Accounting of Carbon Emissions in the Process of Wastewater Treatment from the Perspective of Environmental Protection

Jiaqiang Xiao *
School of Management, Tianjin University of Technology, Tianjin, China

*Corresponding author e-mail: xjq@stud.tjut.edu.cn

Abstract. Environmental protection has become an important part of my country's economic development. Sewage treatment is an important part of environmental protection. There are many sewage treatment plants in various regions of the country, with various treatment methods applied, and overall treatment conditions are also different. Theoretically speaking, a large amount of greenhouse gases will be produced in the process of sewage treatment, and it is necessary to account for the produced greenhouse gases in order to ensure the economic benefits of the treatment. Carbon emissions are the most important accounting process, and the accuracy of accounting is a key concern. This article mainly analyzes the accounting boundary of sewage treatment technology, provides a reasonable basis for the accounting of carbon emissions with three commonly used accounting methods, and analyzes related comprehensive characteristics.

1. Introduction

In recent years, my country's sewage treatment has developed rapidly. As of the end of 2018, my country has built 4,205 sewage treatment plants. The establishment of sewage treatment plants will produce a large amount of surplus sludge. The output of sludge has exceeded 46 million tons. By the end of 2020, the sludge output is expected to reach 60-90 million tons. My country is a country where coal is the main energy source. Coal can account for more than 70% of total energy consumption. The proportions of oil and natural gas are ranked second and third respectively, so CO_2 emissions are very large. . Relevant data shows that in 2020, with the continuous development of my country's transportation industry, carbon emissions will rise to more than 100×108 tons. Similar to other industries, as the sewage treatment process continues to develop, a large amount of carbon will also be generated on the basis of energy consumption. Emissions, carbon emissions from the sewage treatment process have aroused social concern.

2. Current status of carbon emissions from sewage treatment in my country

At present, there are many sewage treatment plants in my country, and it has been clearly pointed out in the above that it is necessary to strengthen the accounting of carbon emissions from sewage treatment plants. Since 2007, carbon emissions from sewage treatment have reached 8.4MtCO2-eq and increased to 1.4MtCO2-eq in 2016, an increase of 2.7 times. With the increase in the treatment volume, the output of sludge generated in the sewage treatment process is increasing, and the phenomenon of carbon emission will also appear in the sludge treatment process, and the proportion of carbon emission is also very large. Therefore, the sewage treatment is often carried out. The calculation and analysis of carbon

emissions select appropriate optimized treatment processes to achieve energy-saving and emission-reduction in sewage treatment. Regarding the calculation process of carbon emissions, it is necessary to integrate the accounting boundaries of carbon emissions to make the calculation more accurate and avoid missing calculations due to repeated accounting. In addition, a comprehensive analysis of the process links of carbon emissions, a summary of the emission related content of each process, and a comprehensive analysis of various functions will also help the accuracy of the accounting. The international climate-related research section mentioned the boundary content of carbon emissions from solid waste, and pointed out that the relevant content of carbon sources includes carbon sources and carbon sinks. Carbon sources refer to both natural and anthropogenic carbon sources [1]. In general, anthropogenic carbon Sources can also be divided into direct emissions and indirect emissions. Direct emission refers to the emission of carbon generated during the disposal process. Both anaerobic digestion and land use belong to direct carbon emission. Indirect emission refers to the carbon emission from the chemical reaction of the electricity consumed or the chemicals generated during the treatment process. In addition, carbon sink refers to the carbon emissions from the biogas power generation generated during the anaerobic digestion process during the sludge treatment process, or the carbon emissions generated during the thermal energy generated during the incineration process. The current research on boundary accounting is also limited to general analysis. For the treatment of sludge generated by wastewater treatment, the treatment process of carbon sources has not been disassembled. Therefore, in the following, the author will discuss the related carbon emissions. Method for systematic analysis and comprehensive discussion of accounting methods.

3. Definition method of carbon emission accounting

At present, there are mainly two accounting methods for carbon emissions: one is direct emissions and indirect emissions, and the other is the accounting method of carbon footprint. The analysis content obtained by different accounting methods is different, and they all need to be systematically analyzed. The specific accounting boundaries are defined in the following ways:

Regarding direct emissions and indirect emissions, the core content is the need to combine the boundaries of sludge carbon emissions, and focus on the content of carbon sources [2]. Direct emissions can only be the total gas emissions in the production process of various industries, mainly from the use of fuel and energy consumption in the industrial production process. As well as the greenhouse gases generated in the process of solid waste treatment, indirect emissions only refer to the additional emissions generated by the equipment used in the emission process, such as carbon source emissions generated during the operation of some energy equipment and power equipment.

Regarding the carbon footprint is a model related to ecology, it is derived from the ecological footprint. The relevant data in the research process is different. In the general research process, it mainly involves the regional carbon footprint, personal carbon footprint, product carbon footprint, four categories of corporate carbon footprint. In addition, the carbon footprint analysis of urban sewage treatment alone also involves the carbon footprint of sewage treatment in a broad sense. Broadly speaking, carbon footprint is the carbon emissions generated by various activities in the sewage treatment process, that is, some carbon emissions generated during the actual treatment process. This type of carbon footprint activity is a form of borrowing from multiple perspectives, such as a direct type of carbon footprint. The carbon footprint in a narrow sense refers to the carbon emissions generated during the final demand process. Taking a city as an illustration point, the total carbon emissions of the city in a year's development and construction with residents' consumption as the core [3]. The emission of CO2 in the sewage treatment process has existed for a long time. People are mining coal, petroleum, mineral deposits and other industrially synthesized products that are used in large quantities, causing part of the fossil carbon to enter the sewage, and the total organic carbon of the sewage also includes part of the fossil carbon. In the current accounting methods [4], there are also some unreasonable phenomena. Because the sources of biogenic carbon and fossil carbon in sewage are not clear, the method of measurement at the time is restricted and the basic data analysis is not clear. At present, from the definition of the existing carbon emission accounting boundary, there are two methods, direct and

indirect. It is assumed that both the biogas and the heat generated by the combustion of gas produced in the treatment process can achieve the effect of recycling, and the calculation results are relatively uniform and accurate. On the contrary, it is not accurate, but each accounting process requires actual analysis of the actual situation [5, 6].

4. Accounting of different treatment and disposal processes Boundary analysis

Combining the current accounting methods, three accounting methods are listed: sanitary landfill, anaerobic digestion and dry incineration processes as examples. Different treatment and disposal processes have different accounting boundaries. In the process of accounting for the carbon emissions of the wastewater treatment plant, it is not possible to simply use the same accounting method or to use uniform treatment and treatment processes with different parameters for accounting. Each link should be analyzed according to the specific treatment process of the wastewater treatment plant.

4.1. Sanitary landfill process-the treatment method of concentrated water

Since the sludge thickening and dewatering process requires a large amount of power input and fuel consumption, and the dewatering process requires additional dosage of chemicals, this part is an indirect emission within the accounting boundary, which will generate a large amount of CO2 equivalent. The relevant accounting boundary is shown in Figure 1.

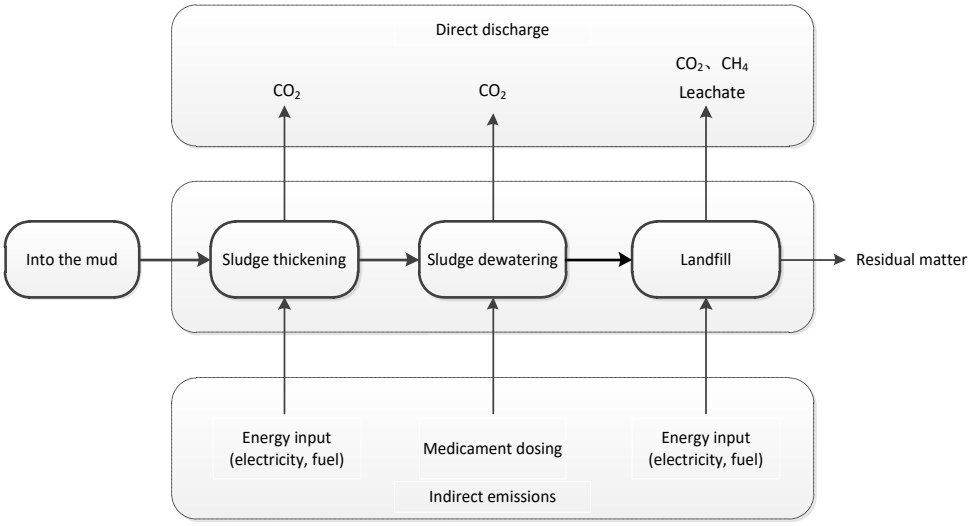

Figure 1. Sanitary landfill accounting.

4.2. Anaerobic digestion-biogas utilization process

Anaerobic digestion also needs to account for carbon emissions. The gases covered in sludge anaerobic digestion include CH_4 (about 60%), CO_2 (about 40%) and some mixed gases. The anaerobic treatment process will produce carbon dioxide. The carbon dioxide emissions in the process are very large, and the electricity consumed is also a lot. After 1t of sludge is treated by anaerobic treatment, 180kg of carbon dioxide is produced and 89kW·h of electric energy is consumed. The generated heat and biogas can be converted into 29kW·h of electric energy (see Figure 2).

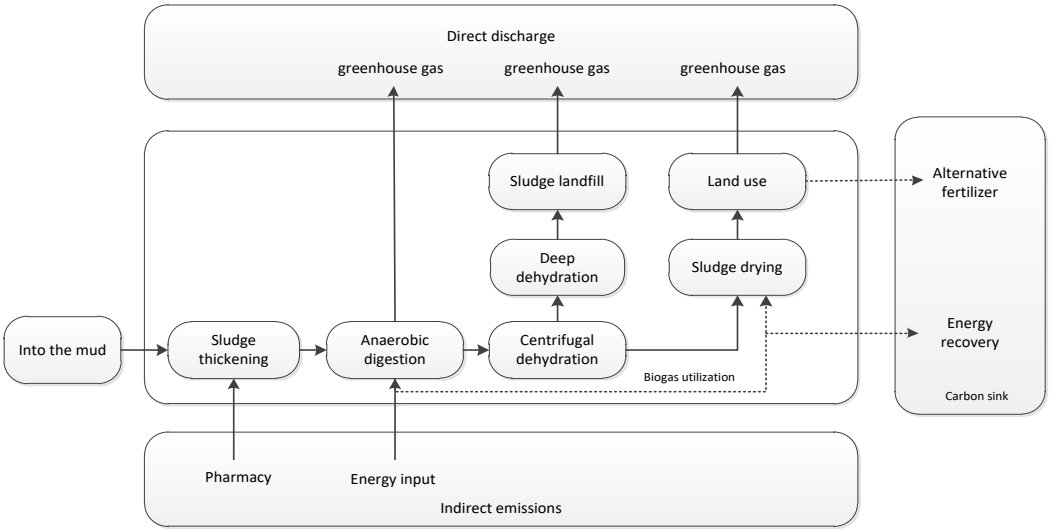

Figure 2. Sludge anaerobic digestion related processes.

4.3. Drying-incineration process

The sludge incineration process is also a commonly used treatment method. The incineration process has been used abroad to treat sludge. From the perspective of carbon emissions, the drying and incineration of sludge will generate heat and cause carbon sinks. The incineration process needs to consume a lot of electric energy, and the treatment process needs to be reasonably calculated. From the perspective of carbon emissions, incineration has little advantage in energy saving and emission reduction. In Figure 3, the incineration process includes

enrichment-dehydration-drying-incineration-landfilling and other links. Different links have different roles. Each process is continuously optimized, and the calculation of carbon emissions in each link is strengthened to achieve energy saving and emission reduction in the sewage treatment plant. There is a certain guiding significance.

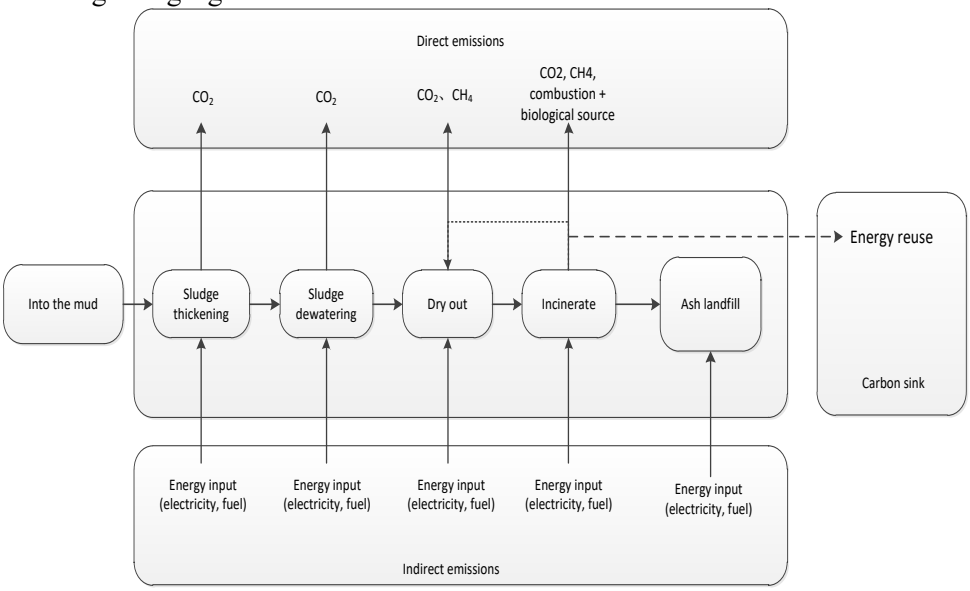

Figure 3. Sludge drying-incineration process accounting

5. Accounting basis and related accounting methods

5.1. Accounting for carbon emissions from domestic sewage

Combined with the related accounting methods of "2006 PICC", the accounting formula used by the author is:

$$E_{CH4}=TOW.EF-R \quad (1)$$

Among them, E_{CH4} is the annual CH_4 emissions; TOW is the total BOD emissions in domestic sewage discharge; EF is the emission factor of CH_4 organic matter emissions (BOD); R is the recovery volume, the default value is 0. In the N_2O processing process, the application principle belongs to the process of releasing molecular nitrogen and N_2O. Combined with the IPCC processing method, the relevant calculation methods are as follows:

$$E_{N2O}=N.EF.44/28 \quad (2)$$

Where E_{N2O} is the amount of N emission, and N is the N content discharged into the aquatic environment. EF as the sourceSelf-emission related emission factors. Combined with the default value of 0.005 in the IPCC, 44/22 is the conversion of N_2O-N and kgN_2O. The total amount of nitrogen in sewage is:

$$N= (P.\ P_{protein}.\ F_{NPR}.\ F_{NON-CON}.\ F_{IND-COM})-N_{sludge} \quad (3)$$

In the formula, N is the annual nitrogen emission, P is the number of people, and P protein is the annual per capita protein consumption. Take $F_{IND-COM}$ as the protein factor, and the value is 1.25. N sludge is the content of nitrogen as the sludge is removed, and it is taken as 0.

In summary, the calculation process of carbon emissions, for the process of carbon emissions in wastewater treatment plants, needs to pay attention to the calculation of carbon emissions-related values. The accounting process is of great significance to sewage treatment. In addition, it should be noted that the values of the relevant values of carbon emissions from sewage treatment plants in different regions are different, and specific analysis of specific issues is required to make the accounting more reasonable.

Conclusion

From the previous analysis, it can be seen that there are certain differences in the carbon emission accounting of different sludge treatment and disposal processes. In the accounting process, the same calculation formula or parameters cannot be simply used to account for different treatment and disposal processes. It is important to analyze the accounting boundary of each link of the specific treatment and disposal process of the sewage plant, which is of great significance to the carbon emission accounting.

References

[1] Li Pengyao. China's sewage treatment industry can reduce annual carbon emissions by 39.4% [J]. World Environment, 2017(1):84-85.
[2] Xia Hong, Dong Guijun. Comparative analysis of process technology of sewage treatment system in small towns considering carbon emission [J]. Environmental Protection and Circular Economy, 2018,38(11):37-39,71.
[3] Xi'an University of Technology. A quantitative calculation method for carbon emissions from sewage treatment plants: CN201810054818. X [P]. 2018-06-19.
[4] Zhu Zhiming, Wang Qian, Fu Lei. Research on the Shadow Price of Carbon Emissions in Wastewater Treatment in China [J]. Water Conservancy Economics, 2018, 36(6):8-13, 56.
[5] Zhang Xiumei. Sewage treatment system carbon emission analysis and emission reduction countermeasures [J]. Science & Technology Economic Guide, 2016(18):110-110.
[6] Zhang Xing. Research on carbon emission of urban domestic sewage treatment system [D]. Nanjing: Nanjing University of Information Technology, 2018.