Tubular-Membrane System Handles Diecaster's Wastewater Easily, Cost-Effectively

Effective, reliable, and economical methods for separating and concentrating die lubricant are important for diecasting operations – and it was the problem faced by Metaldyne's aluminum diecasting plant in Twinsburg, OH. Bill Cleary, Metaldyne's wastewater treatment manager, worked with 22 different wastewater treatment vendors over 10 years, in addition to academic experts and agents from the U.S. Department of Energy in the hunt for an optimal solution.

The Twinsburg plant diecasts aluminum valve components. Metaldyne's production process uses a specially-formulated die lubricant, an oil and water emulsion, that helps to control the temperature of the die as well as the removal of the complex castings during the part ejection process.

Each cycle of the highly-automated process begins with numerous nozzles spraying a controlled volume of lubricant onto specific locations on the die. Next, molten aluminum, at 1,250°F, is auto-ladled into the cold chamber and injected into the die under high pressure.

The plant's drainage system collects the waste generated from the casting process, including the die lubricant, as well as detergents from washing operations and glycol from the hydraulic fluid used in the robotic machinery. In addition, some process cooling water and cooling tower bleed are piped into the wastewater treatment system. The total combined wastewater flow is 9,000 to 11,000 gal/day, with chemical oxygen demand (COD) ranging from 20,000 to 40,000 mg/l.

Clogged MBR, high disposal costs— "The oil from the die lube and the glycol from the hydraulic fluid combine to create an extremely difficult wastewater treatment challenge," Cleary explains. "We cannot use flammable hydraulic oil because of the high temperatures of the molten metal. Instead, we use glycol which, must be removed to meet our COD discharge limits."

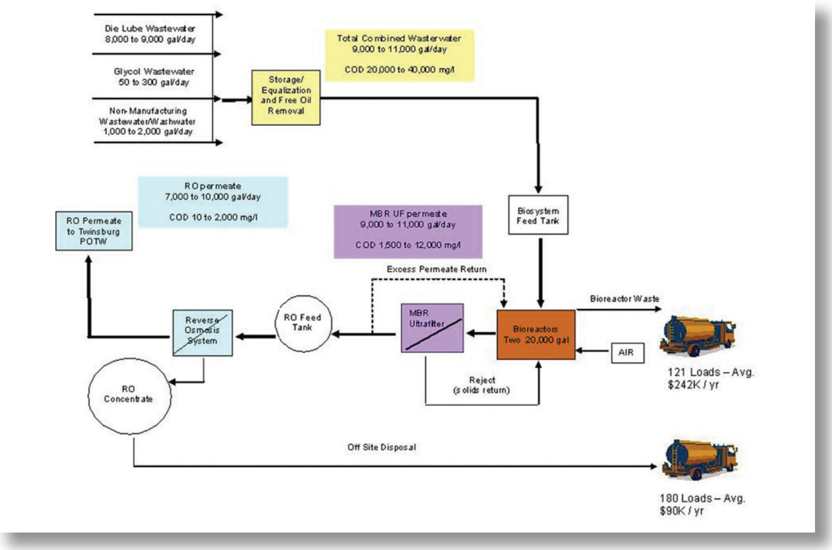


Figure 1. Metaldyne's membrane bioreactor system, with tubular membranes situated outside the bioreactor.

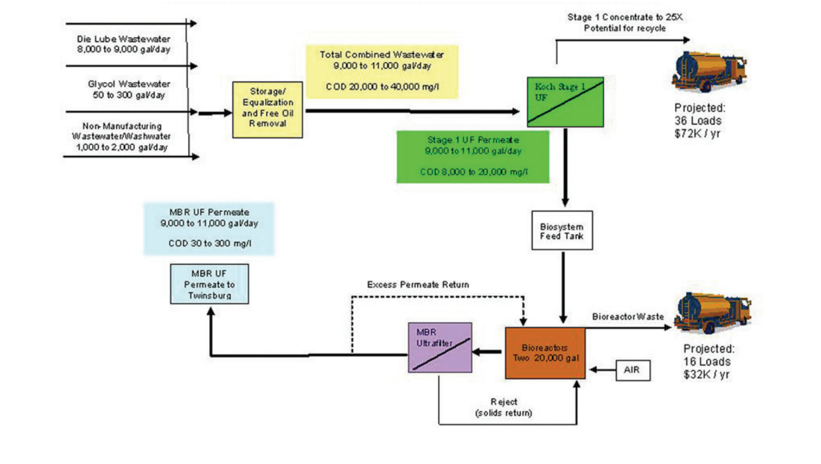
The plant's original physical-chemical wastewater treatment system performed poorly, because it was difficult to maintain a consistent recipe. This situation was further complicated by the uncontrolled and unpredictable flow rate and the difficult composition of the wastewater stream.

In 1995, Metaldyne installed a bioreactor system to consume the glycol. The membrane bioreactor (MBR) system was arranged with the tubular membranes external from the bioreactor, thus separating the water from the activated sludge. The effluent from the MBR was polished by a reverse osmosis (RO) system, prior to discharge into the municipal wastewater system *(see Fig 1.)*.

Unfortunately, the tubular membranes in the MBR had difficulty handling the oils and greases, resulting in clogged pores in as little as three weeks. A scum, with a consistency of a foamy milkshake, formed on the top of the bioreactor tanks, often overflowing onto the floor. The die lube, which accounted for approximately 80% of the waste stream, seemed to be the source of the problem.

"Uncontrolled wasting from the biological tank caused a mess and it became extremely expensive to haul away all of the waste," said Cleary. "We were hauling over 120 truckloads of bioreactor waste each year, at an annual cost of nearly $250,000. We knew that we needed to find an effective way to prefilter the feed water to the MBR in order to remove the oil and other components that were wreaking havoc on the MBR system."

FEG™ tubular membranes — Cleary and his team worked with almost two dozen vendors to test a wide variety of pretreatment solutions, using many different types of membranes.



The Konsolidator industrial wastewater system features tubular membranes with an open-channel configuration, to handle high loads of suspended solids.

Off-Site Disposal				
	Prior to Installation of Stage 1 UF		After Installation of Stage 1 UF	
Stage 1 UF Concentrate (25 x Concentration, Potential to Recycle)	NA	NA	36 loads	$72,000
Bioreactor Waste	121 loads	$242,000	16 loads	$32,000
RO Concentrate	180 loads	$90,000	0 load	$0
Total Truck Loads Per Year	**221 loads**	**$332,000**	**52 loads**	**$104,000**

Figure 3

Chemical Oxygen Demand (COD)		
	Prior to Installation of Stage 1 UF	After Installation of Stage 1 UF
Total Combined Wastewater Stream	20,000 - 40,000 mg/l	20,000 - 40,000 mg/l
Stage 1 UF Permeate	NA	8,000 - 20,000 mg/l
MBR UF Permeate	1,500 - 12,000 mg/l	30 - 300 mg/l
RO Permeate	10 - 2,000 mg/l	NA

Figure 4

For example, a grant from the DOE funded tests of a spinning membrane system. The system worked effectively, but it was not commercially available and high electricity costs made the system uneconomical.

"A few years ago, we heard that a new tubular membrane was developed by Koch Membrane Systems that could handle extremely difficult oily wastewater, and indeed it proved effective," says Cleary. "Finally, we had a system capable of removing the solids upstream of our bioreactor."

In 2006, the Twinsburg plant installed a Konsolidator™ 150 industrial wastewater system, from Koch Membrane Systems (www.kochmembrane.com). The pre-engineered, pre-packaged system contains 150 FEG™ Plus tubular UF membranes.

KMS tubular membranes have an open-channel configuration capable of handling extremely high loads of suspended solids. They are well suited to applications in heavy industrial wastes including oily wastewaters and can be cleaned mechanically using "sponge balls." The FEG Plus membranes are rated at 120,000-dalton molecular weight cutoff (MWCO), roughly equivalent to a membrane pore size of 0.02 microns *(See Figure 2.)*

This new "Stage 1 UF system" removes solids and concentrates the waste 25 times, and achieves the equivalent of a 96% reduction in water content. Cleary is investigating options for recycling the oily concentrate.

Removing the solids makes it possible for the bioreactor process to work smoothly. Off-site disposal of bioreactor waste has been reduced tenfold, from an average of 10 truckloads per month (at a cost of $242,000/year), to only one and a half truckload per month (at a cost of $32,000/year) *(See Figure 3.)*

Prior to the installation of the Stage 1 UF system, the MBR permeate contained a wide variation in COD levels, ranging from 1,500 to 12,000 mg/1. With the Stage 1 UF system, the MBR system now produces permeate with COD of only 30 to 300 mg/l. The MBR permeate now is well below the discharge standards set for the municipal wastewater system (COD <500 mg/l), even without polishing with RO. As a result, the RO system was shut down and permeate from the MBR is discharged directly to the sewer.

Cleary calculates that the total annual cost of off-site disposal of waste has been reduced from $332,000 to $104,000, a 69% reduction that amounts to a $228,000-per-year savings.

"We have been able to reduce our costs and still maintain a reliable, manageable process," says Cleary. "We went five months without wasting in the bio system and without any ill effects. With the Stage 1 UF system, we finally have a process that works."