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THE USE OF AN AGITATION TEST FOR NOTIFICATION OF ALTERNATIVE BASE OILS FOR DRILLING FLUIDS

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ABSTRACT

There is increasing pressure to reduce the discharge of diesel oil to waters of the North sea. The companies which manufacture drilling fluids have responded by developing new "safe-mud" systems containing alternative base oils.

The UK Government Department of Energy requires the provision of data concerning the toxicity of these new base oils and drilling fluids to ensure that they are acceptable alternatives to diesel and diesel-based products.

The test which the UK government has developed for testing base oils is described and the results obtained from testing a wide range of oils are presented. It has been found that, while muds based on safe oils are generally very safe, not all products based on "toxic" oils are as toxic as might be predicted.

Some preliminary analytical results are presented indicating which components of one particular type of base oil are associated with the toxicity of that oil.

KEYWORDS

Marine ecotoxicology, Methods, Regulations, Crustaceans, Crangon crangon, Oil, Drilling fluids.

MATERIALS AND METHODS

UK Government has adopted a standard test for the purpose of assessing the relative toxicity of the base oils, (Blackman et al., 1977). The test organism used is the brown shrimp, (Crangon crangon), which is widely distributed and relatively easy to handle. Animals with a body length of 50 mm ± 10 mm are selected. They are held in the laboratory for a minimum of 5 days and fed on a specially prepared diet. The shrimps are maintained at the test temperature for at least 3 days before being transferred to the test

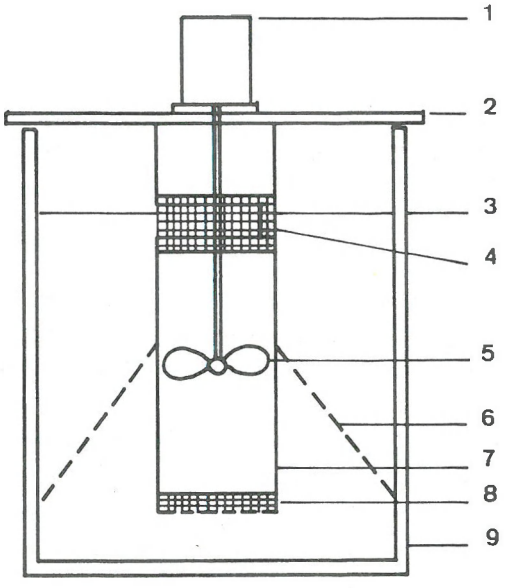

Fig. 1. Diagram of test apparatus : 1 = 12 V motor, 2 = perspex lid, 3 = level of test solution, 4 = slot covered by plastic mesh, 5 = 3-bladed propellor, 6 = plastic mesh cone, 7 = perspex column, 8 = plastic mesh, 9 = cylindrical glass tank.

vessels. Food is withheld throughout the test period. The test apparatus used is shown in Fig. 1. Filtered natural seawater with a salinity of approximately 34.5 ‰ is used as the dilution water. The temperature of the dilution water is controlled to 15 °C ± 1 °C before being added to the test vessel.

The test is carried out a 15 °C ± 1 °C. A range of test concentrations is established in a logarithmic series to a maximum concentration of 1 000 $mg.l^{-1}$. A reference oil is tested as a positive control on each occasion. Twenty shrimps are placed in each test vessel and mortalities are recorded after 24,48,72, and 96 h exposure. The LC50 values are calculated using probit analysis and when necessary dose response curves are plotted. (Fig.2).

All procedures are carried out in accordance with Good Laboratory Practice ; all original data are stored in the Brixham Laboratory Archive.

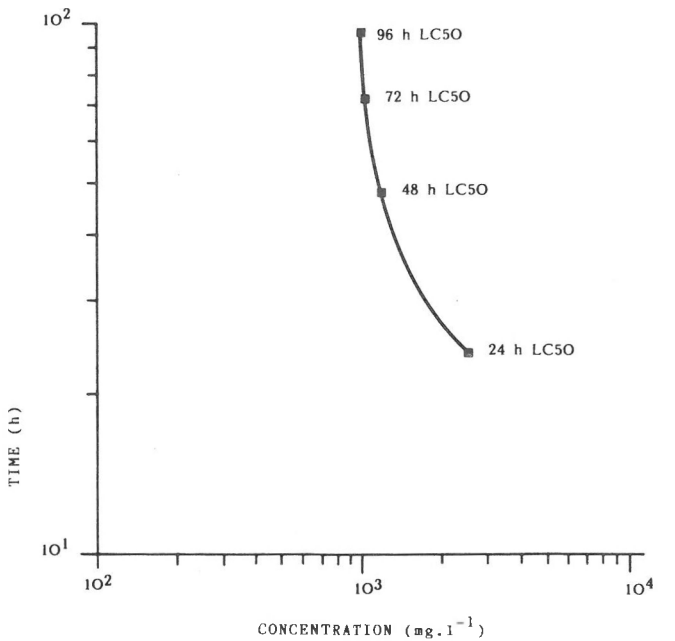

Fig. 2. Dose-response curve for the brown shrimp (Crangon crangon) exposed to diesel-based drilling fluid (horizontal bars = 95 % fiducial limits).

RESULTS AND CONCLUSIONS

A wide range of oils and drilling fluids has now been tested (Fig. 3). While muds based on oils of very low toxicity are generally very safe themselves, not all fluids based on the relatively more "toxic" oils (96 h LC50 < 1 000 $mg.l^{-1}$) are as toxic as might be predicted. In fact, on the basis of the evidence presented here, it would appear that most oils with a 96 h LC50 in excess of 100 $mg.l^{-1}$ would be suitable (as far as toxicity is concerned) as alternative base oils. It is recognised, however, that in setting guidelines it may be necessary to allow some extra "safety" margin.

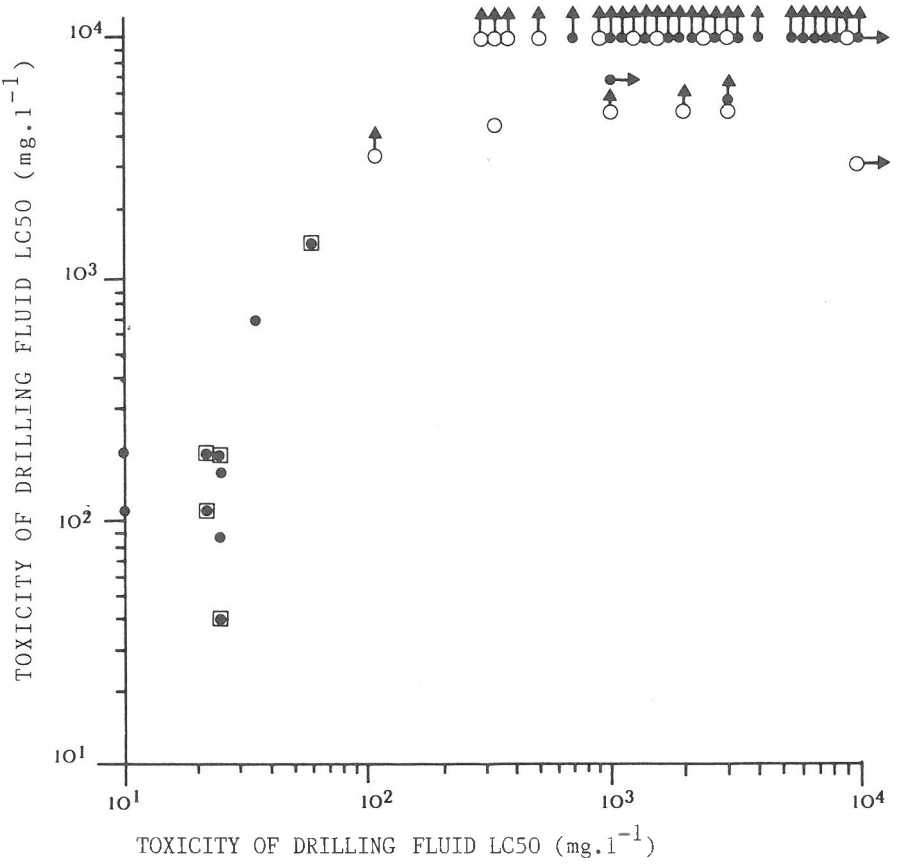

Fig. 3. The relationship between the toxicity for Crangon crangon (96 h LC50) of drilling fluids and their respective base oils. • = ICI data, ○ = MAFF data, ◙ = Diesel oil.

Preliminary analytical investigations have indicated that certain specific aromatic components of one base oil are associated with the toxicity of that oil. While this may prove to be a profitable line of research, it should be noted that other workers have failed to show this relationship (pers. commun.).

ACKNOWLEDGEMENTS

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