Evaluation of the Microtox® Toxicity Testing System: Does it Belong in the Environmental Industry?

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Microtox® toxicity testing technology is a biosensor-based measurement system for toxicity. Microtox® test systems are based on the use of luminescent bacteria (Vibrio fischeri) which produce light as a by-product of normal metabolism. Any inhibition of normal metabolism, such as that produced by exposure to toxic substances, results in a decreased rate of luminescence. The level or degree of toxicity can be deduced by the extent of inhibition of light production. The Microtox® toxicity test has been established as the industry standard for the evaluation of drilling waste toxicity and as such has been widely used across Alberta.

There has been much debate surrounding the use of the Microtox® toxicity test in the environmental industry. In general, concern has been raised regarding the effects of handling (e.g., temperature, time) on sample integrity, and the validity of data generated using the test system (e.g., laboratory precision, reproducibility). Consequently, we have conducted a study to evaluate the effects of time and temperature on results from the Microtox® toxicity testing system and to assess laboratory precision and reproducibility.

To evaluate the effects of temperature and time on data generated using the Microtox® test system, fifteen standard reference material (SRM) soil samples were sent to a laboratory for Microtox® toxicity testing. Upon arrival at the laboratory, five of the soil samples were stored at 22°C (room temperature; RT), five were stored at 4°C (fridge), and five at -20°C (freezer). A thermochron was stored with each group of samples to log the temperature over the course of the study. On days 1, 3, 5, 7 and 9, one soil sample stored at RT, 4°C and -20°C underwent Microtox® testing. At all three temperatures, sample integrity appeared to be compromised on day 7 of testing.

To evaluate laboratory precision and reproducibility, seven SRM soil samples were sent to the laboratory for Microtox®toxicity testing. Six of the samples failed the Microtox® test (with or without charcoal treatment) but passed following sample filtration suggesting that toxicity was associated with suspended solids. The one anomalous sample passed the Microtox® test following charcoal treatment suggesting that toxicity was due to the presence of weakly water-soluble chemicals such as hydrocarbons.

Collectively, these data suggested that Microtox® toxicity testing should be conducted within 7 days of sample collection to ensure data validity. Furthermore, test results (including data QA/QC) should be closely scrutinized for inaccuracies as even SRM results can vary due to laboratory error.

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