

# TOXICITY EVALUATION OF AN INDUSTRIAL EFFLUENT DISCHARGING INTO UK MARINE WATERS

by Jackie Eggleton and Kevin Thomas

## Introduction

Toxicity Identification Evaluation (TIE) procedures are a powerful tool in the assessment of effluent ecotoxicology. These techniques allow the cause of harmful effects to be characterised, sometimes identified and often remediated by using a series of bioassay directed manipulations. The purpose of this study was to assess the ecotoxicology of industrial effluent being discharged into the marine environment and to isolate the toxicant(s) responsible for any observed toxicity. This has been achieved by assessing the toxicity of 12 effluent samples, collected from within a UK industrial plant, using biological assays.

## Methods

Direct Toxicity Assessment (DTA) procedures were used to evaluate the toxicity of individual effluent stream samples. The copepod, *Tisbe battagliai* (Figure 1), and marine algae, *Skeletonema costatum* (Figure 2), were the test organisms used to determine the toxic effect (LC50/EC50) arising from all the contaminants present in each sample.

- Effluent samples were filtered through 0.22µm filters, then adjusted for pH and salinity to remove influence of these parameters from the test. Each effluent was diluted with filtered sea water to the following concentrations of the 100% effluent: 50, 33, 10, 3.3, 1.0, 0.33 %
- 48/72 hr bioassays were carried out using *T. battagliai* and *S. costatum*, following CEFAS Standard Operating Procedures.



Figure 1: *Tisbe battagliai*

## Results and Discussion

LC50 values for *T. battagliai* were calculated using ToxCalc™. Microsoft Excel™ was used to calculate EC50 values for growth inhibition of *S. costatum*.

The resulting LC50/EC50 values were converted to toxic units (100/LC50 value) and used in conjunction with effluent stream flow data supplied by the industrial plant, to establish the toxic contribution (in terms of load) of each effluent entering the final effluent.

The results show that four of the effluents have very high toxic contribution to the final effluent (Figure 3).

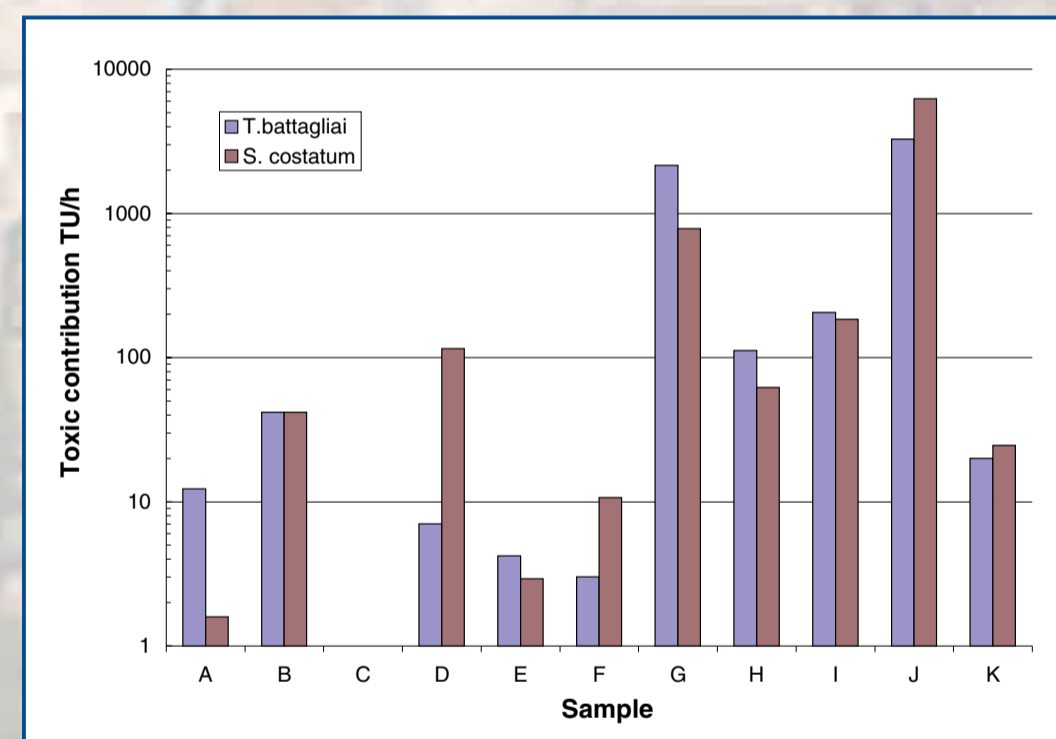


Figure 3: Toxic contribution of each of the 12 effluent samples analysed using a crustacean and algae



Figure 2: *Skeletonema costatum*

## TIE phase 1

The effluent streams showing the highest toxicity were identified as containing either phenol (H and I) or formaldehyde (G and J) (pers. comm. Industrial plant). These effluents were further analysed for phenol/formaldehyde content, the results of which are shown in Table 1.

Table 1: Analysis for Phenols and Formaldehyde in 100% effluent

Sample	Total Monohydric phenols (mg/L)	Formaldehyde (mg/L)
G	N/A	3420
J	N/A	467
H	15100	N/A
I	8500	N/A

N/A not analysed

Bioassays using *T. battagliai* and *S. costatum* were performed using dilution series of both phenol and formaldehyde. These data suggest that there is sufficient formaldehyde and phenol in the effluents tested to account for the measured toxicity. Future work will confirm whether this is the case.

TIE procedures are currently being conducted to test whether phenol and formaldehyde are indeed the compounds responsible for the observed toxicity.

Table 2: Toxicity of phenol and formaldehyde to *T. battagliai* and *S. costatum*

Compound	<i>T. battagliai</i> LC50 (mg/L)	<i>S. costatum</i> EC50 (mg/L)
Phenol	81.12	68.26
Formaldehyde	4.45	1.48

## Future Work

Further work is being carried out in order to firmly establish the cause of the toxicity, including:

1. Removal of phenol/formaldehyde from the original effluent samples, by SPE, purging and/or activated carbon and re-testing using *T. battagliai* and *S. costatum*.
2. Adding phenol/formaldehyde to the cleaned effluents and re-testing using both bioassays.

## Summary and Conclusions

The analysis of 12 effluent streams identified four that were highly toxic to both *T. battagliai* and *S. costatum*. Targeted chemical analysis suggested that phenol and formaldehyde are present at sufficiently high concentrations to be responsible for the measured toxicity. Further work using TIE phase 1 procedures and toxicity confirmation procedures will be used to firmly establish whether these compounds are responsible for the measured effluent toxicity.