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Industrial wastewater treatment plant adopts new BOD determination technology

By Ian Culverwell, Nicole Visaggio and Robert Menegotto

Clean Harbors provides environmental, energy and industrial services throughout North America. They offer a broad range of hazardous material management and disposal services, including the collection, packaging, transportation, recycling, treatment and disposal of hazardous and non-hazardous waste. Clean Harbors recently acquired Safety-Kleen and Thermo Fluids Inc., companies involved in oil recycling and cleaning services, to expand their range of environmental services.

The company's wastewater treatment facilities use highly refined, chemical precipitation processes to remove heavy metals, suspended solids and organics, in order to generate safe effluent for discharge into municipal sewer systems. Its Guelph, Ontario plant manages large quantities of industrial waste, including oily water and non-hazardous sludge from a wide range of industries.

This location has experienced steady growth, with 37 million litres processed in 2014. This meant applying for a permit amendment with the Ontario Ministry of Environment and Climate Change (MOECC) to increase holding and process capacity, and eventually plant expansion.

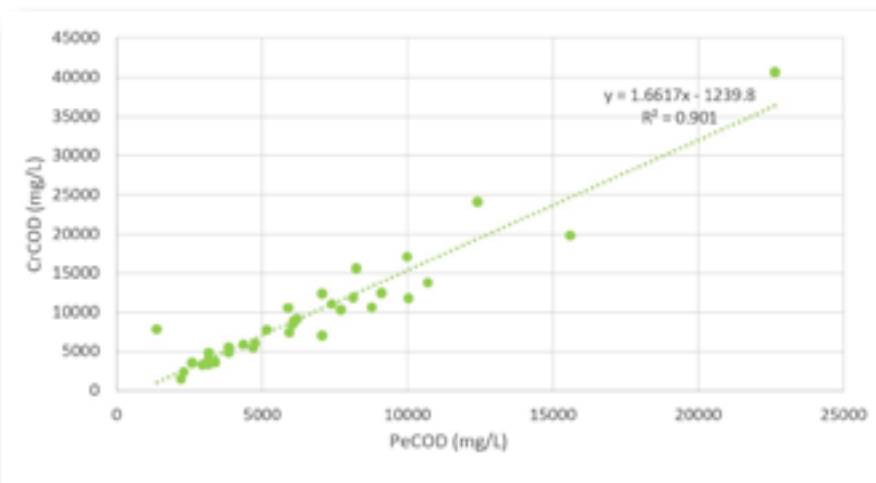
Ian Culverwell, general manager of Clean Harbors Guelph, explains the on-site treatment processes and challenges:

"We do primary chemical coagulation, physical separation of oils, aqueous phases and solids, and chemical coagulation to further remove heavy metals and organics. Biological oxidation and a final filtration step are performed before discharge. We also do biological oxidation, which helps with organic and BOD (biochemical oxygen demand) removal. Our discharge permit with the municipality includes a hard cap on BOD, so we require accurate fast assessment."

As a result of the discharge cap on BOD, samples are sent daily to an accredited laboratory. BOD is a ubiquitous measurement of overall water quality. The standard BOD test requires a five day incubation period, so it is unable to



Clean Harbors Lab Supervisor John Stockton (L), and General Manager Ian Culverwell (R), in front of their automated PeCOD system.



A scatterplot demonstrating a strong correlation between PeCOD and COD_{Cr} for treated effluent from a variety of industrial wastewater samples.

provide continuous monitoring of organic load. With trucks arriving throughout the day, Clean Harbors does not have the holding capacity to keep industrial wastewater in tanks for five days.

Dichromate chemical oxygen demand (COD) was, therefore, implemented to estimate BOD values. COD measures the amount of oxygen required to chemically oxidize organic species in the sample,

and can be used to estimate BOD. The standard method for COD analysis uses hazardous and potentially toxic chemicals, including potassium dichromate, mercury sulfate, and sulfuric acid. Samples can be run in batches; however, the test takes up to three hours to complete.

Clean Harbors required a faster method to allow them to make quick decisions on how to treat wastewater sam-

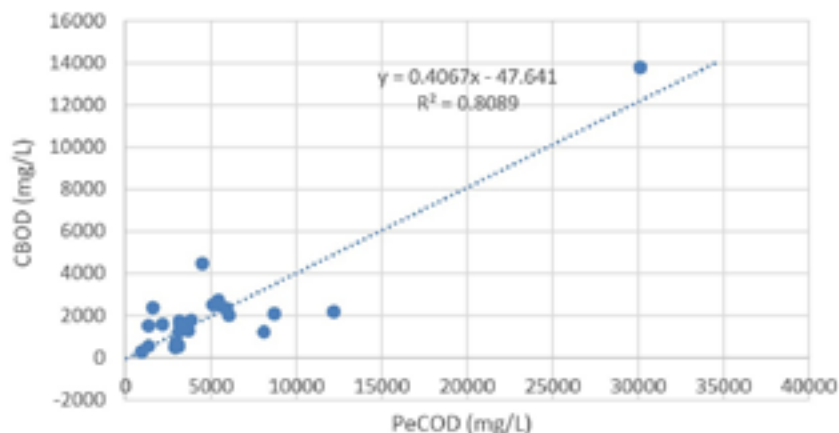
ples, and for continuous monitoring of influent and effluent COD. As a result of the three hour dichromate COD test, trucks (some 16 per day) were not being unloaded in a timely fashion. Culverwell learned of PeCOD® from Robert Menegotto, of MANTECH. This technology, recognized by the MOECC, is an alternative COD analysis method that overcomes the limitations of the traditional dichromate method. Its patented photo-electrochemical COD analysis uses a nanotechnology based approach to oxidize soluble organics in the sample in situ. PeCOD eliminates the use of harmful chemicals. It generates results in 15 minutes through the use of UV activated TiO₂ (titanium dioxide) oxidation and an internal electrode, by directly measuring electron transfer.

Clean Harbors and MANTECH initiated a trial project at the Guelph treatment plant in November 2014. The goal was to establish a correlation between the PeCOD and the dichromate COD (COD_{Cr}) method, and with the BOD₅ test. Samples were prepared in duplicate to test both COD methods. Samples were sent periodically to an accredited laboratory to gather BOD data. Results showed a strong correlation between the PeCOD and dichromate COD for both untreated truck delivered wastewater and treated effluent samples.

Across different industry wastewater samples, there was a stronger correlation between PeCOD and BOD₅, versus COD_{Cr} and BOD₅. Upon a successful 45-day testing period, Clean Harbors decided to invest in an automated PeCOD system to replace the COD_{Cr} method.

Culverwell explained that, “we run a 16-hour per day operation, so retention time on the majority of our waste is less than 24 hours. Timing on the PeCOD is critical for us. With the PeCOD we can get results in 15 minutes, allowing us to turn over our processing tanks much quicker, and process more waste without increasing the size of our tank farm.”

Clean Harbors ordered an automated system, which allows multiple samples to be run in a single batch and has the capability to add a priority sample whenever required. Another advantage of the MANTECH system is that calibrations and quality control checks can be started-up and run before the analyst arrives.



A scatterplot demonstrating a strong correlation between PeCOD and BOD₅ for composite daily sampling by the City of Guelph.

Regarding the positive effect on operational efficiency, Culverwell says that, “it really helps drive the efficiency of the operators here. We run a batch process, with every batch being processed on an individual basis. Therefore, you have an operator determining what the dosage of chemicals and coagulants dispensed

into the tank is going to be. The more knowledge you can equip the operator with, the better the treatment result.”

Ian Culverwell is with Clean Harbors. Nicole Visaggio and Robert Menegotto are with MANTECH. Email: rmenegotto@mantech-inc.com

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