Assessing petrochemical effluents using mesocosms:
understanding the biological responses

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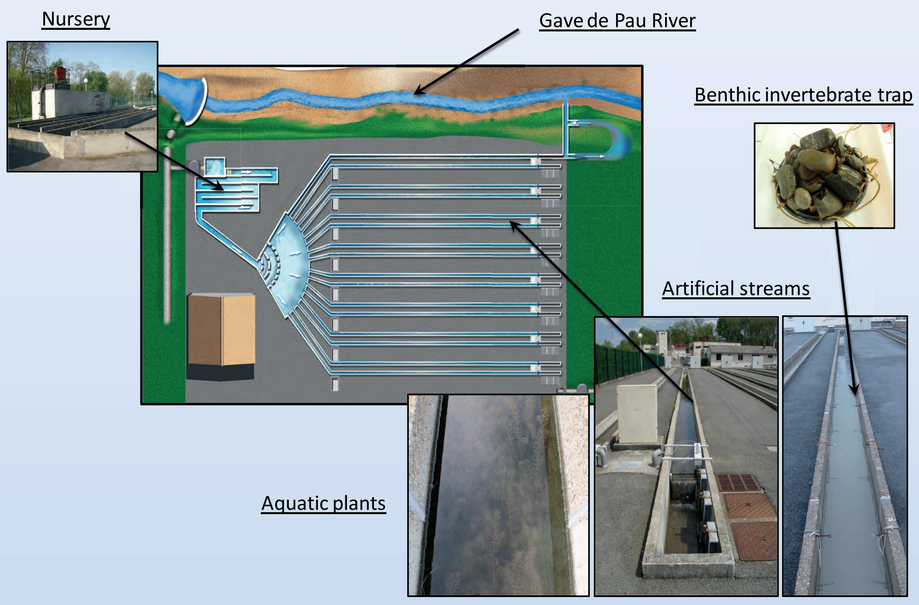
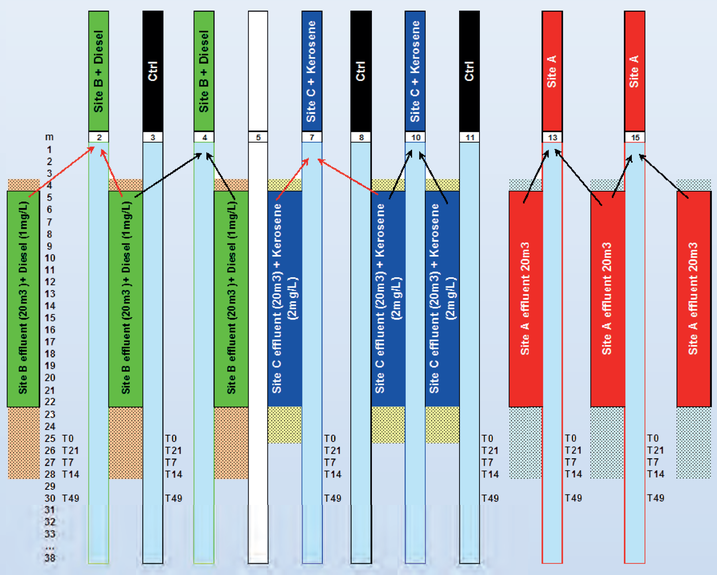
INTRODUCTION

The data described in this poster are derived from a project jointly organised by TOTAL and CONCAWE. The project was designed to determine whether Whole Effluent Toxicity (WET) data obtained from laboratory tests and assessments can be used to predict effects in outdoor artificial stream mesocosms. The project was undertaken in three successive stages which were 1) experimental design and feasibility assessment; 2) understanding the biological responses in effluents and mesocosms and 3) comparing predicted, laboratory and mesocosm effects. In this, the second of three posters, the biological data obtained from the mesocosm experiments is described. Data are presented on benthic invertebrate abundance and biodiversity, diatom abundance and biodiversity, chlorophyll concentration. Results from short-term (acute) invertebrate (Daphnia magna) and bacteria (Microtox) and longer-term (chronic) green algae (Pseudokirchneriella subcapitata) bioassays conducted on samples of the unfortified and fortified effluent samples collected from the flexible storage tanks over the treatment period are also described. The other two stages of the project are described in Cailleaud et al. (2013) and Comber et al. (2013).

Stream mesocosms fed continuously with natural water from the Gave de Pau River

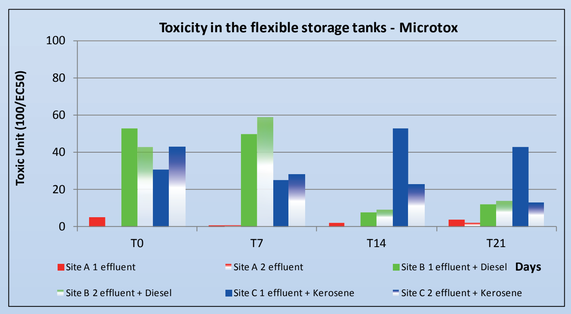


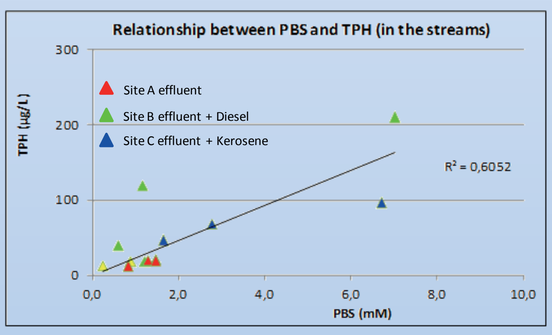
Experimental Design



Flexible tanks

Laboratory toxicity studies of whole effluents (WET)
15/30 min Microtox acute toxicity
24 h *Daphnia magna* acute toxicity
72 h *Pseudokirchneriella subcapitata* chronic toxicity

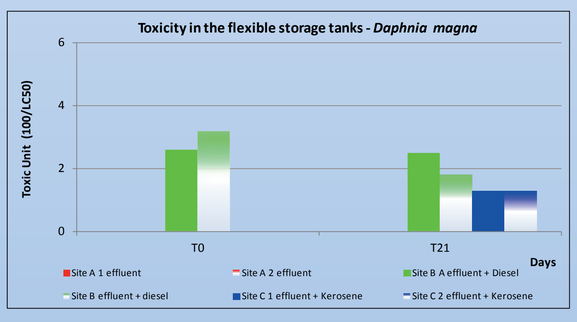


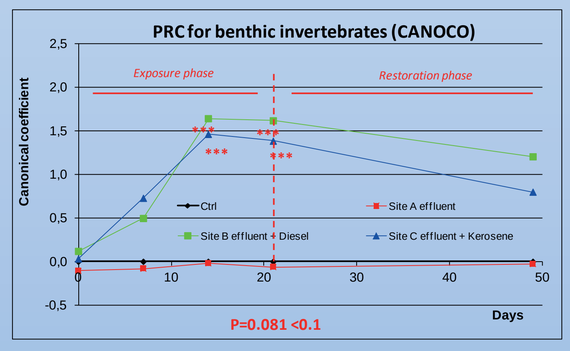


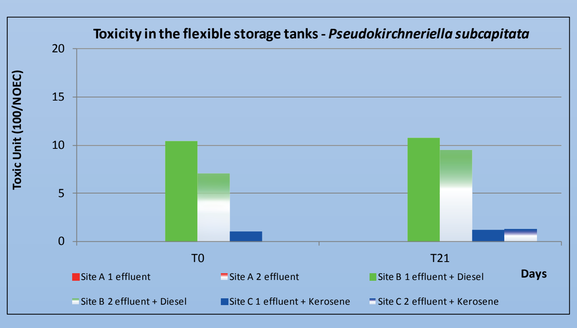
The following biological and chemical analyses were performed during the experiment:

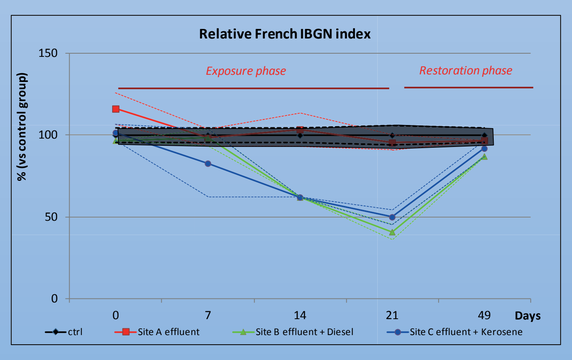
Chemical analyses in the streams
- TPH analyses
- PBS analyses using solid phase micro-extraction (SPME) (Leslie *et al.* 2005)
- 2D-GC analyses (not presented in the poster)

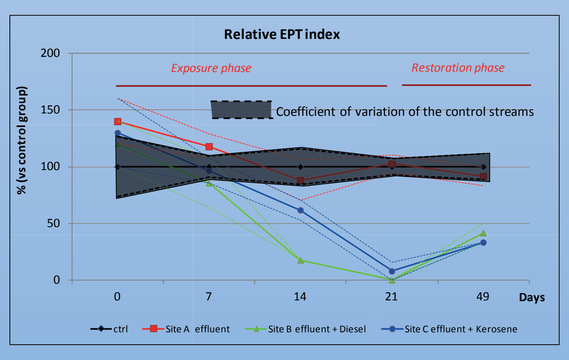
Ecosystem studies of effluents in the streams
- Statistical multivariate analysis of diatoms and benthic invertebrate using CANOCO software (**P**rincipal **R**esponse **C**urve)
- Ecological indices based on biodiversity and abundances (French IBGN, **E**phemeroptera-**P**lecoptera-**T**richoptera (EPT, Lenat & Penrose 1996) index for benthic invertebrates, and IBD for diatoms)











	Bacteria			µalgae			Invertebrates		
	Site A effluent	Site C effluent + Kerosene	Site B effluent + Diesel	Site A effluent	Site C effluent + Kerosene	Site B effluent + Diesel	Site A effluent	Site C effluent + Kerosene	Site B effluent + Diesel
Bioassays	Acute								
	Non toxic	toxic	toxic	-	-	-	Non toxic	No effect	No effect
	Chronic								
	-	-	-	Non toxic	Non toxic	Slightly toxic	Non toxic	Slightly toxic	toxic
Ecological indicators	Acute								
	No effect	Low effect observed	Low effect observed	No effect	Low effect observed	Low effect observed	No effect	No significant effect	No significant effect
	Chronic								
	No effect	Low effect observed	Low effect observed	No effect	Low effect observed	effect observed	No effect	effect observed	effect observed

DISCUSSION AND CONCLUSIONS

- The laboratory bioassays conducted on the fortified effluents injected into the streams showed that they were all toxic.
- No acute or chronic effects were observed in the streams treated with unfortified effluent.
- There was an apparent acute effect of all the fortified effluents on benthic invertebrate community after 7 days of exposure. However, this effect was not statistically significant.
- A significant chronic effect was determined on community structure of the benthic invertebrates after 14 and 21 days. This effect could be measured using ecological indices (IBGN and EPT).
- Within 30 days of ceasing treatment, no significant difference could be measured in the benthic invertebrate community of the previously treated and control streams. The data for ecological indices showed the same pattern. The two sets of data therefore suggest that recovery of the treated streams was quite rapid.
- This study showed that stream mesocosms can be used to study the potential impacts of refinery effluents on aquatic ecosystems, especially those resulting from longer-term (chronic) exposures.
- The data for the effluents that were examined suggest that risk assessments based simply on data obtained from whole effluent tests (WET) conducted in the laboratory are likely to be conservative in relation to outcomes observed in more realistic exposure systems, such as stream mesocosms.

REFERENCES

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Lenat, D. R., and D. L. Penrose. 1996. History of the EPT taxa richness metric. Bulletin North NorthAmerican Benthological Society 13: 305-307.