

Ecotoxicological Screening of Industrial Wastewater Discharges in Trancão River Basin

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INTRODUCTION

Environmental toxicity is the major problem of industrial wastewater. The establishment of limits for the discharges in terms of chemical determinants alone is an approach that has been shown not to be adequate in all cases in terms of providing receiving waters protection. This approach is suitable if there is a good understanding of the effluent composition, are water quality standards for most of the contaminants known to occur in the discharges and there is evidence to link impact in the receiving waters with the presence of specific chemicals in the discharges. Where this is not the case and when there are issues with complex effluents for which many chemicals cannot be quantified and / or interactive effects are likely to be significant or the receiving waters impaired and the causes cannot be identified the Direct Toxicity Assessment (DTA) approach can provide an added value approach. A DTA based approach uses bioassays with different test species in the assessment of ecotoxicity and the need to use more than one test is recognised to ensure the detection of effects.

To evaluate the usefulness of the DTA approach a demonstration programme was set up for the Trancão River Basin, Portugal, a site with severe pollution problems, that aims to make an ecotoxicological evaluation of municipal and industrial wastewaters.

METHODOLOGY

Sampling:

A set of about 50 industries, based on the Trancão River Basin, from different industrial sectors namely: Chemical (C), Food (F), Printing (P), Repair (R) and Surface treatment (ST), as well as two WWTP were selected according to background information and sampled. Samples were kept frozen till analysis.

Ecotoxicological assays:

- Daphnia test (ISO 6341, 1996; OECD 1984, 1999), abbreviated protocols - Test organism: *Daphnia magna*, Exposure time: 24h; Endpoint: EC50 (%).
- Daphnia test - DAPHTOXKIT FTM - Test organism: *Daphnia magna*, Exposure time: 24h; Endpoint: EC50 (%).
- Microtox test (Microbics, 1994) - Test organism: *Vibrio fischeri*, Exposure time: 5 and 15 min; Endpoint: EC50 (%).

Biodegradability Evaluation:

BOD5 - manometric method, WTW-OxiTop® Measurement System

COD - Reactor Digestion Method - HACH

Biodegradability (%) = (BOD5/COD) x 100

RESULTS AND DISCUSSION

In Fig. 1 are presented the toxicity and the biodegradability results for the samples tested from several industrial sectors. The result used from the Daphnia tests was the lowest value obtained when comparing the two used protocols.

Ecotoxicity evaluation of the different samples showed that in general the crustacean, *Daphnia magna*, was more sensitive than the bacterium, *Vibrio fischeri*. For the most toxic samples (EC50 < 20%) the bacterium seemed to be more sensitive. Regarding the WWTP samples, it can be highlighted a less efficient treatment in WWTP1 once the effluent shows toxicity and low biodegradability.

The lowest biodegradability values were observed for the Chemical and Surface Treatment sectors samples, followed by the Printing and Repair sectors, contrasting with the Food sector samples which presented the highest ratios. The WWTP1 presented lower biodegradability than WWTP2, being the value below to the expected for a WWTP (40 – 50%).

The most polluting industries were determined by allocating points based on the ecotoxicity and biodegradability of their effluents, and on whether or not the effluents are discharged directly to the river. Polluting industries have high scores.

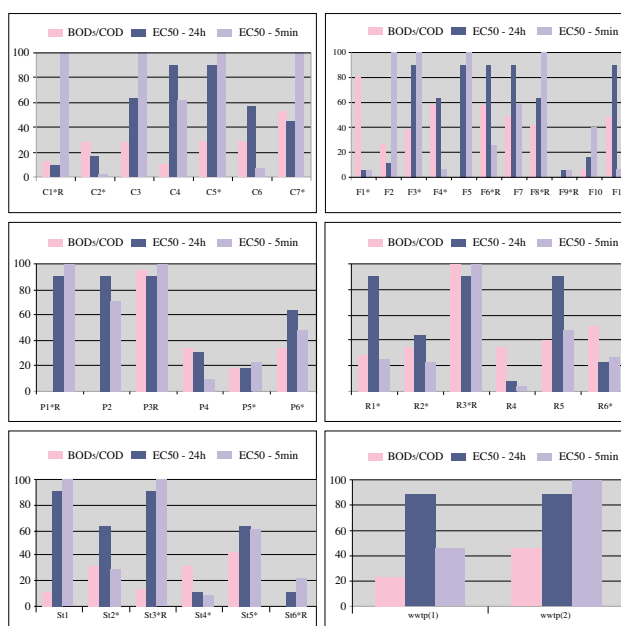


Fig. 1 - Values obtained for *Daphnia magna*, *Vibrio fischeri* and the biodegradability index for the different samples by industrial sector where * - Frielas (2) subsystem, S. João da Talha (1) subsystem, R – river discharge.

Table I: Scoring system used

Criterion	Values	Score
Ecotoxicity:	EC50 > 10% vol./vol.	0
	EC50 < 10% vol./vol.	1
Biodegradability:	BOD5/COD > 40 mg/l	0
	BOD5/COD < 40 mg/l	1
River discharge:	Yes	1
	No	0

FUTURE DEVELOPMENTS

A set of about 20 industries were selected with the above criteria for the second phase of the project that aims at a full chemical and ecotoxicological characterisation of both the effluents and receiving waters. The ecotoxicological characterisation will include in addition to the tests already performed other bioassays using organisms from different trophic levels (i.e. algae and macrophyte) as well as chronic assays.

References:

- ISO 6341, 1996. Water Quality - Determination of the inhibition of the mobility of *Daphnia magna* Straus (Cladocera, Crustacea)-Acute toxicity test.
- Microbics, 1994. Microtox M500 Manual. A toxicity testing Handbook. Carlsbad, CA.
- SOP, 2002 (DAPHTOXKIT FTM MAGNA) Crustacean Toxicity Screening Test for Freshwater. Cressel, Belgium.
- Wissenschaftlich - Technische Werkstätten GmbH (1997). OxiTop® - Instruction manual, Weilheim, Germany.

