PeCOD® Case Study #05

Landfill Leachate

The PeCOD® method for chemical oxygen demand (COD) analysis is well suited for landfill leachate samples as the rapid results helps provide information on the quality of the groundwater beneath landfills. Regular monitoring of groundwater is essential to ensure that leachate from landfills is not entering the environment, as it may contain highly toxic chemicals. Leachate typically contains high concentrations of nitrogen, iron, organic carbon, manganese, chloride and phenols. Additionally, pesticides, solvents and heavy metals may be present. Furthermore, leachate samples are often low in COD, or contain interferences that require dilution to remove. The traditional dichromate COD test lacks the sensitivity for many of these samples, whereas PeCOD® is able to accurately analyze down to sub-ppm levels.

Twelve leachate samples were analyzed by dichromate and PeCOD® COD methods. Results are plotted below.

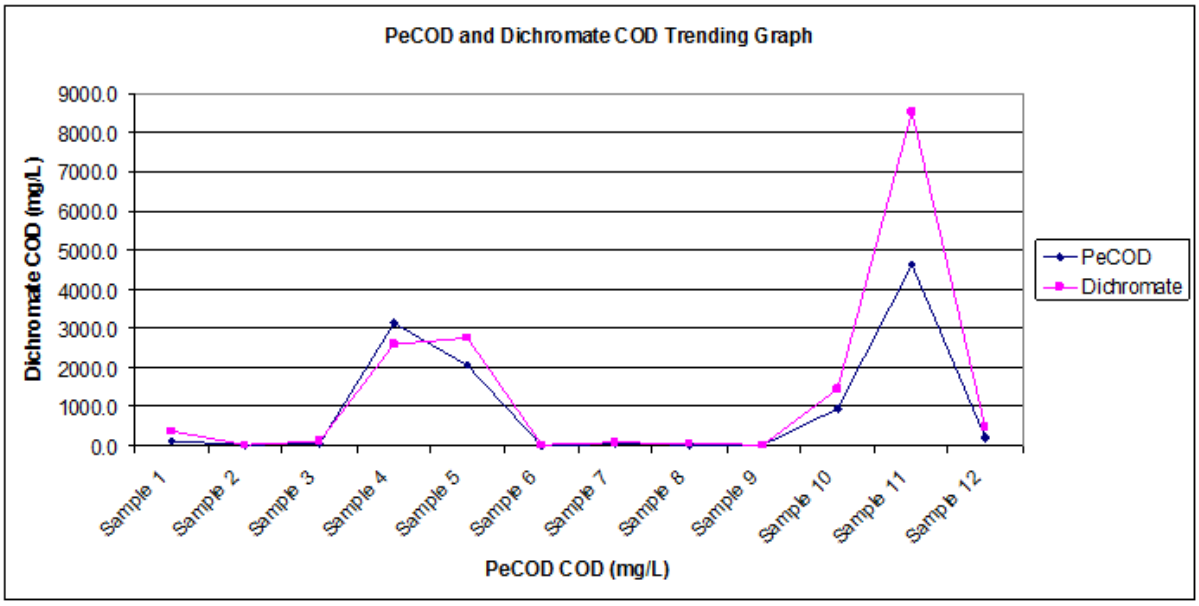

Figure 1: Plot of Dichromate COD and PeCOD® COD for Various Landfill Leachate Samples

The above trending graph demonstrates the excellent correlation observed between PeCOD® COD and dichromate COD. The dichromate method tends to report higher values as it measures total COD, whereas the PeCOD® method measures soluble COD. Most importantly however, a similar trend is observed, meaning that PeCOD® can be used to quickly and accurately determine if any contamination has occurred, and if required, provide a good estimation of dichromate COD and/or biochemical oxygen demand (BOD).

One sample analyzed reported a higher value for PeCOD® COD than for dichromate. The reason for this is unknown, however considering the complex matrix, it is possible that it may contain difficult compounds that dichromate could not oxidize. The core of the PeCOD® technology comes from a titanium dioxide (TiO_2) sensor which is a powerful oxidizing agent (3.1V) that will readily lead to the transfer of electrons from organic species in the cell. Since the chemical potential of dichromate is 1.6V, TiO_2 has a much higher oxidizing power compared to dichromate, meaning that it is better able to break the bonds contained within difficult organic compounds and liberate electrons. Furthermore, it is a possibility that interferences were present which may have biased results for one or both methods.

Figure 2 illustrates a scatter plot of PeCOD® COD against dichromate COD, with one sample removed as an outlier, as discussed above. An excellent correlation is observed, with an R^2 value of 0.98, indicating that PeCOD® can accurately estimate the COD value obtained via the dichromate method with 98% certainty. It is important to note that the outlier is likely due to a contaminant that was successfully oxidized and measured by PeCOD®, but not the dichromate COD method, for example, benzene or diethyl amine. This is an important consideration for effective and reliable COD information and decision making by environmental authorities.

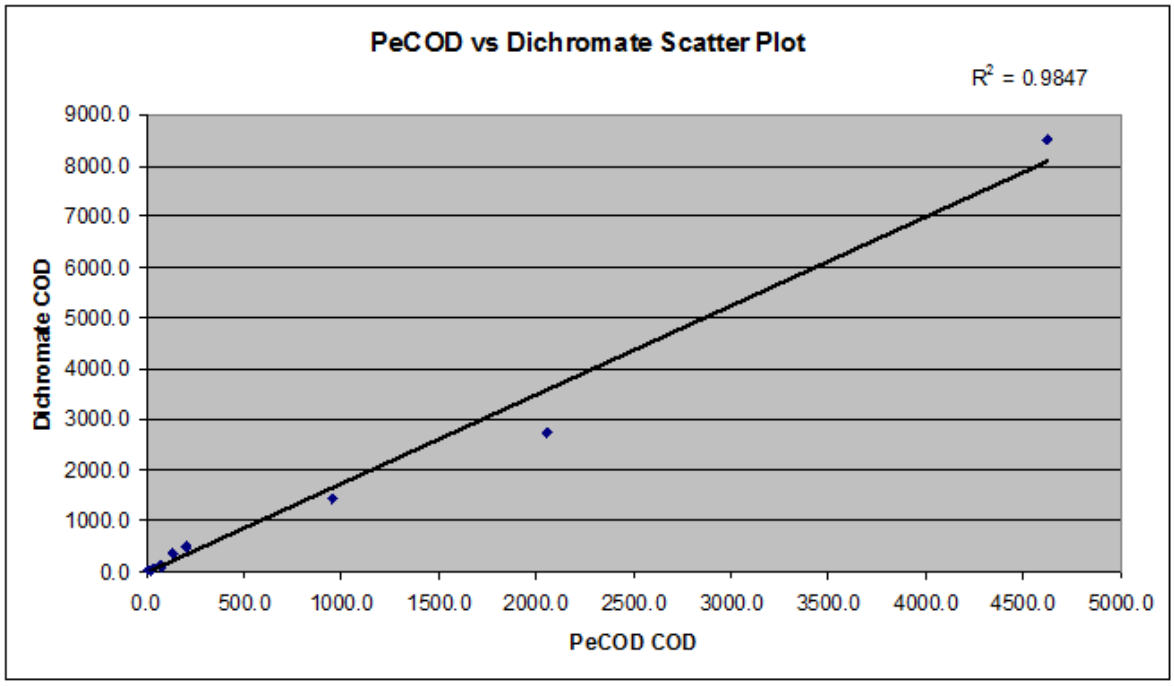

Figure 2: Scatter plot of Dichromate COD against PeCOD COD, after removing the outlier.

The PeCOD® method for COD analysis provides consistent results faster and safer than the dichromate method, which takes 3+ hours to run and can be a dangerous and costly way to obtain COD information. PeCOD® consumables are cost effective, and provide accurate and precise results generated in 15 minutes. The PeCOD® is therefore ideal for analysing landfill leachate samples as it provides the benefit of faster, more continuous organic monitoring, allowing for immediate notification of any groundwater contamination.