TOXICITY REDUCTION EVALUATION (TRE)/ TOXICITY IDENTIFICATION EVALUATION (TIE)

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INTRODUCTION:

REGULATORY/ TECHNICAL BACKGROUND

NPDES PERMITS SOMETIMES REQUIRE BIOMONITORING, OR WHOLE EFLUENT TOXICITY (WET) TESTING OF THE EFFLUENT. RATHER THAN LOOKING AT A PARTICULAR POLLUTANT, WET TESTS HOW THE EFFLUENT AFFECTS CERTAIN AQUATIC SPECIES UNDER LABORATORY CONDITIONS. THE TEST MAY BE TIED TO A NUMERICAL LIMIT OR MAY BE JUST FOR MONITORING PURPOSES. IN EITHER CASE, WHEN TOXICITY IS OBSERVED AT OR NEAR THE CRITICAL DILUTION, THE PERMITTEE SHOULD, OR IN MANY CASES MUST, CONDUCT AT TOXICITY REDUCTION EVALUATION (TRE).

TRE is defined as a site-specific study conducted in a stepwise process, designed to identify the causative agent(s) of effluent toxicity, isolate the source(s) of toxicity, evaluate the effectiveness of toxicity control options, and then confirm reductions in effluent toxicity.

OUR SERVICES & APPROACH:

PREPARING A TRE PLAN

EPA recommends that any facility conducting WET tests prepare a TRE plan before toxicity is observed; the permits require a TRE plan when toxicity is observed and confirmed. Sage helps develop that plan. When whole effluent toxicity is observed, Sage works with the client, the biomonitoring lab, and the regulatory agency to ensure an effective and efficient implementation.

CONFIRMING TOXICITY

When excessive toxicity is observed, the first step of the TRE is to increase the frequency of testing to confirm the toxicity. Typically, that means switching to monthly testing; however, more frequent testing may be appropriate depending on the nature and severity of the toxicity. We help make that determination. If the toxicity is not confirmed, the TRE is typically ended.

PREPARING A TRE PLAN

PROCESS OPTIMIZATION

The TRE plan is specific to the facility, and we work directly with the facility to make sure that the plan is appropriate for the conditions that exist. The TRE is a stepwise process, but the particular steps and the order of those steps are determined based on the specific conditions. We offer experience with this process and a set of fresh eyes that help facilities to optimize TRE plans.

REGULATORY UPDATES

During the TRE, we provide periodic updates to the regulatory agency. Typically, this is done on a quarterly basis as a written report with the results of any testing done. As we develop solutions to the toxicity, we negotiate a compliance plan that is acceptable to the agency and to the client. As the plans are executed, we monitor toxicity and look for the expected improvement.

CONTINUOUS PROGRESS

Agencies expect continuous process on the TRE. As a stepwise process, there are many decision points, many tests, and many reports to make. Facilities are not typically staffed to do all of this extra work, and likely don't have the expertise to do it if they are. Sage is.

STEP 1 The first step is to gather data. We compile the data below and look for any anomalies, trends, or changes that might give clues to the cause (or source) of toxicity:

- The permit and the objectives of the TRE
- Existing effluent and (if available) influent monitoring data (i.e., biomonitoring results, chemical analysis, flow rates, temperatures)
- Chemicals used in the facility (i.e., MSDS, the processes using/producing the chemicals, the quantities, additional aquatic toxicity data)
- Plant processes (what does the customer do, how does he do it, what are his raw materials, etc.)
- Design and operational data of the wastewater treatment plant

STEP 2 Three areas we always want to evaluate are housekeeping, chemical use, and the wastewater treatment system. The evaluations take place both in the plant and at the desk. In each case, if we find issues that may cause toxicity, we develop corrective action plans.

- **Housekeeping** - We facilitate a study team at the plant to look at housekeeping issues that could affect toxicity. Is the SPCC plan sufficient to protect wastewater in the event of a spill? Are housekeeping procedures followed? Is the run on or run off from the wastewater system? How is lab waste managed? It's important to get folks from the plant involved. Our role is to keep the focus on the wastewater toxicity and to ensure that all potential sources of toxicity are considered.
- **Chemical usage** - We develop a list of chemicals, their properties (MSDS, etc.), and their quantities. What chemicals are used/generated in the process, and do they get to wastewater? If they get to wastewater, how are they treated and how do they affect toxicity? Can we

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substitute chemicals, can we change quantities, can we modify handling so it doesn't get to the wastewater? If there are suspect chemicals, then we identify and implement the control strategies. We conduct follow up toxicity testing. If the toxicity is resolved, then we're done. If not, we move to another step.

- **Wastewater treatment system** - We look at the unit processes in the wastewater treatment system. Are the units operating as designed? Is the influent consistent with design? If not, we ask what changes we can make to reduce the toxicity. This becomes the compliance plan. If everything is working as designed, we move on to the TIE.

STEP 3 If we can't determine the toxicity using the tools above, we do a TIE.

TOXICITY IDENTIFICATION EVALUATION

Toxicity Identification Evaluation (TIE) is defined as follows: A process that identifies the toxic components of an effluent or ambient medium by chemically manipulating the effluent or medium and testing the resulting material.

The TIE is a part of the TRE. It is not always required but is nearly always recommended. It's good to design—and begin—the TIE early in the process. Even if we find a potential toxicant doing the evaluations above, a TIE will help confirm that we have identified the correct toxicant.

LAB DIRECTION

The TIE is conducted by the biomonitoring lab. Sage wouldn't normally manipulate the samples; however, according to EPA, the leading problem with TIEs failing is that the lab fails to follow procedures properly. We help qualify biomonitoring labs and audit their procedures.

There is a normal suite of manipulations (e.g., carbon adsorbption, aeration, EDTA chelation) to the effluent. We normally recommend running the entire suite in early tests. However, in subsequent runs, we can reduce the number of tests depending on the results. We perform WET tests on the manipulated samples and determine the impacts that the manipulation had on the toxicity.

RUNNING THE TIE

There is great deal of flexibility in how to best run the TIE. We need to choose the frequency and the number of tests to do based on the quantitative and qualitative variability of the toxicity. While the goal of the TRE is to eliminate significant toxicity at the critical dilution, this may not be the dilution at which to run the tests. To reduce the number of tests required and the time it takes to do the TRE, we want to ensure that there is sufficient toxicity in the samples, so we would like to increase the concentration of effluent in the sample. However, by increasing the concentration too much, we increase the possibility of additional chemicals reaching a toxic concentration or causing masking or compounding of toxicity.

OUR SERVICES AND APPROACH:

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We evaluate how the manipulations affect toxicity. For instance, if EDTA reduced toxicity, we suspect a metal is contributing. We look to concentrations of various metals in the water and look for sources of metals in the plant. If multiple manipulations affect toxicity, then it gives us even more clues to the source of toxicity. We may find multiple toxicants or a single toxicant that's affected by multiple tests. We choose the appropriate suite of chemical tests (e.g. HPLC, GCMS, ICP, wet chemistry, etc.) to identify the specific compounds that are causing toxicity.

Having identified a suspect toxicant, we confirm it. We search literature for toxicity information. We manipulate samples to remove or reduce that particular compound. Alternately, we reconstitute the effluent in the lab, with and without the suspected toxicant. In the end, we want to see that removing the suspected toxicant actually eliminates reduces toxicity to the acceptable level.

Having confirmed the toxicant, we look to the source and work with the client to develop plans for controlling the toxicity. We work with the client and the agency to modify the permit (if necessary) and develop a compliance plan.

TOXICITY REDUCTION METHODOLOGY

As an alternative, based on the TIE, we can choose a toxicity reduction methodology regardless of the identity or source of the toxicant. For instance, if we find that activated carbon removes toxicity, we could propose adding activated carbon to the wastewater treatment system. This, then, becomes the condition of the permit rather than a concentration of a particular contaminant.

In all cases, the TRE ends only after corrective actions have been taken, and toxicity reduction has been confirmed through testing.

SUMMARY:

SAGE'S TRE SERVICES

When biomonitoring tests show unacceptable toxicity, a permittee must conduct a TRE. Each TRE is specific to the facility. Sage provides the knowledge of the TRE process and the labor and effort it takes to keep the process going to conclusion. An intimate knowledge of the plant processes is essential, and so we remain heavily involved with the client regarding tests, reports, and decisions that must be made. We provide the expertise and the man hours to get the work done timely, cost-effectively, and to the agencies' satisfaction