# TOXICITY

## What is Toxicity?

Toxicity is not about what is in a sample but rather about the effect of whatever is in the sample. Toxicity assessment is complex because toxicity is itself a complex phenomenon subject to a wide array of variables.

Many of today's most reliable measures of environmental toxicity are based upon the same principle: expose an organism to the unknown sample and determine whether a hazard may exist.

Toxicity is therefore the early alert signal that confirms the toxicant presence but not saying the nature of it.

When we are talking about toxicity we have to take always into account to what is the toxicity referred; because what it is toxic for one specimen could be not toxic for the other. Even, within the same specimen family, some forms of life could be perfectly adapted to some specific compounds that are toxic to the rest. As a matter of fact there are many microorganisms that are born in a *toxic* (to the others) environment and they actually need this type of environment for living.

## What is the target to detect Toxicity?

The aim and target for toxicity detection and measurement should be not other than to protect the life. Then the objective will strictly depend of the type of life to be protected. For example: toxicity detection in rivers and sea would be approached to protect the aquatic life; toxicity detection in drinking water will protect the human water consumption and toxicity in a biological wastewater treatment process should protect the bacteria contained in the activated sludge responsible of the treatment.

## Toxicity in water

There are some effective methods to test the toxicity in water based on micro-organism mobility, mortality and bioluminescent trace signals that will give a reliable detection and measurement of toxicity in water.

The use of intact luminous bacteria (Vibrio fischeri) for toxicity assessment has some clear advantages that have been scientifically validated. These bacteria are self-maintained luminescent units that, under proper conditions, emit high and steady levels of luminescence that can be measured and compared with a standard.

## Toxicity for a biological wastewater treatment process

Many toxic components are dumped into water and wastewater coming from industries and others. During wastewater processing in specific plants these toxic components underlay degradation. But the following components could be also toxic and are killing or inhibiting the microorganisms of the activated sludge responsible of the biological treatment, so that the overall toxicity of wastewater does not change during the whole process and the own process could be then destroyed.

When the toxicity stops the process the wastewater treatment plant is unusable and could take an important time period and money to be recovered. In the mean time: wastewater is not treated and causing the inevitable possible damage to the environment.

What we should never forget is that the actual objective to detect toxicity in a biological treatment process is the protection of the micro-organism responsible of such treatment process. For that reason the only valid microorganisms to be used in this specific type of toxicity should be the own microorganisms contained in the activated sludge of the treatment process and not others.

Those microorganisms have the faculty to be easily adapted to many environments, even when such environments could have some toxicity for water. In other words: it could happen that the water contains some light toxic, the microorganisms from activated sludge are completely adapted to it and the treatment process is running perfectly; then the target is reached and for the activated sludge the toxic water would not at all represent any toxicity.

As making use of the activated sludge from the treatment plant we are given full validity to the toxicity test. The reason is that the test is carried on the own bacteria of the activated sludge.

## Respirometry with the own activated sludge of the wastewater treatment plant

For toxicity detection and measurement in a wastewater treatment plant, the Respirometry with the own activated sludge of the process is the only one solution and should be not utilized any other method for toxicity in water.

The reason to use the Respirometry is because through this technology we can use the own microorganism of the activated sludge: *just the microorganisms we want to protect*.

By other side, respiration rate of activated sludge has been recognised as a key controlling element in the modelling of process control, by the International Water Association Task Group.

For toxicity application, Respirometry can be extended in different techniques: laboratory respirometry through sample respirograms, on-line respirometry by continuous respiration rates measurement and on-line respirometry by resultant oxygen due to microorganism oxygen uptake.

When using other methods different than respirometry it is very common to fall in important false positive toxicity results, creating confusion in the plant operator and leading the process control out of a coherent criterion. Then, if we have not any other tool than an instrument to detect toxicity in water, results obtained with any other biological material coming from process would be just an approach to the reality but not the reality.

## Comparative Study

Techniques carried on other organisms different than the bacteria of the activated sludge a frequent and erroneously toxicity tools for the screening of wastewaters discharged into wastewater treatment plants. There is however currently an increasing controversy between those test and others using activated sludge.

A Microtox and respirometry comparative study for toxicity determination has been performed. Seven organic and five inorganic toxic compounds have been assessed for comparing both methods. Microtox proved to have a higher sensitivity to toxicants but was less representative of effects on activated sludge compared to respirometry. For instance, assays accomplished a biodegradable reference surfactant, showed a toxic effect by Microtox but good biodegradability and no toxicity in respirometry. This could be explained by the different nature of the biological material used, as Microtox utilises the seawater Vibrio fischeri, whereas respirometry uses the bacterial consortium in activated sludge. For the evaluation of the potential toxicity of a compound on a wastewater treatment plant the preferred biological material be used should be activated sludge itself. Results obtained with any other biological material would be just an approach to reality.

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