

Whole Effluent Toxicity Compliance

What to do if a whole effluent toxicity test goes astray?

by Jurek Patoczka, Hatch Mott MacDonald

Most of the wastewater treatment plants discharging to freshwaters in New Jersey are advanced treatment facilities, typically relying on a nitrifying activated sludge treatment with some form of polishing such as sand filters. These facilities most of the time generate effluents with no measurable whole effluent toxicity (WET) even during chronic exposure either to *Ceriodaphnia dubia* nor *Pimephales promelas* (fathead minnows). However, occasionally, some of the facilities experience an unusual adverse result, with attendant compliance problems and costs.

Before addressing the title question, let us briefly review the status of the WET testing in New Jersey. When the acute and chronic testing was introduced to New Jersey in the 80's, the regulators and EPA hailed WET testing as the ultimate tool in protection of our waters from toxic pollutants. In the 90's, when fresh-water dischargers in New Jersey began to receive enforceable chronic toxicity permit limits, significant discussions between stake-holders took place regarding the test reliability. As a result, modifications to the implementation of the limit and quality control measures by the bioassay laboratories were introduced and the chronic limit is now a standard, enforceable permit requirement. While most dischargers rarely, if ever, have WET compliance problems, few face difficult to address, costly and protracted battles with the bioassay results.

It should also be noted that one of the recent changes to the way WET criteria are being implemented in New Jersey is application of the maximum daily limits calculation procedure from the Waste Load Allocation (WLA). In the worst case scenario, dischargers to intermittent stream (zero dilution), who originally faced IC₂₅ limit equal to WLA of 100%, now are entitled to the Maximum Daily limit of 61% (based on a default Coefficient of Variation of 0.6). Thus, if a plant has a chronic limit greater than 61%, it most likely is not getting what it is entitled to. On the other end of the spectrum, some facilities with a significant in-stream dilution have acute toxicity limits only, most frequently a minimum State Standard of LC₅₀ of 50%. Such limits are difficult to fail, and a failure indicates a problem at the facility, most likely inadequate nitrification. Most ocean dischargers have acute limit only on appropriate salt-water species.

While chronic toxicity failures are relatively uncommon, they do happen. Despite all the quality control measures and lab certification procedures, at least some of the failures are

a result of laboratory error. This has been recently documented in a New Jersey Effluent's article.¹

So what to do when a bad bioassay result is reported by the contract lab? Actually, dischargers should not wait for that. Every chronic bioassay report, even with reportable result >100% should be briefly scrutinized for signs of possible problems. On one of the first pages of the lab report there should be a summary table indicating test species response for different test dilutions either in terms of growth data (for fatheads) or reproduction (for *Ceriodaphnia*). The data should ideally be pretty flat, i.e. response at all dilutions should be the same as for the control. Watch for a declining trend as the dilutions decrease (i.e. percent of the effluent increases from 0% to 100%). The test where the response does not decline by more than 25% (approximately), as compared to the control, will have a calculated result of >100%. When the decline in the response is more than 25%, the results will be something less than 100%. Any test, which shows a declining trend in the response, and particularly a test with IC₂₅ less than 100%, should be flagged for a review. Depending on the test result in the context of other results from the same facility and in respect to the permit limit, the following actions could be taken:

1. At a minimum, the discharger should request from the contract bioassay lab a review of the report and confirmation that test is valid and that all quality control standards were adhered to.
2. Any test with a result of less than 100% should be visually checked for a consistent dose-response. If a zigzagging trend is present, if there is a dramatic difference in response between two neighboring dilutions, if a "sudden death syndrome" is present or anything else in the report looks funny or unusual, send a copy of the report with a letter requesting review and invalidation of the test to Michelle Potter, DEP Office of Quality Assurance, 9 Ewing St., Second Floor, Trenton, NJ 08625, phone (609) 984-3870. Remember, even if the test is not a violation of the limit, a clean record of all IC₂₅ (or LC₅₀) > 100% will assure removal of the limit from the permit during the next permit renewal.
3. Perform other analytical tests, particularly for heavy metals, on a split, middle (second) bioassay sample, or do an additional test for metals (particularly zinc and copper) on

a composite (or individual) samples collected for the bioassay. Enter all the results in a summary table and look for trends/correlations.

4. Include into your summary table a result from the most recent SRT (Standard Reference Toxicant) test found in the bioassay lab report, expressed as ppm (mg/L) of KCl. Look for a correlation with your IC₂₅ results.
5. Should bad results persist (toxicity present) or a violation occurs, ask a bioassay expert to do a detailed review of your tests report(s). A technical person from a different bioassay laboratory could best do this.
6. Schedule parallel WET testing of an exact, split sample by two or more different laboratories. Divergent results are a powerful indication that the apparent toxicity is an artifact of the test procedure and not the actual toxicity.

If split sample testing confirms presence of toxicity, it is recommended that the discharger performs the below outlined tests aimed at identifying toxicity source and/or identifying a method of eliminating it. These tests are aimed at finding a practical solution to a confirmed presence of toxicity before a more formal testing may be required by the permit. A typical NJPDES permit requires that a specific Toxicity Reduction Implementation Requirements (TRIR) be performed, once two out of six consecutive WET tests demonstrate non-compliance.

- Evaluate potential toxicity from polymer used in the sludge dewatering operations by adding a range of polymer doses to samples activated sludge, aerating it overnight and testing supernatants for toxicity.
- Test grab samples collected at the same time (with a delay corresponding to the average hydraulic retention time) from various in-plant locations, for example: clarifier effluent, polishing pond effluent, chlorine contact tank effluent and dechlorinated final effluent.
- Test final effluent sample and laboratory-filtered final effluent sample.
- Treat the final effluent with a coagulant (alum) in a manner similar to potential use of alum for phosphorus removal.
- Aerate the final effluent overnight.

Samples treated/manipulated in the above outlined manner should be screened for toxicity by an abbreviated bioassay. Below there is a list of most frequent toxicants identified in municipal plant effluents: ²

1. Chlorine (0.05 to 1 mg/L)
2. Ammonia (> 5 mg/L)
3. Organophosphate insecticides such as Diazinon (0.12-0.58 ug/L), Chloropyrifos (0.03 ug/L)
4. Metals (Cd, Cu, Pb, Ni and Zn)
5. Dechlorination chemicals and sludge polymers
6. Surfactants

However, as discussed above, the first order of business when a bad bioassay result is received, is to investigate/confirm that the reported toxicity is not an artifact of the testing procedure.

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¹ J Patoczka and R. Rowby, "Trouble with Chronic Toxicity," *New Jersey Effluents*, January 2007.

² *Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants*, EPA 833-B-99-002, August 1999.



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