Ensuring the most appropriate oil spill treatment products are available – A review of toxicity testing and approval issues in the UK

Mark F Kirby, Bryony Devoy and Robin J. Law
Centre for Environment Fisheries and Aquaculture Science (Cefas), Burnham on Crouch, UK
www.cefas.co.uk

Introduction

A scheme for the testing and approval of oil spill treatment products in the UK has been in place for over 30 years. The presence of a robust and comprehensive approval process is seen as a key element in the ability to use the right products during oil spill response both in terms of efficiency and environmental acceptability.

The current UK scheme involves an efficacy assessment (for dispersants only) and two toxicity assessments, the Sea Test (Figures 1 and 2) and the Rocky Shore Test (Figure 3). During 2007 the UK government undertook a full review and public consultation involving stakeholders to ensure that the testing methods and approval processes are appropriate for modern products and take into account any significant operational considerations in the testing and approval process.

Figure 1. The statutory Sea Test rig set-up as used for the toxicity assessment of oil spill treatment products in the United Kingdom.

Figure 2. A standard Sea Test in process. The difference can clearly be noted between mechanically dispersed oil (left) and chemically dispersed oil (right).

Figure 3. The common limpet (Patella vulgata) is used in the standard Rocky Shore test. Here the test organisms are seen on the Perspex plate prior to oil or product treatment.

Issues

Combined toxicity/efficacy

Considerations were made of combining the separate assessments of toxicity and efficiency. Cefas has developed a preliminary option based on the UK Sea Test but incorporating an element of flow-through dilution allowing for reductions in dispersed oil concentrations in treatments using more efficacious products. This would result in a reduced overall exposure and to test organisms and a subsequent reduction in toxicity.

Type 2 vs Type 3 testing

Many modern dispersants can be used water diluted (Type 2) or neat (Type 3). The current Sea Test allows for the testing of both but does not distinguish between the results when providing an approval. Evidence suggests that products produce higher mortality when used as a Type 3 (Figure 4).

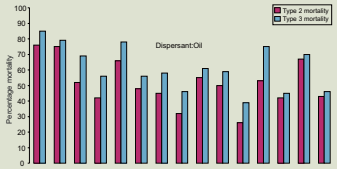

Figure 4. A selection of comparitive brown shrimp (Crangon crangon) mortality results obtained during Sea Test exposures when a dispersant is applied as either a Type 2 or a Type 3 product.

Products other than dispersants

Current standard tests were designed specifically for the testing of dispersants and have been modified for the assessment of other products. The review considered whether the testing regime was appropriate for other products (e.g. sorbents, surface cleaners, bioremediation agents etc.).

Product : oil ratios

Current tests for dispersants employ a product to oil ratio of 1:10. Manufacturer recommendations are generally 1:20 to 1:30 and claims are made for some products of efficiency at ratios as low as 1:100.

Preliminary evidence suggests that a change to the application ratio can affect the outcome of the Sea Test and can vary between different dispersant formulations (Figure 5). Is the use of a fixed product to oil ratio a required safety factor or are we rejecting products that could be useful at lower application rates?

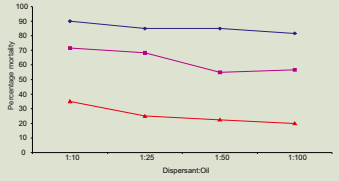

Figure 5. Mortalities of brown shrimp (Crangon crangon) during a standard Sea Test when three selected dispersants are applied at reducing product:oil ratios.

Different oils

Current approvals are based on testing using a representative standard oil (Kuwait crude). Increasingly, however, a higher proportion of marine spill incidents involve the intermediate and heavy fuel oils from the vessels rather than the cargo oils from tankers. Furthermore, heavy crude oils are now frequently transported through European waters. Should a process allowing for the approval of products to specifically treat heavier oils be developed?

Physical conditions

It is well understood that certain physical conditions can have a significant impact on the behaviour of oil, the effectiveness of spill treatments and the toxicity of oil and products. For example, preliminary data using the Sea Test confirm that Kuwait crude toxicity is affected by temperature (Figure 6) and salinity (Figure 7). The standard test process employs standard physical conditions of temperature (15ºC) and salinity (30-35 ‰). Should the approval process take account of other physical conditions that might be encountered when testing products?

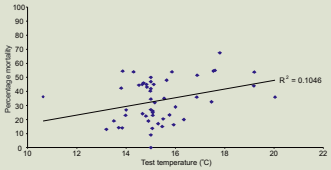

Figure 6. The relationship between test temperature and final mortality levels of brown shrimp (Crangon crangon) exposed to Kuwait crude oil during the standard Sea Test.

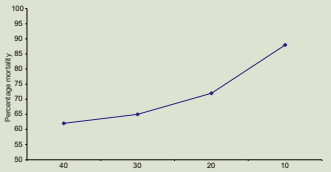

Figure 7. The mortality of brown shrimp (Crangon crangon) when exposed to chemically dispersed Kuwait crude oil in varying salinity conditions.

Sea and Rocky Shore Test Assessment?

Currently products need to pass both tests to gain an approval. Does a product need, for example, to pass the Rocky Shore test if it is only ever to be used in offshore environments?

Conclusions

The scheme review was strongly supportive of the UK approach and concluded that it offered a relevant and robust product assessment process.
Details of the review and downloadable documents can be viewed at http://www.mfa.gov.uk/environment/oil/products-approval.htm

The main developmental priorities from the review were:

1. **Development of a new testing procedure for Heavy Fuel Oils and more viscous oils.**
   It was concluded that given the increased importance of heavy oils a specific testing and approval process was needed to identify products for use against heavy oil spills.

2. **Separate Type 2 and Type 3 Testing.**
   The current practice of allowing dispersants to be approved for use as a Type 2/3 on the basis of a Type 2 assessment only was not felt to be sufficiently protective. Products that can be used neat (Type 3) will now have to undergo a compulsory Type 3 assessment

The test development required to introduce these changes will take place during 2008/09 for statutory implementation thereafter.

For further information on this or related work contact mark.kirby@cefas.co.uk