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A FLOW-THROUGH SYSTEM FOR TESTING OIL DISPERSANT TOXICITY

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ABSTRACT

The toxicity of three oil dispersants was initially assessed by a single bioassay in which the brown shrimp Crangon crangon was exposed to a range of concentrations of the dispersant in seawater, and the 48 h LC50s were determined. In a later stage, in order to evaluate the additional environmental impact of the use of dispersants on an oil slick, additional tests were carried out based on the comparison of the toxicity of physically and chemically dispersed oil under identical conditions of agitation.

KEYWORDS

Marine ecotoxicology, Methods, Flow-through system, Oil dispersant, Crangon crangon.

INTRODUCTION

Although a continuous-dilution system is an appropriate simulation of the natural dispersion of a treated oil slick in nature , such a procedure was found to be impractical for routine application. Therefore all tests are presently still based on the exposure of organisms to fixed test concentrations of oil/dispersants for a fixed time with determination of the mortality after one, two or three days of exposure.

MATERIALS AND METHODS

In the present study the concept of continuous dilution of dispersed oil from the surface into the upper part of the water column was applied by

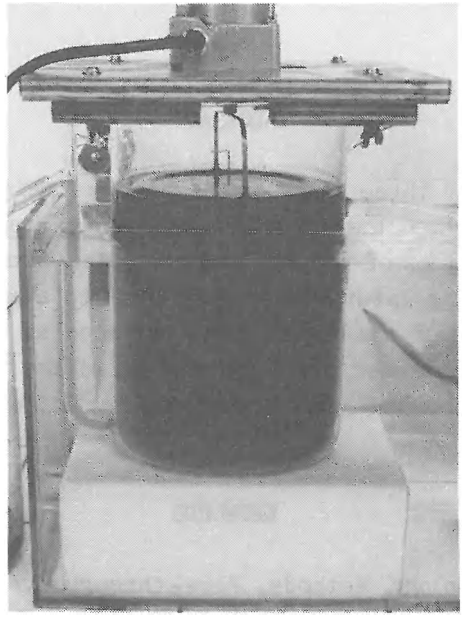

Fig. 1. Continuous dilution system simulating dispersion of a treated oil slick.

using a glass cyclindrical vessel provided at the bottom with an overflow pipe and, at the surface with a pipe supplying clean seawater. Mixing is obtained by a ring agitator which induces rhythmical splashing at the water surface (Fig. 1). Thevertical flow in the vessel is generated by the combined effects of the ring agitator and the overflow output. Two different types of vessels have been used : a smaller model which is thermoregulated and a larger one which can hold 30 shrimps or fishes for bioassays in a temperature-controlled room.

RESULTS AND CONCLUSIONS

Experimentation revealed that the decrease in concentration in the vessel of any homogeneously mixed compound with an initial concentration of x_0 $g.l^{-1}$ follows an equation of the type : $x = x_0 e^{-Dt}$. It can be assumed that in case of an immediate and complete emulsion of the oil, i.e. a pseudo-solubilization, the dispersion of the oil would follow an ideal evolution with 86.5 % recovery after 4 h of exposure.

Table I. Toxicity of three oil dispersants for Crangon crangon (4 h LC50) recorded in continuous-flow tests

Initial oil content ($g.l^{-1}$)	Dispersant/ oil ratio	Dispersant	% Oil washed out after 4 h	Toxicity index (ppm.h)	Number of dead shrimps (total = 30)
1	0.050	C	66	2 340	7
	0.025	A	72	4 665	13
		C	69	4 720	8
2	0.050	A	77	4 360	9
		B	33	6 570	18
		C	69	4 640	22
	0.100	A	83	4 190	7
		C	79	4 130	22
3	0.050	A	77	6 540	24
		C	58	7 990	15

The results obtained with the three dispersants A, B, and C with an initial oil content of 2 $g.l^{-1}$ and under a dispersant/oil ratio of 0.05, (Table I) are illustrating the main advantages of the flow-through bioassay: the present test procedure was able to differentiate a bad dispersant (B) from two good dispersants (A and C), and to assess the respective toxic effects of the dispersants by comparison of their lethal effects for a common toxicity index.