.D.
 25) Hexane                        0.000   57        0      N.D.
 26) Chloroform                    0.000   83        0      N.D.
 27) 2,2-Dichloropropane           0.000   77        0      N.D.
 28) Dibromofluoromethane (...     0.000  111        0      N.D.
 29) 1,2- Dichloroethane           0.000   62        0      N.D.
 30) 1,1,1-Trichloroethane         0.000   97        0      N.D.
 31) 1,1- Dichloropropene          0.000   75        0      N.D.
 32) Benzene                       9.909   78   322095    13.88 ppbv       97
 33) Carbon Tetrachloride          0.000  117        0      N.D.
 34) Cyclohexane                   0.000   84        0      N.D. d
 35) Dibromomethane                0.000  174        0      N.D.
 36) 1,2-Dichloropropane           0.000   63        0      N.D.
 37) Ethyl Acrylate                0.000   55        0      N.D.
 38) Bromodichloromethane          0.000   83        0      N.D.
 39) Trichloroethene               0.000  132        0      N.D.
 40) Methyl Methacrylate           0.000   69        0      N.D.
 41) cis-1,3-Dichloropropene       0.000   75        0      N.D.
 42) Methyl Isobutyl Ketone        0.000   58        0      N.D.
 43) Methyl Cyclohexane            0.000   98        0      N.D.
 44) trans-1,3-Dichloropropene     0.000   75        0      N.D.
```

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 45) 1,1,2-Trichloroethane        0.000   97          0      N.D.
 46) Toluene-d8  (SMC)            0.000   98          0      N.D.
 47) Toluene                     13.511   91      80491     3.02 ppbv       93
 48) 1,3-Dichloropropane          0.000   76          0      N.D.
 49) Methyl Butyl Ketone(2-...    0.000   43          0      N.D. d
 50) Dibromochloromethane         0.000  129          0      N.D.
 51) 1,2- Dibromoethane           0.000  107          0      N.D.
 52) Tetrachloroethene            0.000  166          0      N.D.
 54) 1,1,1,2 - Tetrachloroe...    0.000  131          0      N.D.
 55) Chlorobenzene                0.000  112          0      N.D. d
 56) Ethylbenzene                 0.000   91          0      N.D. d
 57) (m and /or p) Xylene         0.000   91          0      N.D. d
 58) Bromoform                    0.000  173          0      N.D.
 59) Butyl Acrylate               0.000   55          0      N.D. d
 60) Styrene                      0.000  104          0      N.D. d
 61) 1,1,2,2-Tetrachloroethane    0.000   83          0      N.D.
 62) o-Xylene (1,2-Dimethyl...    0.000   91          0      N.D. d
 63) 1,2,3-Trichloropropane       0.000  110          0      N.D.
 65) Isopropylbenzene             0.000  105          0      N.D.
 66) Bromobenzene                 0.000  156          0      N.D.
 67) o-Chlorotoluene              0.000  126          0      N.D.
 68) n-Propylbenzene              0.000  120          0      N.D.
 69) p-Chlorotoluene              0.000  126          0      N.D.
 70) 1,3,5-Trimethylbenzene       0.000  105          0      N.D.
 71) tert-Butylbenzene            0.000  134          0      N.D.
 72) 1,2,4-Trimethylbenzene       0.000  105          0      N.D. d
 73) 1,3-Dichlorobenzene          0.000  146          0      N.D.
 74) 1,4-Dichlorobenzene          0.000  146          0      N.D.
 75) sec-Butylbenzene             0.000  105          0      N.D.
 76) p-Isopropyltoluene           0.000  119          0      N.D.
 77) 1,2-Dichlorobenzene          0.000  146          0      N.D.
 78) n-Butylbenzene               0.000   91          0      N.D.
 79) 1,2-Dibromo-3-chloropr...    0.000  157          0      N.D.
 80) 1,2,4-Trichlorobenzene       0.000  180          0      N.D.
 81) Naphthalene                 25.739  128      72647     4.29 ppbv       95
 82) 1,2,3-Trichlorobenzene       0.000  180          0      N.D. d
 83) Hexachlorobutadiene          0.000  225          0      N.D.
---------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Thu Jan 07 12:44:18 2010
```

#6

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File        :C:\msdchem\1\DATA\01042010\0104-09.D
Operator    : JM
Acquired    :  4 Jan 2010    4:31 pm using AcqMethod TO15PPB8.M
Instrument :    5973A MSD
Sample Name: 100cc IS,50cc,AS16,6445,TO15.mpt
Misc Info  : MSD,Dig Gas,121809,Train #4,35-300amu @4.64mi
Vial Number: 9
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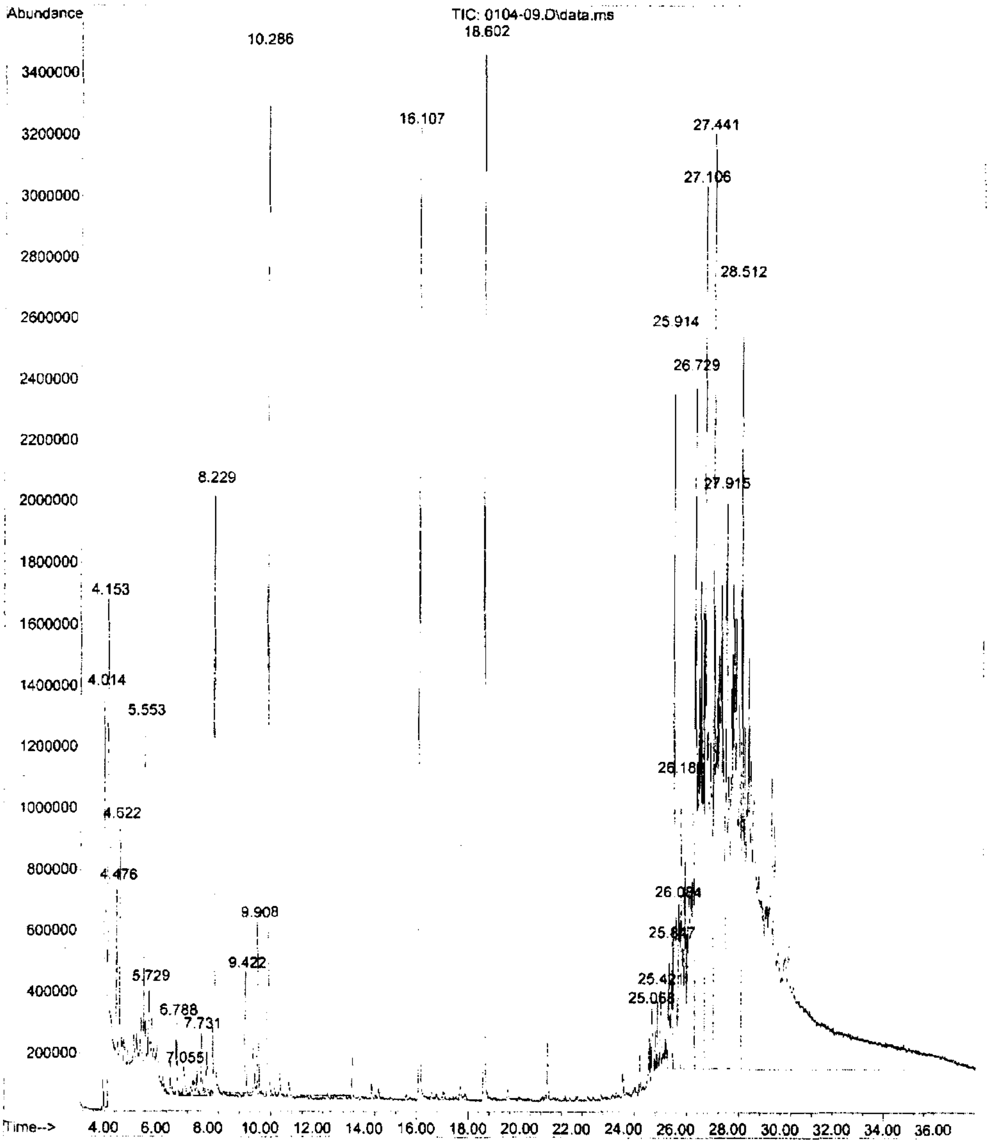

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                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\01042010\
Data File : 0104-09.D
Acq On    :  4 Jan 2010   4:31 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS16,6445,TO15.mpt
Misc      : MSD,Dig Gas,121809,Train #4,35-300amu @4.64mi
ALS Vial  : 9   Sample Multiplier: 30

Quant Time: Jan 07 11:43:29 2010
Quant Method : C:\msdchem\1\METHODS\T015ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Fri Dec 11 10:00:41 2009
Response via : Continuing Cal File: C:\msdchem\1\DATA\12162009\A1216-02.D

 Internal Standards              R.T. QIon  Response  Conc Units Dev(Min)
--------------------------------------------------------------------------
  1) 1,4-Difluorobenzene        10.286  114  3353582     4.12 ppbv    0.00
 53) Chlorobenzene-d5           16.107   82  1469472     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane          8.229  128   719588     4.32 ppbv    0.00
 64) p-Bromofluorobenzene       18.602  174  1355804     3.76 ppbv    0.00

 Target Compounds                                                 Qvalue
  2) Freon 22 (CLF2Methane)      0.000   67        0     N.D.
  3) Freon 12 (Cl2F2Methane)     0.000   85        0     N.D. d
  4) Chloromethane               4.354   50    16783m   3.66 ppbv
  5) Freon 114 (Cl2F4Ethane)     0.000   85        0     N.D.
  6) Vinyl Chloride              0.000   62        0     N.D.
  7) 1,3- Butadiene              4.652   54    41619m   9.27 ppbv
  8) Bromomethane                0.000   94        0     N.D.
  9) Chloroethane                0.000   64        0     N.D.
 10) Acetone                     5.553   58   522566m 145.04 ppbv
 11) Freon 11 (Cl3Fmethane)      0.000  101        0     N.D.
 12) Acrylonitrile               0.000   53        0     N.D. d
 13) 1,1-Dichloroethene          0.000   96        0     N.D.
 14) Methylene Chloride          6.252   84    21451m   3.01 ppbv
 15) Methyl Acetate              0.000   43        0     N.D.
 16) Freon 113 (Cl3F3Ethane)     0.000  101        0     N.D.
 17) Carbon Disulfide            6.556   76    46337m   2.27 ppbv
 18) Trans-1,2-Dichlorothene     0.000   96        0     N.D.
 19) 1,1-Dichloroethane          0.000   63        0     N.D.
 20) Methyl T-Butyl Ether (...   0.000   73        0     N.D.
 21) Methyl Ethyl Ketone(2-...   7.724   43   352732   25.72 ppbv        98
 22) Chloroprene(2-Cl-1,3-B...   0.000   88        0     N.D.
 23) cis-1,2-Dichloroethene      0.000   96        0     N.D.
 25) Hexane                      0.000   57        0     N.D.
 26) Chloroform                  0.000   83        0     N.D. d
 27) 2,2-Dichloropropane         0.000   77        0     N.D.
 28) Dibromofluoromethane (...   0.000  111        0     N.D.
 29) 1,2- Dichloroethane         0.000   62        0     N.D.
 30) 1,1,1-Trichloroethane       0.000   97        0     N.D.
 31) 1,1- Dichloropropene        0.000   75        0     N.D.
 32) Benzene                     9.908   78   670291   30.51 ppbv        99
 33) Carbon Tetrachloride        0.000  117        0     N.D.
 34) Cyclohexane                 0.000   84        0     N.D. d
 35) Dibromomethane              0.000  174        0     N.D.
 36) 1,2-Dichloropropane         0.000   63        0     N.D.
 37) Ethyl Acrylate              0.000   55        0     N.D.
 38) Bromodichloromethane        0.000   83        0     N.D.
 39) Trichloroethene             0.000  132        0     N.D.
 40) Methyl Methacrylate         0.000   69        0     N.D.
 41) cis-1,3-Dichloropropene     0.000   75        0     N.D.
 42) Methyl Isobutyl Ketone      0.000   58        0     N.D.
 43) Methyl Cyclohexane          0.000   98        0     N.D.
 44) trans-1,3-Dichloropropene   0.000   75        0     N.D.
```

```
45) 1,1,2-Trichloroethane          0.000    97        0      N.D.
46) Toluene-d8  (SMC)              0.000    98        0      N.D.
47) Toluene                       13.522    91   143254      5.43 ppbv       98
48) 1,3-Dichloropropane            0.000    76        0      N.D.
49) Methyl Butyl Ketone(2-...      0.000    43        0      N.D. d
50) Dibromochloromethane           0.000   129        0      N.D.
51) 1,2- Dibromoethane             0.000   107        0      N.D.
52) Tetrachloroethene              0.000   166        0      N.D.
54) 1,1,1,2 - Tetrachloroe...      0.000   131        0      N.D.
55) Chlorobenzene                  0.000   112        0      N.D. d
56) Ethylbenzene                   0.000    91        0      N.D. d
57) (m and /or p) Xylene           0.000    91        0      N.D. d
58) Bromoform                      0.000   173        0      N.D.
59) Butyl Acrylate                 0.000    55        0      N.D. d
60) Styrene                        0.000   104        0      N.D. d
61) 1,1,2,2-Tetrachloroethane      0.000    83        0      N.D.
62) o-Xylene (1,2-Dimethyl....     0.000    91        0      N.D. d
63) 1,2,3-Trichloropropane         0.000   110        0      N.D.
65) Isopropylbenzene               0.000   105        0      N.D.
66) Bromobenzene                   0.000   156        0      N.D.
67) o-Chlorotoluene                0.000   126        0      N.D.
68) n-Propylbenzene                0.000   120        0      N.D.
69) p-Chlorotoluene                0.000   126        0      N.D.
70) 1,3,5-Trimethylbenzene         0.000   105        0      N.D.
71) tert-Butylbenzene              0.000   134        0      N.D.
72) 1,2,4-Trimethylbenzene         0.000   105        0      N.D. d
73) 1,3-Dichlorobenzene            0.000   146        0      N.D.
74) 1,4-Dichlorobenzene            0.000   146        0      N.D.
75) sec-Butylbenzene               0.000   105        0      N.D.
76) p-Isopropyltoluene             0.000   119        0      N.D. d
77) 1,2-Dichlorobenzene            0.000   146        0      N.D.
78) n-Butylbenzene                 0.000    91        0      N.D. d
79) 1,2-Dibromo-3-chloropr...      0.000   157        0      N.D.
80) 1,2,4-Trichlorobenzene         0.000   180        0      N.D.
81) Naphthalene                   25.738   128    64417      1.95 ppbv       97
82) 1,2,3-Trichlorobenzene         0.000   180        0      N.D.
83) Hexachlorobutadiene            0.000   225        0      N.D.
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(#) = qualifier out of range (m) = manual integration (+) = signals summed

T015ppb8.M Thu Jan 07 11:45:03 2010
```

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File         :C:\msdchem\1\DATA\03232010\0323-03.D
Operator     : JM
Acquired     : 23 Mar 2010   11:05 am using AcqMethod TO15PPB8.M
Instrument :    5973A MSD
Sample Name: 100cc IS,500cc,AS15,6458,TO15.mpt
Misc Info  : Sample Date: 022610, FB MSD.
Vial Number: 3
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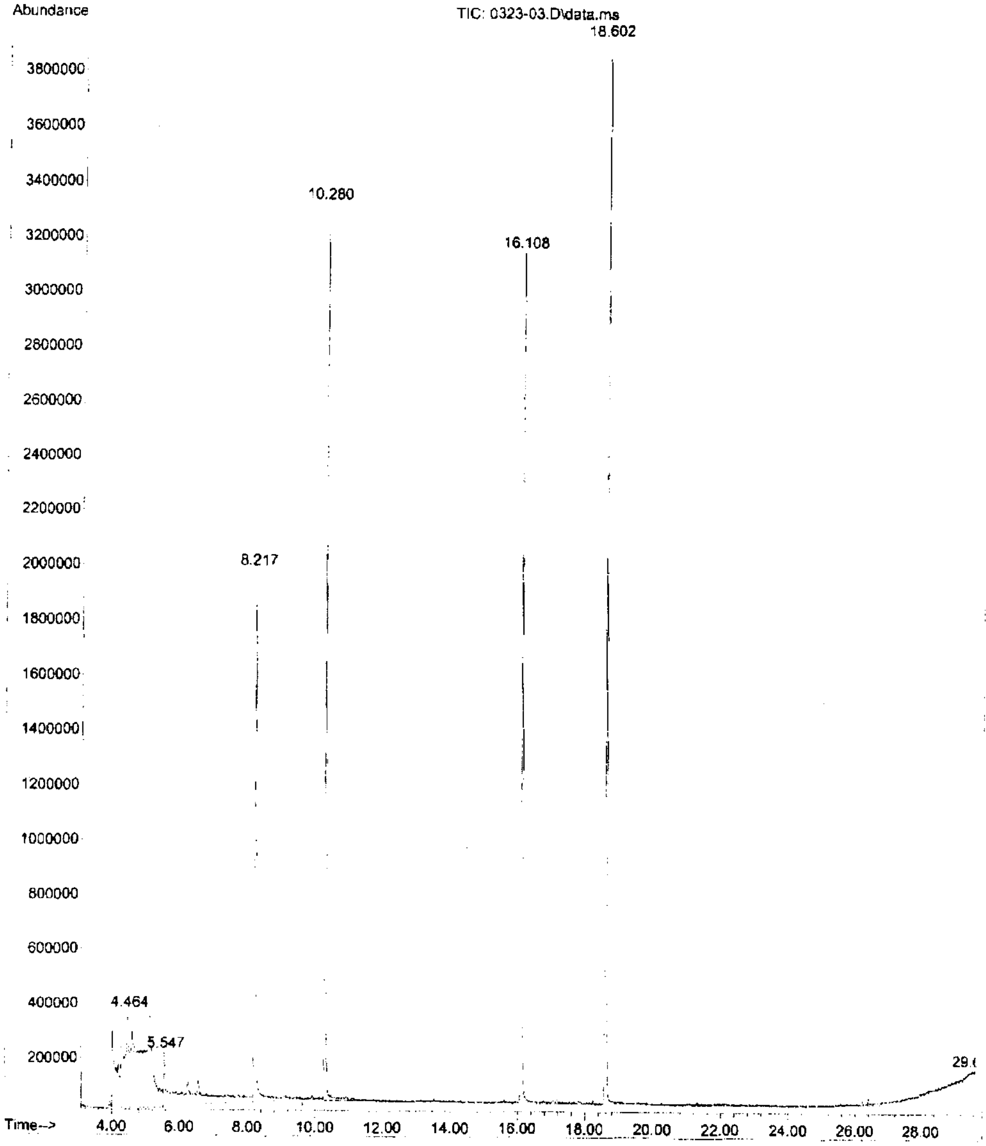

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                    Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\DATA\03232010\
Data File : 0323-03.D
Acq On    : 23 Mar 2010  11:05 am
Operator  : JM
Sample    : 100cc IS,500cc,AS15,6458,TO15.mpt
Misc      : Sample Date: 022610, FB MSD.
ALS Vial  : 3   Sample Multiplier: 1

Quant Time: Mar 23 11:58:08 2010          .
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Tue Mar 23 11:48:01 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\03232010\A0323-02.D

 Internal Standards                R.T. QIon  Response  Conc Units Dev(Min)
------------------------------------------------------------------------------
  1) 1,4-Difluorobenzene          10.280  114  2922750    4.12 ppbv    0.00
 53) Chlorobenzene-d5             16.108   82  1365410    4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane            8.217  128   678685    4.49 ppbv    0.00
 64) p-Bromofluorobenzene         18.602  174  1367961    3.89 ppbv    0.00

 Target Compounds                                                    Qvalue
   2) Freon 22 (CLF2Methane)       4.111   67     1881     N.D.
   3) Freon 12 (Cl2F2Methane)      4.208   85    10908     N.D.
   4) Chloromethane                4.348   50     1644     N.D.
   5) Freon 114 (Cl2F4Ethane)      0.000   85        0     N.D.
   6) Vinyl Chloride               0.000   62        0     N.D.
   7) 1,3- Butadiene               0.000   54        0     N.D.
   8) Bromomethane                 0.000   94        0     N.D.
   9) Chloroethane                 0.000   64        0     N.D.
  10) Acetone                      5.547   58    64593m   0.54 ppbv
  11) Freon 11 (Cl3Fmethane)       5.614  101     6043     N.D.
  12) Acrylonitrile                0.000   53        0     N.D.
  13) 1,1-Dichloroethene           0.000   96        0     N.D.
  14) Methylene Chloride           6.240   84    23739    0.11 ppbv       94
  15) Methyl Acetate               0.000   43        0     N.D.
  16) Freon 113 (Cl3F3Ethane)      0.000  101        0     N.D.
  17) Carbon Disulfide             6.544   76    10925     N.D.
  18) Trans-1,2-Dichlorothene      0.000   96        0     N.D.
  19) 1,1-Dichloroethane           0.000   63        0     N.D.
  20) Methyl T-Butyl Ether (...    0.000   73        0     N.D.
  21) Methyl Ethyl Ketone(2-...    7.743   43    15157     N.D.
  22) Chloroprene(2-Cl-1,3-B...    0.000   88        0     N.D.
  23) cis-1,2-Dichloroethene       0.000   96        0     N.D.
  25) Hexane                       0.000   57        0     N.D.
  26) Chloroform                   0.000   83        0     N.D.
  27) 2,2-Dichloropropane          0.000   77        0     N.D.
  28) Dibromofluoromethane (...    0.000  111        0     N.D.
  29) 1,2- Dichloroethane          0.000   62        0     N.D.
  30) 1,1,1-Trichloroethane        0.000   97        0     N.D.
  31) 1,1- Dichloropropene         0.000   75        0     N.D.
  32) Benzene                      9.903   78    11764     N.D.
  33) Carbon Tetrachloride         0.000  117        0     N.D.
  34) Cyclohexane                  0.000   84        0     N.D. d
  35) Dibromomethane               0.000  174        0     N.D.
  36) 1,2-Dichloropropane          0.000   63        0     N.D.
  37) Ethyl Acrylate               0.000   55        0     N.D.
  38) Bromodichloromethane         0.000   83        0     N.D.
  39) Trichloroethene              0.000  132        0     N.D.
  40) Methyl Methacrylate          0.000   69        0     N.D.
  41) cis-1,3-Dichloropropene      0.000   75        0     N.D.
  42) Methyl Isobutyl Ketone       0.000   58        0     N.D.
  43) Methyl Cyclohexane           0.000   98        0     N.D.
  44) trans-1,3-Dichloropropene    0.000   75        0     N.D.
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 45) 1,1,2-Trichloroethane        0.000   97        0       N.D.
 46) Toluene-d8  (SMC)            0.000   98        0       N.D.
 47) Toluene                     13.516   91     5439       N.D.
 48) 1,3-Dichloropropane          0.000   76        0       N.D.
 49) Methyl Butyl Ketone(2-...    0.000   43        0       N.D.
 50) Dibromochloromethane         0.000  129        0       N.D.
 51) 1,2- Dibromoethane           0.000  107        0       N.D.
 52) Tetrachloroethene            0.000  166        0       N.D.
 54) 1,1,1,2 - Tetrachloroe...    0.000  131        0       N.D.
 55) Chlorobenzene               16.181  112     5194       N.D.
 56) Ethylbenzene                 0.000   91        0       N.D.
 57) (m and /or p) Xylene        17.057   91     8879       N.D.
 58) Bromoform                   17.160  173     6777       N.D.
 59) Butyl Acrylate               0.000   55        0       N.D.
 60) Styrene                      0.000  104        0       N.D.
 61) 1,1,2,2-Tetrachloroethane    0.000   83        0       N.D.
 62) o-Xylene (1,2-Dimethyl...    0.000   91        0       N.D.
 63) 1,2,3-Trichloropropane       0.000  110        0       N.D.
 65) Isopropylbenzene             0.000  105        0       N.D.
 66) Bromobenzene                 0.000  156        0       N.D.
 67) o-Chlorotoluene              0.000  126        0       N.D.
 68) n-Propylbenzene              0.000  120        0       N.D.
 69) p-Chlorotoluene              0.000  126        0       N.D.
 70) 1,3,5-Trimethylbenzene       0.000  105        0       N.D.
 71) tert-Butylbenzene            0.000  134        0       N.D.
 72) 1,2,4-Trimethylbenzene       0.000  105        0       N.D.
 73) 1,3-Dichlorobenzene          0.000  146        0       N.D.
 74) 1,4-Dichlorobenzene          0.000  146        0       N.D.
 75) sec-Butylbenzene             0.000  105        0       N.D.
 76) p-Isopropyltoluene           0.000  119        0       N.D.
 77) 1,2-Dichlorobenzene          0.000  146        0       N.D.
 78) n-Butylbenzene               0.000   91        0       N.D.
 79) 1,2-Dibromo-3-chloropr...    0.000  157        0       N.D.
 80) 1,2,4-Trichlorobenzene       0.000  180        0       N.D.
 81) Naphthalene                  0.000  128        0       N.D.
 82) 1,2,3-Trichlorobenzene       0.000  180        0       N.D.
 83) Hexachlorobutadiene          0.000  225        0       N.D.
--------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Tue Mar 23 11:58:22 2010
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Operator    : JM
Acquired    : 23 Mar 2010   12:39 pm using AcqMethod TO15PPB8.M
Instrument  :    5973A MSD
Sample Name: 100cc IS,50cc,AS15,6437,TO15.mpt
Misc Info   : Sample Date: 022610,Site: DigesterTRN #1, MSD
Vial Number: 5
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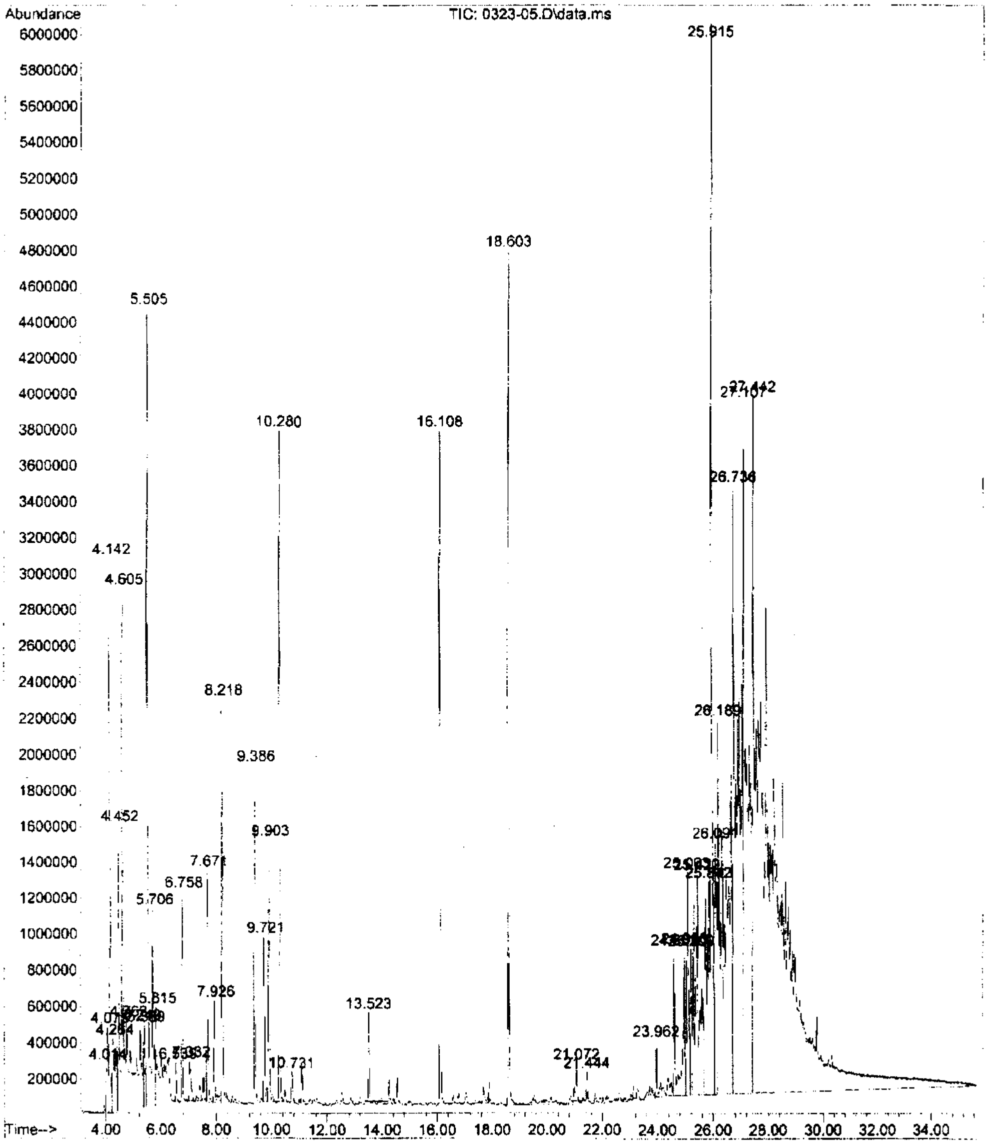

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                    Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\DATA\03232010\
Data File : 0323-05.D
Acq On    : 23 Mar 2010  12:39 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,6437,TO15.mpt
Misc      : Sample Date: 022610,Site: DigesterTRN #1, MSD
ALS Vial  : 5   Sample Multiplier: 30

Quant Time: Mar 24 16:39:36 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Tue Mar 23 11:48:01 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\03232010\A0323-02.D

 Internal Standards                R.T. QIon  Response   Conc Units Dev(Min)
---------------------------------------------------------------------------
   1) 1,4-Difluorobenzene        10.280  114   3495555      4.12 ppbv    0.00
  53) Chlorobenzene-d5           16.108   82   1725641      4.16 ppbv    0.00

 System Monitoring Compounds
  24) Bromochloromethane          8.218  128    764966      4.23 ppbv    0.00
  64) p-Bromofluorobenzene       18.603  174   1824425      4.10 ppbv    0.00

 Target Compounds                                                    Qvalue
   2) Freon 22 (CLF2Methane)      0.000   67         0      N.D.
   3) Freon 12 (Cl2F2Methane)     0.000   85         0      N.D. d
   4) Chloromethane               4.343   50    138137     21.87 ppbv      99
   5) Freon 114 (Cl2F4Ethane)     0.000   85         0      N.D.
   6) Vinyl Chloride              0.000   62         0      N.D.
   7) 1,3- Butadiene              4.635   54    214336m    34.93 ppbv
   8) Bromomethane                0.000   94         0      N.D.
   9) Chloroethane                0.000   64         0      N.D. d
  10) Acetone                     5.511   58   1896013m   400.63 ppbv
  11) Freon 11 (Cl3Fmethane)      0.000  101         0      N.D. d
  12) Acrylonitrile               0.000   53         0      N.D. d
  13) 1,1-Dichloroethene          0.000   96         0      N.D.
  14) Methylene Chloride          6.235   84     35323      4.26 ppbv      89
  15) Methyl Acetate              0.000   43         0      N.D. d
  16) Freon 113 (Cl3F3Ethane)     0.000  101         0      N.D.
  17) Carbon Disulfide            6.539   76    132460      5.73 ppbv      99
  18) Trans-1,2-Dichlorothene     0.000   96         0      N.D.
  19) 1,1-Dichloroethane          0.000   63         0      N.D.
  20) Methyl T-Butyl Ether (...   0.000   73         0      N.D.
  21) Methyl Ethyl Ketone(2-...   7.671   43   1965414    128.58 ppbv      98
  22) Chloroprene(2-Cl-1,3-B...   0.000   88         0      N.D.
  23) cis-1,2-Dichloroethene      0.000   96         0      N.D.
  25) Hexane                      0.000   57         0      N.D. d
  26) Chloroform                  0.000   83         0      N.D. d
  27) 2,2-Dichloropropane         0.000   77         0      N.D.
  28) Dibromofluoromethane (...   0.000  111         0      N.D.
  29) 1,2- Dichloroethane         0.000   62         0      N.D.
  30) 1,1,1-Trichloroethane       0.000   97         0      N.D.
  31) 1,1- Dichloropropene        0.000   75         0      N.D.
  32) Benzene                     9.903   78   1614361     68.27 ppbv      99
  33) Carbon Tetrachloride        0.000  117         0      N.D.
  34) Cyclohexane                 0.000   84         0      N.D. d
  35) Dibromomethane              0.000  174         0      N.D.
  36) 1,2-Dichloropropane         0.000   63         0      N.D.
  37) Ethyl Acrylate              0.000   55         0      N.D.
  38) Bromodichloromethane        0.000   83         0      N.D. d
  39) Trichloroethene             0.000  132         0      N.D.
  40) Methyl Methacrylate        11.388   69     11057m     1.54 ppbv
  41) cis-1,3-Dichloropropene     0.000   75         0      N.D.
  42) Methyl Isobutyl Ketone      0.000   58         0      N.D.
  43) Methyl Cyclohexane          0.000   98         0      N.D.
  44) trans-1,3-Dichloropropene   0.000   75         0      N.D.
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 45) 1,1,2-Trichloroethane       0.000   97         0      N.D.
 46) Toluene-d8  (SMC)           0.000   98         0      N.D.
 47) Toluene                    13.523   91    492711    17.91 ppbv      99
 48) 1,3-Dichloropropane         0.000   76         0      N.D.
 49) Methyl Butyl Ketone(2-...  13.985   43     31986     2.24 ppbv      90
 50) Dibromochloromethane        0.000  129         0      N.D.
 51) 1,2- Dibromoethane          0.000  107         0      N.D.
 52) Tetrachloroethene           0.000  166         0      N.D.
 54) 1,1,1,2 - Tetrachloroe...   0.000  131         0      N.D.
 55) Chlorobenzene               0.000  112         0      N.D. d
 56) Ethylbenzene               16.778   91     39269     1.11 ppbv      95
 57) (m and /or p) Xylene       17.045   91     64630     2.31 ppbv      96
 58) Bromoform                   0.000  173         0      N.D.
 59) Butyl Acrylate              0.000   55         0      N.D. d
 60) Styrene                     0.000  104         0      N.D. d
 61) 1,1,2,2-Tetrachloroethane   0.000   83         0      N.D. d
 62) o-Xylene (1,2-Dimethyl...   0.000   91         0      N.D. d
 63) 1,2,3-Trichloropropane      0.000  110         0      N.D.
 65) Isopropylbenzene            0.000  105         0      N.D. d
 66) Bromobenzene                0.000  156         0      N.D.
 67) o-Chlorotoluene             0.000  126         0      N.D.
 68) n-Propylbenzene             0.000  120         0      N.D.
 69) p-Chlorotoluene             0.000  126         0      N.D.
 70) 1,3,5-Trimethylbenzene      0.000  105         0      N.D. d
 71) tert-Butylbenzene           0.000  134         0      N.D.
 72) 1,2,4-Trimethylbenzene      0.000  105         0      N.D. d
 73) 1,3-Dichlorobenzene         0.000  146         0      N.D.
 74) 1,4-Dichlorobenzene        21.444  146    118048     5.05 ppbv      97
 75) sec-Butylbenzene            0.000  105         0      N.D.
 76) p-Isopropyltoluene          0.000  119         0      N.D. d
 77) 1,2-Dichlorobenzene         0.000  146         0      N.D.
 78) n-Butylbenzene              0.000   91         0      N.D. d
 79) 1,2-Dibromo-3-chloropr...   0.000  157         0      N.D.
 80) 1,2,4-Trichlorobenzene      0.000  180         0      N.D. d
 81) Naphthalene                25.745  128     35735m    1.08 ppbv
 82) 1,2,3-Trichlorobenzene      0.000  180         0      N.D. d
 83) Hexachlorobutadiene         0.000  225         0      N.D.
-------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Wed Mar 24 16:39:41 2010
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File        :C:\msdchem\1\DATA\03232010\0323-04.D
Operator    : JM
Acquired    : 23 Mar 2010  11:50 am using AcqMethod TO15PPB8.M
Instrument :    5973A MSD
Sample Name: 100cc IS,50cc,AS15,6445,TO15.mpt
Misc Info   : Sample Date: 022610,Site:NatGasTRN #4, MSD
Vial Number: 4
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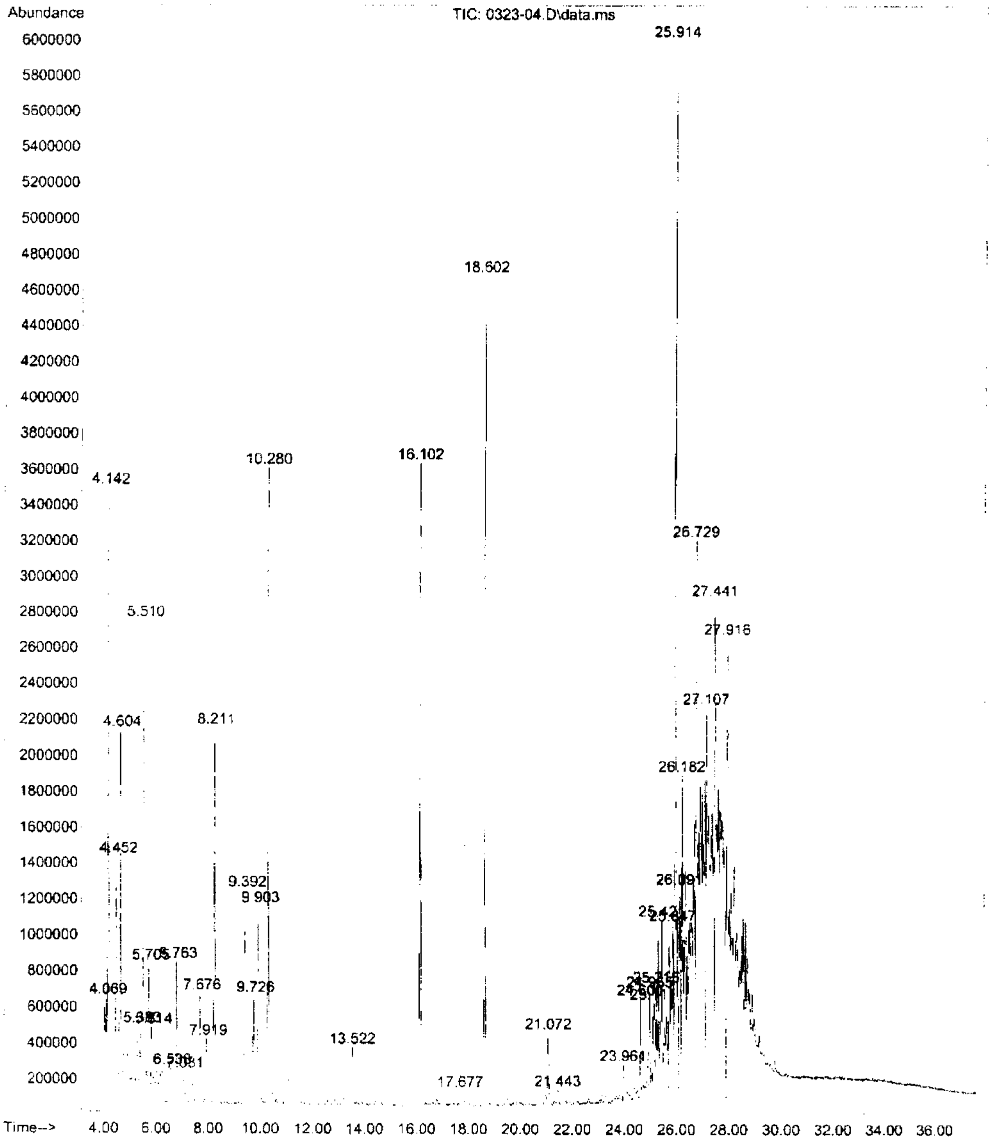

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                 Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\DATA\03232010\
Data File : 0323-04.D
Acq On    : 23 Mar 2010  11:50 am
Operator  : JM
Sample    : 100cc IS,50cc,AS15,6445,TO15.mpt
Misc      : Sample Date: 022610,Site:NatGasTRN #4, MSD
ALS Vial  : 4   Sample Multiplier: 30

Quant Time: Mar 24 16:32:36 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Tue Mar 23 11:48:01 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\03232010\A0323-02.D

 Internal Standards                R.T. QIon  Response  Conc Units Dev(Min)
-----------------------------------------------------------------------------
  1) 1,4-Difluorobenzene          10.280  114  3262956     4.12 ppbv    0.00
 53) Chlorobenzene-d5             16.102   82  1629256     4.16 ppbv    0.00

System Monitoring Compounds
 24) Bromochloromethane            8.211  128   706003     4.18 ppbv    0.00
 64) p-Bromofluorobenzene         18.602  174  1744972     4.15 ppbv    0.00

Target Compounds                                                      Qvalue
  2) Freon 22 (CLF2Methane)        4.111   67    23579    10.40 ppbv      94
  3) Freon 12 (Cl2F2Methane)       0.000   85        0     N.D. d
  4) Chloromethane                 4.342   50    32485     5.51 ppbv      99
  5) Freon 114 (Cl2F4Ethane)       0.000   85        0     N.D.
  6) Vinyl Chloride                0.000   62        0     N.D.
  7) 1,3- Butadiene                0.000   54        0     N.D. d
  8) Bromomethane                  0.000   94        0     N.D.
  9) Chloroethane                  0.000   64        0     N.D.
 10) Acetone                       5.510   58  1176626m  266.35 ppbv
 11) Freon 11 (Cl3Fmethane)        0.000  101        0     N.D. d
 12) Acrylonitrile                 0.000   53        0     N.D. d
 13) 1,1-Dichloroethene            0.000   96        0     N.D.
 14) Methylene Chloride            6.234   84    31760     4.11 ppbv      92
 15) Methyl Acetate                0.000   43        0     N.D. d
 16) Freon 113 (Cl3F3Ethane)       0.000  101        0     N.D.
 17) Carbon Disulfide              6.538   76   102584     4.75 ppbv      99
 18) Trans-1,2-Dichlorothene       0.000   96        0     N.D.
 19) 1,1-Dichloroethane            0.000   63        0     N.D.
 20) Methyl T-Butyl Ether (...     0.000   73        0     N.D.
 21) Methyl Ethyl Ketone(2-...     7.676   43   899851    63.06 ppbv      99
 22) Chloroprene(2-Cl-1,3-B...     0.000   88        0     N.D.
 23) cis-1,2-Dichloroethene        0.000   96        0     N.D.
 25) Hexane                        0.000   57        0     N.D.
 26) Chloroform                    0.000   83        0     N.D. d
 27) 2,2-Dichloropropane           0.000   77        0     N.D.
 28) Dibromofluoromethane (...     0.000  111        0     N.D.
 29) 1,2- Dichloroethane           0.000   62        0     N.D.
 30) 1,1,1-Trichloroethane         0.000   97        0     N.D.
 31) 1,1- Dichloropropene          0.000   75        0     N.D.
 32) Benzene                       9.903   78  1203140    54.50 ppbv     100
 33) Carbon Tetrachloride          0.000  117        0     N.D.
 34) Cyclohexane                   0.000   84        0     N.D. d
 35) Dibromomethane                0.000  174        0     N.D.
 36) 1,2-Dichloropropane           0.000   63        0     N.D.
 37) Ethyl Acrylate                0.000   55        0     N.D.
 38) Bromodichloromethane          0.000   83        0     N.D.
 39) Trichloroethene               0.000  132        0     N.D.
 40) Methyl Methacrylate           0.000   69        0     N.D.
 41) cis-1,3-Dichloropropene       0.000   75        0     N.D.
 42) Methyl Isobutyl Ketone        0.000   58        0     N.D.
 43) Methyl Cyclohexane            0.000   98        0     N.D.
 44) trans-1,3-Dichloropropene     0.000   75        0     N.D.
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45) 1,1,2-Trichloroethane        0.000    97        0      N.D.
46) Toluene-d8  (SMC)            0.000    98        0      N.D.
47) Toluene                     13.522    91   306653    11.94 ppbv      100
48) 1,3-Dichloropropane          0.000    76        0      N.D.
49) Methyl Butyl Ketone(2-...    0.000    43        0      N.D. d
50) Dibromochloromethane         0.000   129        0      N.D.
51) 1,2- Dibromoethane           0.000   107        0      N.D.
52) Tetrachloroethene            0.000   166        0      N.D.
54) 1,1,1,2 - Tetrachloroe...    0.000   131        0      N.D.
55) Chlorobenzene                0.000   112        0      N.D. d
56) Ethylbenzene                 0.000    91        0      N.D. d
57) (m and /or p) Xylene        17.038    91    45946     1.74 ppbv       90
58) Bromoform                    0.000   173        0      N.D.
59) Butyl Acrylate               0.000    55        0      N.D. d
60) Styrene                      0.000   104        0      N.D. d
61) 1,1,2,2-Tetrachloroethane    0.000    83        0      N.D.
62) o-Xylene (1,2-Dimethyl...    0.000    91        0      N.D. d
63) 1,2,3-Trichloropropane       0.000   110        0      N.D.
65) Isopropylbenzene             0.000   105        0      N.D.
66) Bromobenzene                 0.000   156        0      N.D.
67) o-Chlorotoluene              0.000   126        0      N.D.
68) n-Propylbenzene              0.000   120        0      N.D.
69) p-Chlorotoluene              0.000   126        0      N.D.
70) 1,3,5-Trimethylbenzene       0.000   105        0      N.D.
71) tert-Butylbenzene            0.000   134        0      N.D.
72) 1,2,4-Trimethylbenzene       0.000   105        0      N.D. d
73) 1,3-Dichlorobenzene          0.000   146        0      N.D.
74) 1,4-Dichlorobenzene         21.443   146    60631     2.75 ppbv       93
75) sec-Butylbenzene             0.000   105        0      N.D.
76) p-Isopropyltoluene           0.000   119        0      N.D. d
77) 1,2-Dichlorobenzene          0.000   146        0      N.D.
78) n-Butylbenzene               0.000    91        0      N.D. d
79) 1,2-Dibromo-3-chloropr...    0.000   157        0      N.D.
80) 1,2,4-Trichlorobenzene       0.000   180        0      N.D. d
81) Naphthalene                 25.738   128    69812     2.23 ppbv       90
82) 1,2,3-Trichlorobenzene       0.000   180        0      N.D. d
83) Hexachlorobutadiene          0.000   225        0      N.D.
--------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Wed Mar 24 16:32:45 2010
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File         :C:\msdchem\1\DATA\03232010\0323-07.D
Operator     : JM
Acquired     : 23 Mar 2010    2:14 pm using AcqMethod TO15PPB8.M
Instrument :     5973A MSD
Sample Name:  100cc IS,50cc,AS15,6443,TO15.mpt
Misc Info   : Sample Date: 030510,DigesterTRN #1, MSD
Vial Number:  7
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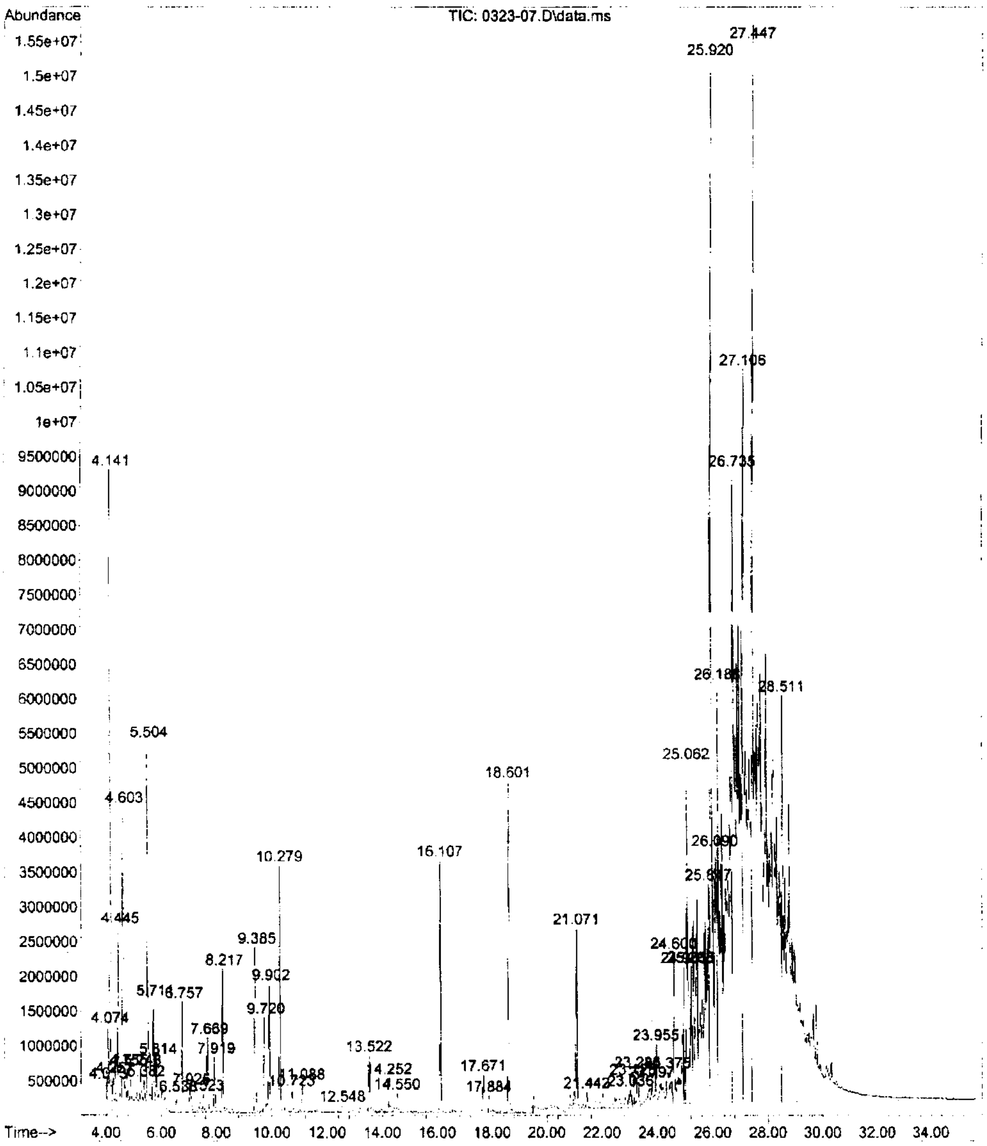

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                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\03232010\
Data File : 0323-07.D
Acq On    : 23 Mar 2010   2:14 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,6443,TO15.mpt
Misc      : Sample Date: 030510,DigesterTRN #1, MSD
ALS Vial  : 7   Sample Multiplier: 30

Quant Time: Mar 25 09:25:12 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Tue Mar 23 11:48:01 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\03232010\A0323-02.D

 Internal Standards              R.T. QIon  Response  Conc Units Dev(Min)
-------------------------------------------------------------------------
   1) 1,4-Difluorobenzene       10.279  114  3370921     4.12 ppbv    0.00
  53) Chlorobenzene-d5          16.107   82  1692367     4.16 ppbv    0.00

 System Monitoring Compounds
  24) Bromochloromethane         8.217  128   718929     4.12 ppbv    0.00
  64) p-Bromofluorobenzene      18.601  174  1918648     4.40 ppbv    0.00

 Target Compounds                                                 Qvalue
   2) Freon 22 (CLF2Methane)     0.000   67        0     N.D. d
   3) Freon 12 (Cl2F2Methane)    0.000   85        0     N.D. d
   4) Chloromethane              4.342   50   170258    27.95 ppbv     100
   5) Freon 114 (Cl2F4Ethane)    0.000   85        0     N.D.
   6) Vinyl Chloride             0.000   62        0     N.D.
   7) 1,3- Butadiene             4.634   54   414514m   70.06 ppbv
   8) Bromomethane               0.000   94        0     N.D.
   9) Chloroethane               0.000   64        0     N.D. d
  10) Acetone                    5.504   58  2508645m  549.68 ppbv
  11) Freon 11 (Cl3Fmethane)     0.000  101        0     N.D. d
  12) Acrylonitrile              0.000   53        0     N.D. d
  13) 1,1-Dichloroethene         0.000   96        0     N.D.
  14) Methylene Chloride         6.228   84    27515     3.44 ppbv      92
  15) Methyl Acetate             0.000   43        0     N.D. d
  16) Freon 113 (Cl3F3Ethane)    0.000  101        0     N.D.
  17) Carbon Disulfide           6.538   76   179679     8.06 ppbv     100
  18) Trans-1,2-Dichlorothene    0.000   96        0     N.D.
  19) 1,1-Dichloroethane         0.000   63        0     N.D.
  20) Methyl T-Butyl Ether (...  0.000   73        0     N.D.
  21) Methyl Ethyl Ketone(2-...  7.669   43  1727025   117.16 ppbv      95
  22) Chloroprene(2-Cl-1,3-B...  0.000   88        0     N.D.
  23) cis-1,2-Dichloroethene     0.000   96        0     N.D.
  25) Hexane                     8.235   57    13562m    1.15 ppbv
  26) Chloroform                 0.000   83        0     N.D. d
  27) 2,2-Dichloropropane        0.000   77        0     N.D.
  28) Dibromofluoromethane (...  0.000  111        0     N.D.
  29) 1,2- Dichloroethane        0.000   62        0     N.D.
  30) 1,1,1-Trichloroethane      0.000   97        0     N.D.
  31) 1,1- Dichloropropene       0.000   75        0     N.D.
  32) Benzene                    9.902   78  2091564    91.72 ppbv      99
  33) Carbon Tetrachloride       0.000  117        0     N.D.
  34) Cyclohexane                0.000   84        0     N.D. d
  35) Dibromomethane             0.000  174        0     N.D.
  36) 1,2-Dichloropropane        0.000   63        0     N.D.
  37) Ethyl Acrylate             0.000   55        0     N.D.
  38) Bromodichloromethane       0.000   83        0     N.D. d
  39) Trichloroethene            0.000  132        0     N.D.
  40) Methyl Methacrylate       11.393   69    17363m    2.51 ppbv
  41) cis-1,3-Dichloropropene    0.000   75        0     N.D.
  42) Methyl Isobutyl Ketone     0.000   58        0     N.D.
  43) Methyl Cyclohexane         0.000   98        0     N.D.
  44) trans-1,3-Dichloropropene  0.000   75        0     N.D.
```

```
 45) 1,1,2-Trichloroethane       0.000    97        0       N.D.
 46) Toluene-d8  (SMC)           0.000    98        0       N.D.
 47) Toluene                    13.522    91   783367     29.54 ppbv       99
 48) 1,3-Dichloropropane         0.000    76        0       N.D. d
 49) Methyl Butyl Ketone(2-...  13.978    43    49701      3.61 ppbv       90
 50) Dibromochloromethane        0.000   129        0       N.D.
 51) 1,2- Dibromoethane          0.000   107        0       N.D.
 52) Tetrachloroethene           0.000   166        0       N.D.
 54) 1,1,1,2 - Tetrachloroe...   0.000   131        0       N.D.
 55) Chlorobenzene               0.000   112        0       N.D. d
 56) Ethylbenzene               16.770    91    64742      1.86 ppbv       96
 57) (m and /or p) Xylene       17.044    91   116394      4.25 ppbv       97
 58) Bromoform                   0.000   173        0       N.D.
 59) Butyl Acrylate              0.000    55        0       N.D. d
 60) Styrene                    17.665   104    55787      2.81 ppbv       70
 61) 1,1,2,2-Tetrachloroethane   0.000    83        0       N.D. d
 62) o-Xylene (1,2-Dimethyl...  17.823    91    54781      1.77 ppbv       92
 63) 1,2,3-Trichloropropane      0.000   110        0       N.D.
 65) Isopropylbenzene            0.000   105        0       N.D. d
 66) Bromobenzene                0.000   156        0       N.D.
 67) o-Chlorotoluene             0.000   126        0       N.D.
 68) n-Propylbenzene             0.000   120        0       N.D. d
 69) p-Chlorotoluene             0.000   126        0       N.D.
 70) 1,3,5-Trimethylbenzene      0.000   105        0       N.D. d
 71) tert-Butylbenzene           0.000   134        0       N.D. d
 72) 1,2,4-Trimethylbenzene      0.000   105        0       N.D. d
 73) 1,3-Dichlorobenzene         0.000   146        0       N.D.
 74) 1,4-Dichlorobenzene        21.442   146   156426      6.83 ppbv       94
 75) sec-Butylbenzene            0.000   105        0       N.D. d
 76) p-Isopropyltoluene          0.000   119        0       N.D. d
 77) 1,2-Dichlorobenzene         0.000   146        0       N.D.
 78) n-Butylbenzene              0.000    91        0       N.D. d
 79) 1,2-Dibromo-3-chloropr...   0.000   157        0       N.D.
 80) 1,2,4-Trichlorobenzene      0.000   180        0       N.D. d
 81) Naphthalene                 0.000   128        0       N.D. d
 82) 1,2,3-Trichlorobenzene      0.000   180        0       N.D. d
 83) Hexachlorobutadiene         0.000   225        0       N.D.
--------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Thu Mar 25 09:25:20 2010
```

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File        :C:\msdchem\1\DATA\03232010\0323-06.D
Operator    : JM
Acquired    : 23 Mar 2010   1:27 pm using AcqMethod TO15PPB8.M
Instrument :    5973A MSD
Sample Name: 100cc IS,50cc,AS15,6455,TO15.mpt
Misc Info  : Sample Date: 030510,Site: Site:NatGasTRN #4,
Vial Number: 6
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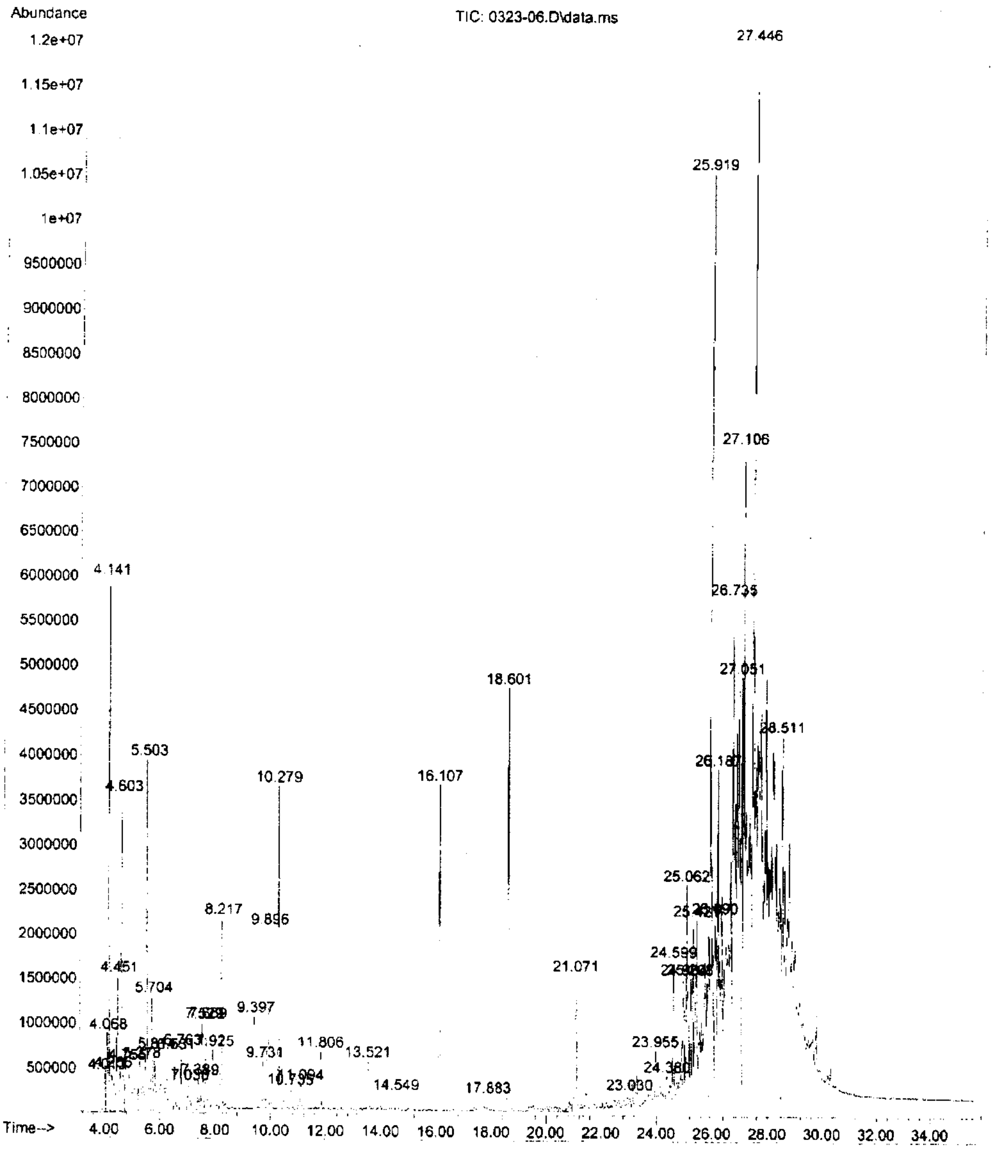

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                      Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\DATA\03232010\
Data File : 0323-06.D
Acq On    : 23 Mar 2010   1:27 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,6455,TO15.mpt
Misc      : Sample Date: 030510,Site: Site:NatGasTRN #4,
ALS Vial  : 6   Sample Multiplier: 30

Quant Time: Mar 25 09:12:33 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Tue Mar 23 11:48:01 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\03232010\A0323-02.D

 Internal Standards                   R.T. QIon  Response  Conc Units Dev(Min)
-------------------------------------------------------------------------------
   1) 1,4-Difluorobenzene           10.279  114  3355498     4.12 ppbv    0.00
  53) Chlorobenzene-d5              16.101   82  1702387     4.16 ppbv    0.00

 System Monitoring Compounds
  24) Bromochloromethane             8.217  128   706818     4.07 ppbv    0.00
  64) p-Bromofluorobenzene          18.601  174  1842933     4.20 ppbv    0.00

 Target Compounds                                                     Qvalue
   2) Freon 22 (CLF2Methane)         0.000   67        0      N.D. d
   3) Freon 12 (Cl2F2Methane)        0.000   85        0      N.D. d
   4) Chloromethane                  4.341   50   137133     22.62 ppbv      98
   5) Freon 114 (Cl2F4Ethane)        0.000   85        0      N.D.
   6) Vinyl Chloride                 0.000   62        0      N.D.
   7) 1,3- Butadiene                 4.633   54   431939m    73.34 ppbv
   8) Bromomethane                   0.000   94        0      N.D. d
   9) Chloroethane                   0.000   64        0      N.D. d
  10) Acetone                        5.509   58  1754771m   386.26 ppbv
  11) Freon 11 (Cl3Fmethane)         0.000  101        0      N.D.
  12) Acrylonitrile                  0.000   53        0      N.D. d
  13) 1,1-Dichloroethene             0.000   96        0      N.D.
  14) Methylene Chloride             6.233   84    36454      4.58 ppbv      89
  15) Methyl Acetate                 0.000   43        0      N.D. d
  16) Freon 113 (Cl3F3Ethane)        0.000  101        0      N.D.
  17) Carbon Disulfide               6.544   76   142561      6.42 ppbv      97
  18) Trans-1,2-Dichlorothene        0.000   96        0      N.D.
  19) 1,1-Dichloroethane             0.000   63        0      N.D.
  20) Methyl T-Butyl Ether (...      0.000   73        0      N.D. d
  21) Methyl Ethyl Ketone(2-...      7.669   43  1441615     98.25 ppbv      97
  22) Chloroprene(2-Cl-1,3-B...      0.000   88        0      N.D.
  23) cis-1,2-Dichloroethene         0.000   96        0      N.D.
  25) Hexane                         0.000   57        0      N.D. d
  26) Chloroform                     0.000   83        0      N.D. d
  27) 2,2-Dichloropropane            0.000   77        0      N.D.
  28) Dibromofluoromethane (...      0.000  111        0      N.D.
  29) 1,2- Dichloroethane            0.000   62        0      N.D.
  30) 1,1,1-Trichloroethane          0.000   97        0      N.D.
  31) 1,1- Dichloropropene           0.000   75        0      N.D.
  32) Benzene                        9.902   78  1900565     83.72 ppbv      98
  33) Carbon Tetrachloride           0.000  117        0      N.D.
  34) Cyclohexane                    0.000   84        0      N.D. d
  35) Dibromomethane                 0.000  174        0      N.D.
  36) 1,2-Dichloropropane            0.000   63        0      N.D.
  37) Ethyl Acrylate                 0.000   55        0      N.D.
  38) Bromodichloromethane           0.000   83        0      N.D. d
  39) Trichloroethene                0.000  132        0      N.D.
  40) Methyl Methacrylate            0.000   69        0      N.D.
  41) cis-1,3-Dichloropropene        0.000   75        0      N.D.
  42) Methyl Isobutyl Ketone         0.000   58        0      N.D.
  43) Methyl Cyclohexane             0.000   98        0      N.D.
  44) trans-1,3-Dichloropropene      0.000   75        0      N.D.
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 45) 1,1,2-Trichloroethane        0.000    97         0      N.D.
 46) Toluene-d8  (SMC)            0.000    98         0      N.D.
 47) Toluene                     13.527    91    531451     20.13 ppbv      99
 48) 1,3-Dichloropropane          0.000    76         0      N.D.
 49) Methyl Butyl Ketone(2-...   13.984    43     39743      2.90 ppbv      79
 50) Dibromochloromethane         0.000   129         0      N.D.
 51) 1,2- Dibromoethane           0.000   107         0      N.D.
 52) Tetrachloroethene            0.000   166         0      N.D.
 54) 1,1,1,2 - Tetrachloroe...    0.000   131         0      N.D.
 55) Chlorobenzene                0.000   112         0      N.D. d
 56) Ethylbenzene                16.764    91    38499m      1.10 ppbv
 57) (m and /or p) Xylene        17.044    91     70963      2.57 ppbv      95
 58) Bromoform                    0.000   173         0      N.D.
 59) Butyl Acrylate               0.000    55         0      N.D. d
 60) Styrene                     17.658   104    36865m      1.85 ppbv
 61) 1,1,2,2-Tetrachloroethane    0.000    83         0      N.D. d
 62) o-Xylene (1,2-Dimethyl...    0.000    91         0      N.D. d
 63) 1,2,3-Trichloropropane       0.000   110         0      N.D.
 65) Isopropylbenzene             0.000   105         0      N.D. d
 66) Bromobenzene                 0.000   156         0      N.D.
 67) o-Chlorotoluene              0.000   126         0      N.D.
 68) n-Propylbenzene              0.000   120         0      N.D.
 69) p-Chlorotoluene              0.000   126         0      N.D.
 70) 1,3,5-Trimethylbenzene       0.000   105         0      N.D. d
 71) tert-Butylbenzene            0.000   134         0      N.D. d
 72) 1,2,4-Trimethylbenzene       0.000   105         0      N.D. d
 73) 1,3-Dichlorobenzene          0.000   146         0      N.D.
 74) 1,4-Dichlorobenzene         21.442   146    141225      6.13 ppbv      98
 75) sec-Butylbenzene             0.000   105         0      N.D.
 76) p-Isopropyltoluene           0.000   119         0      N.D. d
 77) 1,2-Dichlorobenzene          0.000   146         0      N.D.
 78) n-Butylbenzene               0.000    91         0      N.D. d
 79) 1,2-Dibromo-3-chloropr...    0.000   157         0      N.D.
 80) 1,2,4-Trichlorobenzene       0.000   180         0      N.D. d
 81) Naphthalene                 25.737   128     90324      2.76 ppbv      90
 82) 1,2,3-Trichlorobenzene       0.000   180         0      N.D. d
 83) Hexachlorobutadiene          0.000   225         0      N.D.
-------------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Thu Mar 25 09:13:02 2010
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File        :C:\msdchem\1\DATA\03232010\0323-09.D
Operator    : JM
Acquired    : 23 Mar 2010   3:49 pm using AcqMethod TO15PPB8.M
Instrument  :    5973A MSD
Sample Name: 100cc IS,500cc,AS15,6449,TO15.mpt
Misc Info   : Sample Date: 031210,Site: DigesterTRN #4, MSD
Vial Number: 9
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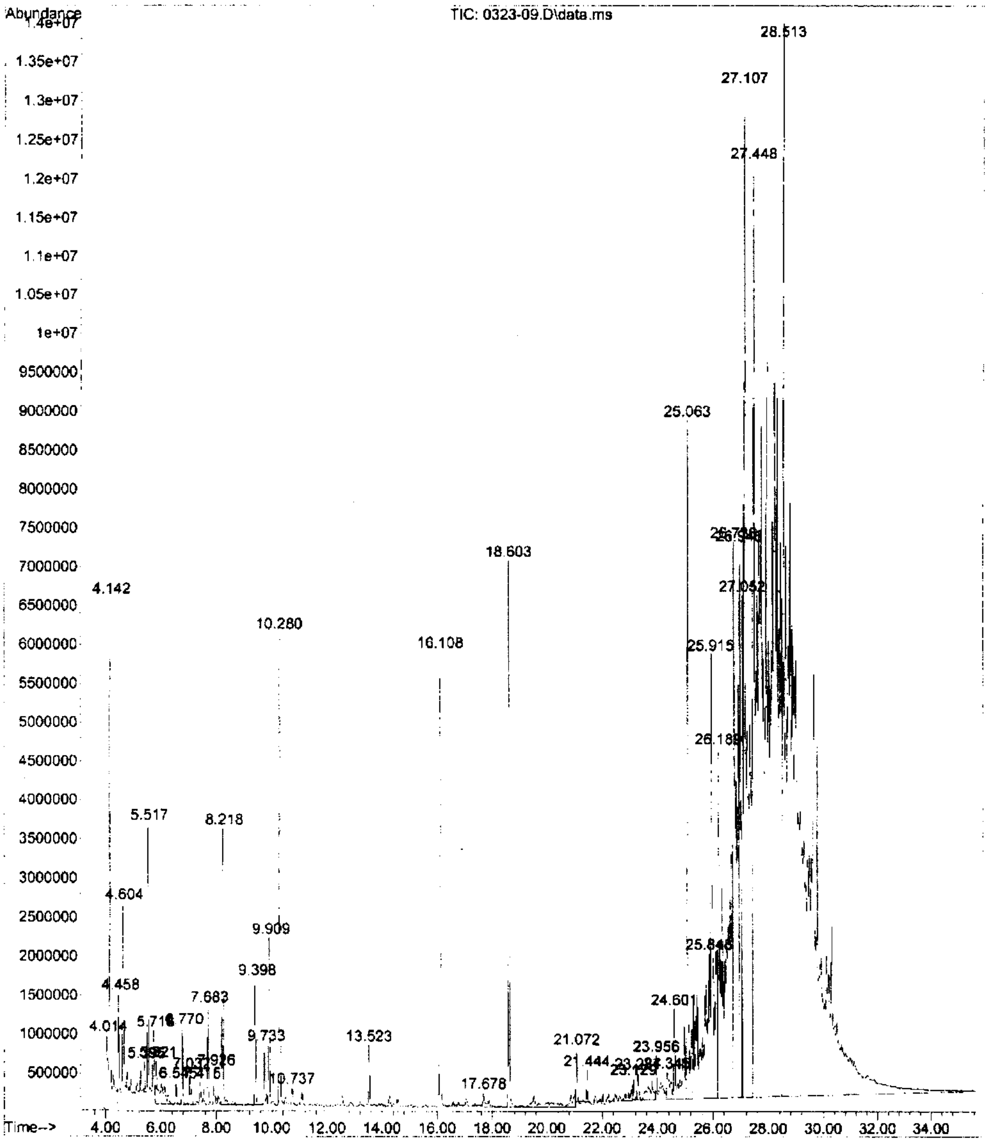

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                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\03232010\
Data File : 0323-09.D
Acq On    : 23 Mar 2010   3:49 pm
Operator  : JM
Sample    : 100cc IS,500cc,AS15,6449,TO15.mpt
Misc      : Sample Date: 031210,Site: DigesterTRN #4, MSD
ALS Vial  : 9   Sample Multiplier: 30

Quant Time: Mar 25 09:37:33 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Tue Mar 23 11:48:01 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\03232010\A0323-02.D

 Internal Standards               R.T. QIon  Response  Conc Units Dev(Min)
---------------------------------------------------------------------------
  1) 1,4-Difluorobenzene        10.286  114  6329976     4.12 ppbv    0.00
 53) Chlorobenzene-d5           16.108   82  2700843     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane          8.218  128  1357245     4.14 ppbv    0.00
 64) p-Bromofluorobenzene       18.603  174  3058046     4.39 ppbv    0.00

 Target Compounds                                                 Qvalue
  2) Freon 22 (CLF2Methane)      0.000   67        0      N.D. d
  3) Freon 12 (Cl2F2Methane)     0.000   85        0      N.D. d
  4) Chloromethane               4.343   50    42901     3.75 ppbv      98
  5) Freon 114 (Cl2F4Ethane)     0.000   85        0      N.D.
  6) Vinyl Chloride              0.000   62        0      N.D.
  7) 1,3- Butadiene              4.635   54   370828m   33.38 ppbv
  8) Bromomethane                0.000   94        0      N.D.
  9) Chloroethane                0.000   64        0      N.D.
 10) Acetone                     5.517   58  1596709m  186.31 ppbv
 11) Freon 11 (Cl3Fmethane)      0.000  101        0      N.D.
 12) Acrylonitrile               0.000   53        0      N.D. d
 13) 1,1-Dichloroethene          0.000   96        0      N.D.
 14) Methylene Chloride          6.247   84    45675     3.04 ppbv      90
 15) Methyl Acetate              0.000   43        0      N.D. d
 16) Freon 113 (Cl3F3Ethane)     0.000  101        0      N.D.
 17) Carbon Disulfide            6.539   76   196782     4.70 ppbv      98
 18) Trans-1,2-Dichlorothene     0.000   96        0      N.D.
 19) 1,1-Dichloroethane          0.000   63        0      N.D.
 20) Methyl T-Butyl Ether (...   0.000   73        0      N.D.
 21) Methyl Ethyl Ketone(2-...   7.683   43  1974637    71.34 ppbv      94
 22) Chloroprene(2-Cl-1,3-B...   0.000   88        0      N.D.
 23) cis-1,2-Dichloroethene      0.000   96        0      N.D.
 25) Hexane                      0.000   57        0      N.D. d
 26) Chloroform                  0.000   83        0      N.D. d
 27) 2,2-Dichloropropane         0.000   77        0      N.D.
 28) Dibromofluoromethane (...   0.000  111        0      N.D.
 29) 1,2- Dichloroethane         0.000   62        0      N.D.
 30) 1,1,1-Trichloroethane       0.000   97        0      N.D.
 31) 1,1- Dichloropropene        0.000   75        0      N.D.
 32) Benzene                     9.909   78  2538857    59.29 ppbv      98
 33) Carbon Tetrachloride        0.000  117        0      N.D.
 34) Cyclohexane                 0.000   84        0      N.D. d
 35) Dibromomethane              0.000  174        0      N.D.
 36) 1,2-Dichloropropane         0.000   63        0      N.D.
 37) Ethyl Acrylate              0.000   55        0      N.D.
 38) Bromodichloromethane        0.000   83        0      N.D. d
 39) Trichloroethene             0.000  132        0      N.D.
 40) Methyl Methacrylate         0.000   69        0      N.D. d
 41) cis-1,3-Dichloropropene     0.000   75        0      N.D.
 42) Methyl Isobutyl Ketone      0.000   58        0      N.D.
 43) Methyl Cyclohexane          0.000   98        0      N.D.
 44) trans-1,3-Dichloropropene   0.000   75        0      N.D.
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 45) 1,1,2-Trichloroethane        0.000    97        0        N.D.
 46) Toluene-d8  (SMC)            0.000    98        0        N.D.
 47) Toluene                     13.523    91   802894     16.12 ppbv        98
 48) 1,3-Dichloropropane          0.000    76        0        N.D. d
 49) Methyl Butyl Ketone(2-...    0.000    43        0        N.D. d
 50) Dibromochloromethane         0.000   129        0        N.D.
 51) 1,2- Dibromoethane           0.000   107        0        N.D.
 52) Tetrachloroethene            0.000   166        0        N.D.
 54) 1,1,1,2 - Tetrachloroe...    0.000   131        0        N.D.
 55) Chlorobenzene                0.000   112        0        N.D. d
 56) Ethylbenzene                 0.000    91        0        N.D. d
 57) (m and /or p) Xylene        17.045    91   108083      2.47 ppbv        95
 58) Bromoform                    0.000   173        0        N.D.
 59) Butyl Acrylate               0.000    55        0        N.D. d
 60) Styrene                     17.647   104    63498      2.01 ppbv        94
 61) 1,1,2,2-Tetrachloroethane    0.000    83        0        N.D. d
 62) o-Xylene (1,2-Dimethyl...    0.000    91        0        N.D. d
 63) 1,2,3-Trichloropropane       0.000   110        0        N.D.
 65) Isopropylbenzene             0.000   105        0        N.D. d
 66) Bromobenzene                 0.000   156        0        N.D.
 67) o-Chlorotoluene              0.000   126        0        N.D.
 68) n-Propylbenzene              0.000   120        0        N.D. d
 69) p-Chlorotoluene              0.000   126        0        N.D.
 70) 1,3,5-Trimethylbenzene       0.000   105        0        N.D. d
 71) tert-Butylbenzene            0.000   134        0        N.D. d
 72) 1,2,4-Trimethylbenzene       0.000   105        0        N.D. d
 73) 1,3-Dichlorobenzene          0.000   146        0        N.D.
 74) 1,4-Dichlorobenzene         21.450   146   304224      8.32 ppbv        99
 75) sec-Butylbenzene             0.000   105        0        N.D.
 76) p-Isopropyltoluene           0.000   119        0        N.D. d
 77) 1,2-Dichlorobenzene          0.000   146        0        N.D.
 78) n-Butylbenzene               0.000    91        0        N.D. d
 79) 1,2-Dibromo-3-chloropr...    0.000   157        0        N.D.
 80) 1,2,4-Trichlorobenzene       0.000   180        0        N.D. d
 81) Naphthalene                 25.738   128   213759      4.11 ppbv        97
 82) 1,2,3-Trichlorobenzene       0.000   180        0        N.D. d
 83) Hexachlorobutadiene          0.000   225        0        N.D.
--------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Thu Mar 25 09:37:38 2010
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File         :C:\msdchem\1\DATA\03232010\0323-08.D
Operator     : JM
Acquired     : 23 Mar 2010    3:02 pm using AcqMethod TO15PPB8.M
Instrument :    5973A MSD
Sample Name: 100cc IS,50cc,AS15,6447,TO15.mpt
Misc Info    : Sample Date: 031210,Site: NatGasTRN #4
Vial Number: 8
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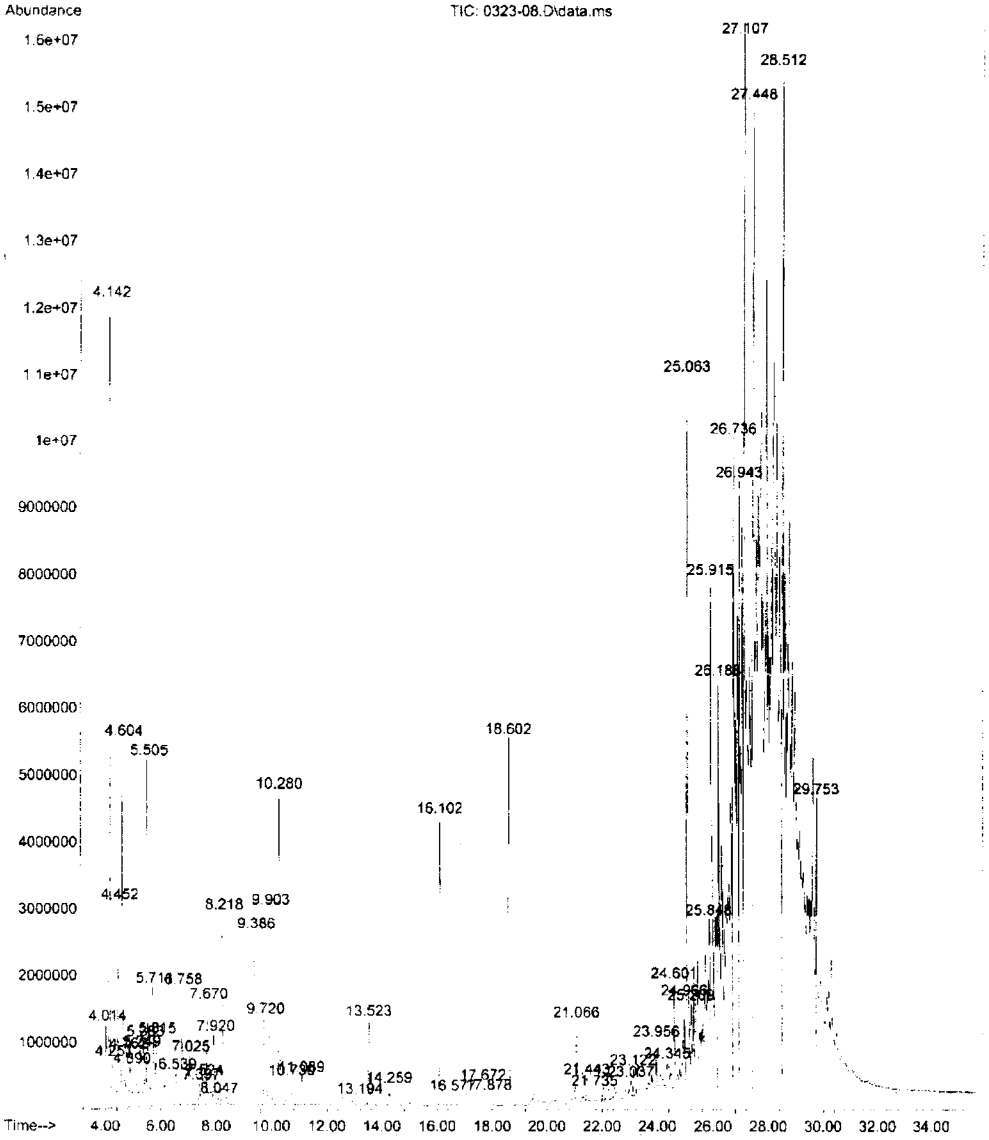

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                    Quantitation Report     (QT Reviewed)

Data Path : C:\msdchem\1\DATA\03232010\
Data File : 0323-08.D
Acq On    : 23 Mar 2010   3:02 pm
Operator  : JM
Sample    : 100cc IS,50cc,AS15,6447,TO15.mpt
Misc      : Sample Date: 031210,Site: NatGasTRN #4
ALS Vial  : 8   Sample Multiplier: 30

Quant Time: Mar 25 09:32:29 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Tue Mar 23 11:48:01 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\03232010\A0323-02.D

 Internal Standards                  R.T.  QIon  Response  Conc Units Dev(Min)
------------------------------------------------------------------------------
  1) 1,4-Difluorobenzene            10.280  114  4564908     4.12 ppbv    0.00
 53) Chlorobenzene-d5               16.102   82  2055654     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane              8.218  128  1028208     4.35 ppbv    0.00
 64) p-Bromofluorobenzene           18.602  174  2321539     4.38 ppbv    0.00

 Target Compounds                                                     Qvalue
  2) Freon 22 (CLF2Methane)          0.000   67        0      N.D. d
  3) Freon 12 (Cl2F2Methane)         0.000   85        0      N.D. d
  4) Chloromethane                   4.343   50   124434    15.09 ppbv       99
  5) Freon 114 (Cl2F4Ethane)         0.000   85        0      N.D.
  6) Vinyl Chloride                  0.000   62        0      N.D.
  7) 1,3- Butadiene                  4.635   54   416239m   51.95 ppbv
  8) Bromomethane                    0.000   94        0      N.D.
  9) Chloroethane                    0.000   64        0      N.D.
 10) Acetone                         5.505   58  2422316m  391.94 ppbv
 11) Freon 11 (Cl3Fmethane)          0.000  101        0      N.D.
 12) Acrylonitrile                   0.000   53        0      N.D. d
 13) 1,1-Dichloroethene              0.000   96        0      N.D. d
 14) Methylene Chloride              6.235   84    38951     3.60 ppbv       85
 15) Methyl Acetate                  0.000   43        0      N.D. d
 16) Freon 113 (Cl3F3Ethane)         0.000  101        0      N.D.
 17) Carbon Disulfide                6.539   76   344657    11.41 ppbv       99
 18) Trans-1,2-Dichlorothene         0.000   96        0      N.D.
 19) 1,1-Dichloroethane              0.000   63        0      N.D.
 20) Methyl T-Butyl Ether (...       0.000   73        0      N.D. d
 21) Methyl Ethyl Ketone(2-...       7.670   43  2397933   120.12 ppbv       94
 22) Chloroprene(2-Cl-1,3-B...       0.000   88        0      N.D.
 23) cis-1,2-Dichloroethene          0.000   96        0      N.D.
 25) Hexane                          0.000   57        0      N.D. d
 26) Chloroform                      0.000   83        0      N.D. d
 27) 2,2-Dichloropropane             0.000   77        0      N.D.
 28) Dibromofluoromethane (...       0.000  111        0      N.D.
 29) 1,2- Dichloroethane             0.000   62        0      N.D.
 30) 1,1,1-Trichloroethane           0.000   97        0      N.D.
 31) 1,1- Dichloropropene            0.000   75        0      N.D.
 32) Benzene                         9.903   78  3415745   110.60 ppbv       98
 33) Carbon Tetrachloride            0.000  117        0      N.D.
 34) Cyclohexane                     0.000   84        0      N.D. d
 35) Dibromomethane                  0.000  174        0      N.D.
 36) 1,2-Dichloropropane             0.000   63        0      N.D.
 37) Ethyl Acrylate                  0.000   55        0      N.D.
 38) Bromodichloromethane            0.000   83        0      N.D. d
 39) Trichloroethene                 0.000  132        0      N.D.
 40) Methyl Methacrylate             0.000   69        0      N.D. d
 41) cis-1,3-Dichloropropene         0.000   75        0      N.D.
 42) Methyl Isobutyl Ketone          0.000   58        0      N.D. d
 43) Methyl Cyclohexane              0.000   98        0      N.D.
 44) trans-1,3-Dichloropropene       0.000   75        0      N.D.
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 45) 1,1,2-Trichloroethane        0.000    97          0      N.D.
 46) Toluene-d8  (SMC)            0.000    98          0      N.D.
 47) Toluene                     13.523    91    1270997    35.39 ppbv       99
 48) 1,3-Dichloropropane          0.000    76          0      N.D. d
 49) Methyl Butyl Ketone(2-...   13.991    43      62294     3.34 ppbv       92
 50) Dibromochloromethane         0.000   129          0      N.D.
 51) 1,2- Dibromoethane           0.000   107          0      N.D.
 52) Tetrachloroethene            0.000   166          0      N.D.
 54) 1,1,1,2 - Tetrachloroe...    0.000   131          0      N.D.
 55) Chlorobenzene                0.000   112          0      N.D. d
 56) Ethylbenzene                16.771    91      94588     2.24 ppbv       97
 57) (m and /or p) Xylene        17.039    91     190297     5.72 ppbv       96
 58) Bromoform                    0.000   173          0      N.D.
 59) Butyl Acrylate               0.000    55          0      N.D. d
 60) Styrene                     17.659   104      77635     3.22 ppbv       93
 61) 1,1,2,2-Tetrachloroethane    0.000    83          0      N.D. d
 62) o-Xylene (1,2-Dimethyl...   17.824    91      65858     1.75 ppbv       93
 63) 1,2,3-Trichloropropane       0.000   110          0      N.D.
 65) Isopropylbenzene             0.000   105          0      N.D. d
 66) Bromobenzene                 0.000   156          0      N.D.
 67) o-Chlorotoluene              0.000   126          0      N.D.
 68) n-Propylbenzene              0.000   120          0      N.D. d
 69) p-Chlorotoluene              0.000   126          0      N.D.
 70) 1,3,5-Trimethylbenzene       0.000   105          0      N.D. d
 71) tert-Butylbenzene            0.000   134          0      N.D. d
 72) 1,2,4-Trimethylbenzene      21.017   105      58417     1.30 ppbv       93
 73) 1,3-Dichlorobenzene          0.000   146          0      N.D.
 74) 1,4-Dichlorobenzene         21.443   146     244155     8.77 ppbv       98
 75) sec-Butylbenzene             0.000   105          0      N.D. d
 76) p-Isopropyltoluene           0.000   119          0      N.D. d
 77) 1,2-Dichlorobenzene          0.000   146          0      N.D.
 78) n-Butylbenzene               0.000    91          0      N.D. d
 79) 1,2-Dibromo-3-chloropr...    0.000   157          0      N.D.
 80) 1,2,4-Trichlorobenzene       0.000   180          0      N.D. d
 81) Naphthalene                 25.738   128     253515     6.40 ppbv       97
 82) 1,2,3-Trichlorobenzene       0.000   180          0      N.D. d
 83) Hexachlorobutadiene          0.000   225          0      N.D.
--------------------------------------------------------------------------------

(#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Thu Mar 25 09:32:36 2010
```
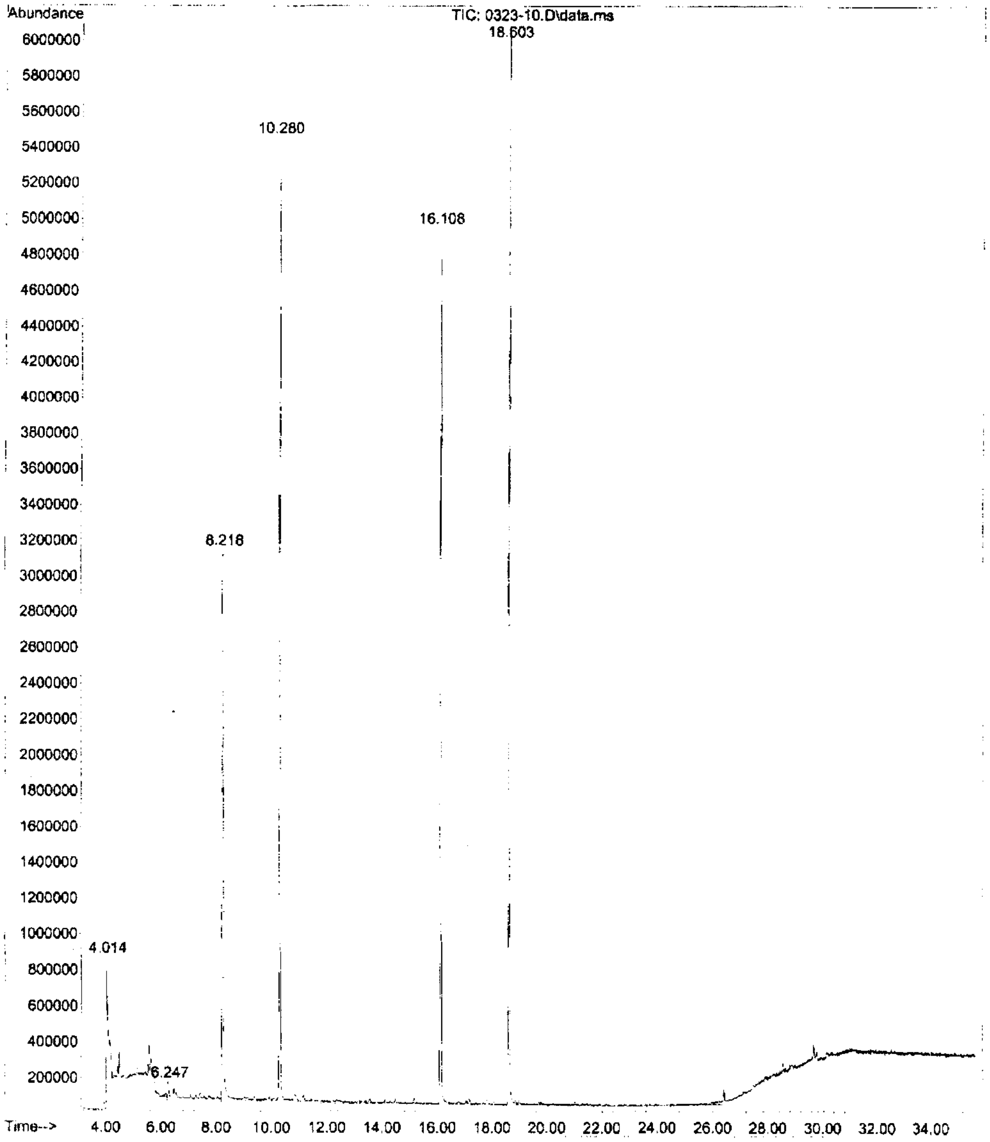

```
File       :C:\msdchem\1\DATA\03232010\0323-10.D
Operator   : JM
Acquired   : 23 Mar 2010    4:40 pm using AcqMethod TO15PPB8.M
Instrument :    5973A MSD
Sample Name: 100cc IS,500cc,AS11,6440,TO15.mpt
Misc Info  : Sample Date: 031610,Site:MethBlnk
Vial Number: 10
```



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                    Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\DATA\03232010\
Data File : 0323-10.D
Acq On    : 23 Mar 2010   4:40 pm
Operator  : JM
Sample    : 100cc IS,500cc,AS11,6440,TO15.mpt
Misc      : Sample Date: 031610,Site:MethBlnk
ALS Vial  : 10   Sample Multiplier: 1.25

Quant Time: Mar 25 10:12:43 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Tue Mar 23 11:48:01 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\03232010\A0323-02.D

 Internal Standards               R.T. QIon  Response  Conc Units Dev(Min)
-------------------------------------------------------------------------
  1) 1,4-Difluorobenzene        10.286  114  5491350     4.12 ppbv    0.00
 53) Chlorobenzene-d5           16.108   82  2166452     4.16 ppbv    0.00

 System Monitoring Compounds
 24) Bromochloromethane          8.224  128  1217659     4.29 ppbv    0.00
 64) p-Bromofluorobenzene       18.603  174  2397093     4.29 ppbv    0.00

 Target Compounds                                                 Qvalue
  2) Freon 22 (CLF2Methane)      4.118   67     6033      N.D.
  3) Freon 12 (Cl2F2Methane)     4.215   85    44252     0.04 ppbv      95
  4) Chloromethane               0.000   50        0      N.D. d
  5) Freon 114 (Cl2F4Ethane)     4.422   85    34561      N.D.
  6) Vinyl Chloride              4.531   62    11750      N.D.
  7) 1,3- Butadiene              4.647   54     9038      N.D.
  8) Bromomethane                0.000   94        0      N.D. d
  9) Chloroethane                4.994   64     5995      N.D.
 10) Acetone                     5.553   58    76816m    0.43 ppbv
 11) Freon 11 (Cl3Fmethane)      5.620  101    44881      N.D.
 12) Acrylonitrile               5.888   53     8023      N.D.
 13) 1,1-Dichloroethene          6.156   96     9165      N.D.
 14) Methylene Chloride          6.241   84    49057     0.16 ppbv      93
 15) Methyl Acetate              6.259   43    25658     0.05 ppbv      89
 16) Freon 113 (Cl3F3Ethane)     6.460  101    29288      N.D.
 17) Carbon Disulfide            6.551   76    53737m    0.06 ppbv
 18) Trans-1,2-Dichlorothene     7.074   96     9260      N.D.
 19) 1,1-Dichloroethane          7.257   63    19497      N.D.
 20) Methyl T-Butyl Ether (...   7.409   73    11360      N.D.
 21) Methyl Ethyl Ketone(2-...   7.731   43    30017     0.05 ppbv      95
 22) Chloroprene(2-Cl-1,3-B...   0.000   88        0      N.D.
 23) cis-1,2-Dichloroethene      8.054   96     8160      N.D.
 25) Hexane                      8.255   57     9561      N.D.
 26) Chloroform                  8.340   83    30343     0.03 ppbv      94
 27) 2,2-Dichloropropane         8.376   77    21296      N.D.
 28) Dibromofluoromethane (...   0.000  111        0      N.D.
 29) 1,2- Dichloroethane         9.118   62    15227      N.D.
 30) 1,1,1-Trichloroethane       9.398   97    30676      N.D.
 31) 1,1- Dichloropropene        9.739   75     7435      N.D.
 32) Benzene                     9.903   78    35338      N.D.
 33) Carbon Tetrachloride       10.073  117    17843      N.D.
 34) Cyclohexane                 0.000   84        0      N.D. d
 35) Dibromomethane             10.822  174    15009      N.D.
 36) 1,2-Dichloropropane        10.852   63     9916      N.D.
 37) Ethyl Acrylate             10.895   55     6551      N.D.
 38) Bromodichloromethane       11.083   83    25062      N.D.
 39) Trichloroethene            11.132  132    10934      N.D.
 40) Methyl Methacrylate         0.000   69        0      N.D.
 41) cis-1,3-Dichloropropene    12.215   75     7769      N.D.
 42) Methyl Isobutyl Ketone      0.000   58        0      N.D.
 43) Methyl Cyclohexane          0.000   98        0      N.D.
 44) trans-1,3-Dichloropropene   0.000   75        0      N.D.
```

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 45) 1,1,2-Trichloroethane       13.127    97     12003       N.D.
 46) Toluene-d8  (SMC)            0.000    98         0       N.D. d
 47) Toluene                     13.529    91     16595       N.D.
 48) 1,3-Dichloropropane         13.553    76      8887m     0.01 ppbv
 49) Methyl Butyl Ketone(2-...    0.000    43         0       N.D.
 50) Dibromochloromethane        14.119   129     14751       N.D.
 51) 1,2- Dibromoethane          14.478   107     14346       N.D.
 52) Tetrachloroethene           15.159   166     12573       N.D.
 54) 1,1,1,2 - Tetrachloroe...    0.000   131         0       N.D. d
 55) Chlorobenzene               16.175   112     25949       N.D.
 56) Ethylbenzene                16.771    91     13266       N.D.
 57) (m and /or p) Xylene        17.045    91     17197       N.D.
 58) Bromoform                   17.155   173     21815       N.D.
 59) Butyl Acrylate               0.000    55         0       N.D.
 60) Styrene                      0.000   104         0       N.D.
 61) 1,1,2,2-Tetrachloroethane   17.812    83     21850       N.D.
 62) o-Xylene (1,2-Dimethyl...   17.830    91     10513       N.D.
 63) 1,2,3-Trichloropropane      18.043   110      6394       N.D.
 65) Isopropylbenzene            18.840   105     16756       N.D.
 66) Bromobenzene                18.974   156      8541       N.D.
 67) o-Chlorotoluene              0.000   126         0       N.D.
 68) n-Propylbenzene              0.000   120         0       N.D.
 69) p-Chlorotoluene              0.000   126         0       N.D.
 70) 1,3,5-Trimethylbenzene      20.221   105      7448       N.D.
 71) tert-Butylbenzene            0.000   134         0       N.D.
 72) 1,2,4-Trimethylbenzene      21.018   105      7976       N.D.
 73) 1,3-Dichlorobenzene         21.310   146     11336       N.D.
 74) 1,4-Dichlorobenzene         21.444   146     10785       N.D.
 75) sec-Butylbenzene            21.577   105     11619       N.D.
 76) p-Isopropyltoluene          21.930   119      9864       N.D.
 77) 1,2-Dichlorobenzene         22.155   146      9028       N.D.
 78) n-Butylbenzene              22.831    91      9932       N.D.
 79) 1,2-Dibromo-3-chloropr...    0.000   157         0       N.D.
 80) 1,2,4-Trichlorobenzene       0.000   180         0       N.D.
 81) Naphthalene                 25.745   128      5469       N.D.
 82) 1,2,3-Trichlorobenzene       0.000   180         0       N.D.
 83) Hexachlorobutadiene         26.402   225     17236       N.D.
--------------------------------------------------------------------------

 (#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Thu Mar 25 10:13:11 2010
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Operator    : JM
Acquired    : 24 Mar 2010    1:04 pm using AcqMethod TO15PPB8.M
Instrument  :    5973A MSD
Sample Name: 100cc IS,500cc,AS4,6435,TO15.mpt
Misc Info  : Sample Date: 032410,10:05AM,MSD Background
Vial Number: 11
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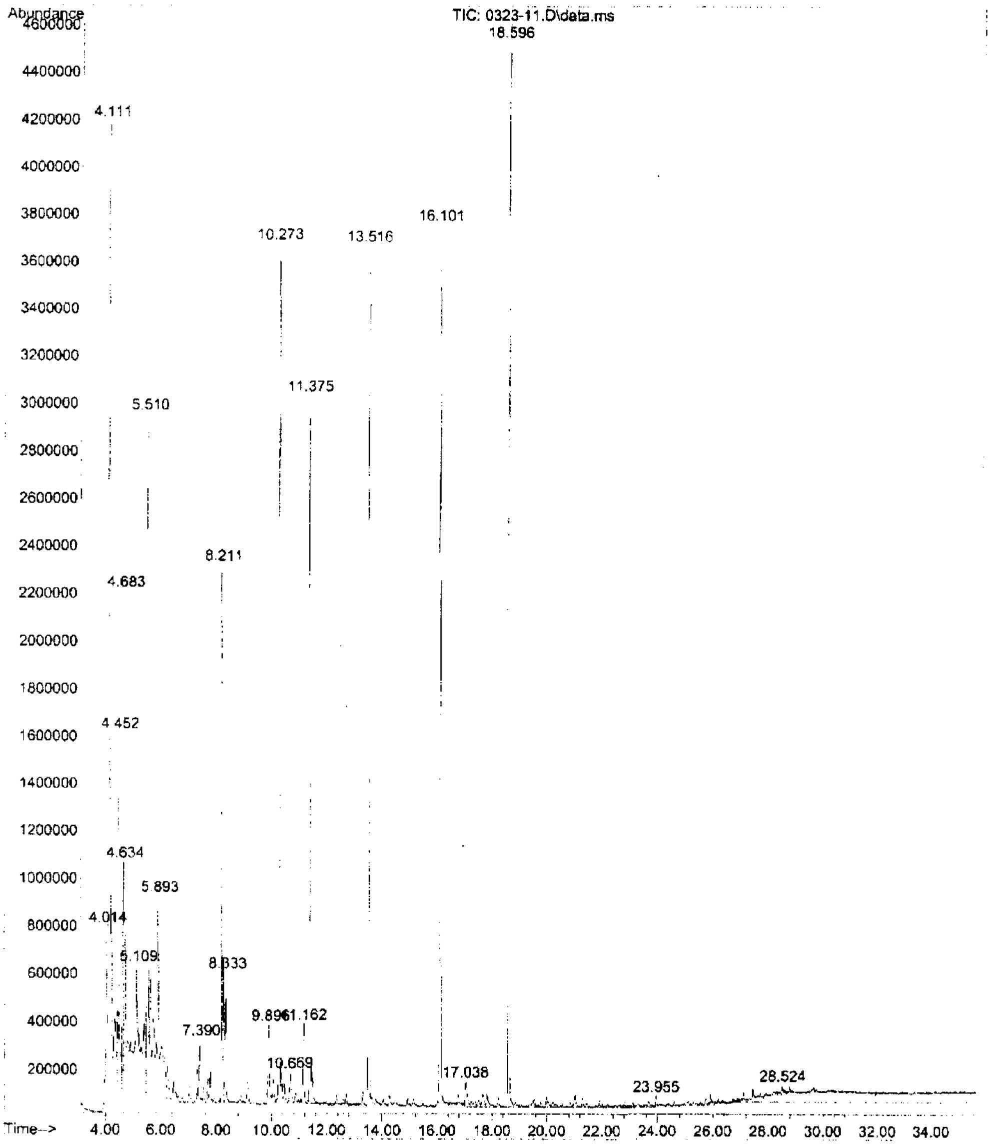

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                     Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\DATA\03232010\
Data File : 0323-11.D
Acq On    : 24 Mar 2010   1:04 pm
Operator  : JM
Sample    : 100cc IS,500cc,AS4,6435,TO15.mpt
Misc      : Sample Date: 032410,10:05AM,MSD Backgroubd
ALS Vial  : 11   Sample Multiplier: 1.25

Quant Time: Mar 24 16:21:57 2010
Quant Method : C:\msdchem\1\METHODS\TO15ppb8.M
Quant Title  : TO14/TO15 Volatile Compounds
QLast Update : Tue Mar 23 11:48:01 2010
Response via : Continuing Cal File: C:\msdchem\1\DATA\03232010\A0323-02.D

 Internal Standards                R.T.  QIon  Response  Conc Units Dev(Min)
-----------------------------------------------------------------------------
  1) 1,4-Difluorobenzene          10.273  114  3483330     4.12 ppbv    0.00
 53) Chlorobenzene-d5             16.101   82  1688943     4.16 ppbv    0.00

System Monitoring Compounds
 24) Bromochloromethane            8.211  128   766533     4.25 ppbv    0.00
 64) p-Bromofluorobenzene         18.596  174  1741903     4.00 ppbv    0.00

Target Compounds                                                    Qvalue
  2) Freon 22 (CLF2Methane)        4.117   67  1055463    18.17 ppbv     95
  3) Freon 12 (CI2F2Methane)       4.208   85   720839     1.04 ppbv     98
  4) Chloromethane                 4.342   50   187063     1.24 ppbv     98
  5) Freon 114 (Cl2F4Ethane)       4.421   85    21755     N.D.
  6) Vinyl Chloride                0.000   62        0     N.D.
  7) 1,3- Butadiene                4.640   54   385261m    2.63 ppbv
  8) Bromomethane                  4.853   94     5615     N.D.
  9) Chloroethane                  0.000   64        0     N.D.
 10) Acetone                       5.516   58   918925m    8.12 ppbv
 11) Freon 11 (Cl3Fmethane)        5.614  101   329902     0.34 ppbv     99
 12) Acrylonitrile                 5.869   53    74238     0.57 ppbv     92
 13) 1,1-Dichloroethene            0.000   96        0     N.D.
 14) Methylene Chloride            6.228   84    52075     0.26 ppbv     99
 15) Methyl Acetate                6.240   43    38967     0.11 ppbv    100
 16) Freon 113 (Cl3F3Ethane)       6.447  101    48457     0.10 ppbv     94
 17) Carbon Disulfide              6.544   76    76746     0.14 ppbv     97
 18) Trans-1,2-Dichlorothene       0.000   96        0     N.D.
 19) 1,1-Dichloroethane            0.000   63        0     N.D.
 20) Methyl T-Butyl Ether (...     0.000   73        0     N.D.
 21) Methyl Ethyl Ketone(2-...     7.694   43   190471     0.52 ppbv     95
 22) Chloroprene(2-Cl-1,3-B...     0.000   88        0     N.D.
 23) cis-1,2-Dichloroethene        0.000   96        0     N.D.
 25) Hexane                        8.236   57    77001     0.26 ppbv     99
 26) Chloroform                    8.333   83   519921     0.92 ppbv    100
 27) 2,2-Dichloropropane           0.000   77        0     N.D.
 28) Dibromofluoromethane (...     0.000  111        0     N.D.
 29) 1,2- Dichloroethane           9.112   62     9869     N.D.
 30) 1,1,1-Trichloroethane         9.379   97     7311     N.D.
 31) 1,1- Dichloropropene          0.000   75        0     N.D.
 32) Benzene                       9.896   78   341001     0.60 ppbv    100
 33) Carbon Tetrachloride         10.073  117    71373     0.12 ppbv     99
 34) Cyclohexane                  10.219   84     9114     N.D.
 35) Dibromomethane                0.000  174        0     N.D.
 36) 1,2-Dichloropropane           0.000   63        0     N.D.
 37) Ethyl Acrylate               10.864   55    52117m    0.14 ppbv
 38) Bromodichloromethane         11.162   83    11149     N.D.
 39) Trichloroethene               0.000  132        0     N.D.
 40) Methyl Methacrylate          11.375   69  1404229     8.18 ppbv     98
 41) cis-1,3-Dichloropropene       0.000   75        0     N.D.
 42) Methyl Isobutyl Ketone        0.000   58        0     N.D.
 43) Methyl Cyclohexane           12.348   98     6404     N.D.
 44) trans-1,3-Dichloropropene     0.000   75        0     N.D.
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  45) 1,1,2-Trichloroethane       0.000   97        0      N.D.
  46) Toluene-d8  (SMC)           0.000   98        0      N.D.
  47) Toluene                    13.516   91  3353567      5.10 ppbv        99
  48) 1,3-Dichloropropane         0.000   76        0      N.D. d
  49) Methyl Butyl Ketone(2-...  13.844   43     6517      N.D.
  50) Dibromochloromethane        0.000  129        0      N.D.
  51) 1,2- Dibromoethane          0.000  107        0      N.D.
  52) Tetrachloroethene          15.140  166    12016      N.D.
  54) 1,1,1,2 - Tetrachloroe...   0.000  131        0      N.D.
  55) Chlorobenzene               0.000  112        0      N.D.
  56) Ethylbenzene               16.765   91    43481      0.05 ppbv        94
  57) (m and /or p) Xylene       17.050   91   116604      0.18 ppbv        94
  58) Bromoform                   0.000  173        0      N.D.
  59) Butyl Acrylate             17.519   55    12731m     0.04 ppbv
  60) Styrene                    17.653  104    24920m     0.05 ppbv
  61) 1,1,2,2-Tetrachloroethane   0.000   83        0      N.D.
  62) o-Xylene (1,2-Dimethyl...  17.823   91    46405      0.06 ppbv        94
  63) 1,2,3-Trichloropropane      0.000  110        0      N.D.
  65) Isopropylbenzene           18.845  105    10853      N.D.
  66) Bromobenzene                0.000  156        0      N.D.
  67) o-Chlorotoluene             0.000  126        0      N.D.
  68) n-Propylbenzene             0.000  120        0      N.D.
  69) p-Chlorotoluene             0.000  126        0      N.D.
  70) 1,3,5-Trimethylbenzene     20.214  105    12249      N.D.
  71) tert-Butylbenzene           0.000  134        0      N.D.
  72) 1,2,4-Trimethylbenzene     21.017  105    38990      0.04 ppbv        88
  73) 1,3-Dichlorobenzene         0.000  146        0      N.D.
  74) 1,4-Dichlorobenzene        21.437  146    10682      N.D.
  75) sec-Butylbenzene            0.000  105        0      N.D.
  76) p-Isopropyltoluene         21.917  119    15566      N.D.
  77) 1,2-Dichlorobenzene         0.000  146        0      N.D.
  78) n-Butylbenzene             22.811   91     7474      N.D.
  79) 1,2-Dibromo-3-chloropr...   0.000  157        0      N.D.
  80) 1,2,4-Trichlorobenzene      0.000  180        0      N.D.
  81) Naphthalene                25.744  128    23181      N.D.
  82) 1,2,3-Trichlorobenzene      0.000  180        0      N.D.
  83) Hexachlorobutadiene         0.000  225        0      N.D.
 --------------------------------------------------------------------------

 (#) = qualifier out of range (m) = manual integration (+) = signals summed

TO15ppb8.M Wed Mar 24 16:22:14 2010
```

APPENDIX C – NOMENCLATURE

Clean Air Act (CAA)

Maximum contaminant levels (MCLs)

National Ambient Air Quality Standards (NAAQS)

New Source Performance Standards (NSPS)

Hazardous Air Pollutants (HAPs)

U.S. Environmental Protection Agency (USEPA)

World Health Organization (WHO)

Louisville Metropolitan Sewer District (MSD)

Volatile Organic Compounds (VOCs)

Greenhouse Gases (GHGs)

Chlorofluorocarbons (CFC)

Hydrofluorocarbons (HFC)

Perfluorocarbons (PFC)

Regenerative Thermal Oxidizers (RTO)

Inhalation Reference Concentration (RfC)

Oral Reference Dose (RfD)

Energy Information Administration (EIA)

CURRICULUM VITAE

NAME: Mahyar Ghorbanian

ADDRESS: 788 Raymond Kent Ct. – Apt # 1
Louisville, KY 40217

DOB: Babol, Iran – August 28, 1986

EDUCATION & TRAINING: B.S. Safety & Technical Inspection Engineering
Petroleum University of Technology (PUT)
2004-2008

M.S. Civil & Environmental Engineering
University of Louisville
2009-2010

AWARDS: Awarded the tuition scholarship for B.S. in Safety & Technical Inspection Engineering from PUT
2004-2008

Awarded Graduate Teaching Assistantship from University of Louisville
2009-2010

PROFESSIONAL SOCITEIS: American Society of Civil Engineers (ASCE), Since 2009
Society of Petroleum Engineers (SPE), 2004-2008

PUBLICATIONS: S. Ebrahimi, M. Ghorbanian, S. Alikhani, S. Khatibi, “Possibility Evaluation in Application of Different Remediation Methods of Petroleum Pollutants in soil and its Algorithm in Industrial Case”, presented at the Eurosoil Congress, 2008, Vienna, Austria.