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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Water and health

Selecting and validating sediment toxicity test methods

A completed Water Research Commission (WRC) study selected and validated sediment toxicity test methods to be included in the national toxicity monitoring programme.

Background

Organic and inorganic contaminants bind the sediment which then act as both a source and sink for these pollutants. Any changes in the physical parameters of the overlying water can cause these pollutants to be released back into solution.

These accumulated contaminants can be released at even higher concentrations than previously detected even once the overlying water concentrations are at or below acceptable water quality guidelines. Sediment contamination has been identified as an overlooked pollutant source in aquatic ecosystems, and therefore the need to monitor for potential impacts is becoming increasingly important.

Although the Department of Water and Sanitation has put measures in place to initiate the development of a national programme to monitor the state of sediments around South Africa, the development of protocols for conducting the standardised sediment toxicity tests required have not been addressed. It is a necessity to determine any practical problems with the international methods as well as standardising the operating procedures.

The most appropriate methods for evaluating sediment toxicity need to be assessed and found to have relevance to the South African aquatic ecosystems. Using an indigenous/native species would be highly advantageous, and therefore this WRC project proposed to develop toxicity test protocols based on international methods which use indigenous species and cover a range of feeding habitats and ecological niches.

South Africa does not currently have standardised methods to assess sediment toxicity. Although international methods exist, they are largely untested in South Africa. It was therefore necessary to determine which methodologies could be applied in South Africa based on availability, ease of use, space requirements and cost.

The broad aims of this WRC project were to, among others, conduct an extensive survey on national and international toxicity testing methods used as well as new methods to evaluate sediment contamination; test and validate the sediment toxicity tests using an in-house culture according to international methodologies; test and validate available sediment toxicity test kits to identify the most cost and time effective methods to screen sediment samples.

Methodology

International methodologies already exist to test and manage sediment toxicity. However, currently in South Africa the methods which will be used to assess sediment toxicity have not been standardised. Without standardised methodologies and test organisms, results obtained by implementing international methods will not provide reliable and reproducible results.

Sediment toxicity testing on field collected sediments and laboratory dosed sediments provide information that is essential in assessing the effects of contaminated sediment on benthic organisms.

A literature survey was undertaken to gather information regarding the current international methodologies to ensure that the latest methods were included in this study. This was

then included into an interim report detailing the selection of applicable tests for the assessment of sediment toxicity.

The *Chironomus caffrarius* culture along with additional sediment test kits (Ostracodtoxkit and the Phytotoxkit) was assessed in order to determine the time and cost effectiveness of the selected methodologies. These method protocols were then validated in order to generate the necessary data to compare each and to determine test utilisations.

This data was necessary in order to determine which tests should be suggested to be incorporated into sediment monitoring programmes. Numerous attributes were taken into consideration when selecting the test methods being assessed, such as the each of handling and breeding under laboratory conditions as well as being able to provide reproducible responses.

Each selected test method was evaluated and the methods documented, including descriptions of the parameters to be assessed, contributions to uncertainty, test procedures and criteria for results. Training of laboratory personnel from the Department of Water and Sanitation Resource Quality Services was undertaken in order to ensure that the sediment toxicity tests developed for national usage will be implemented by informed analysts.

The information gathered during this project has been compiled into a final report that includes the results from the validation report as well as information regarding the time and cost-effectiveness of the methods evaluated.

Conclusions

From the comprehensive literature survey, relevant data on the available toxicity tests was used to select tests for evaluation and the validation process. The hands-on experience with these methods provided useful and applicable information which assisted in providing recommendations for these sediment tests to be considered for inclusion into a sediment monitoring programme.

The Phytotoxkit is easy to use, and requires minimal training and equipment to conduct. This test includes three plant species in the exposure and does not have a lead time as the seeds are used directly from the kit.

Measurement of the end points is done both visually as well as by using an image analysis program. This method has been submitted for consideration as an ISO method.

The seeds are exposed to the dissolvable fraction of contaminants bound to the sediments during the test and therefore the seed germination is not limited by the physical characteristics of the sediment itself.

The Ostracodtoxkit is an ISO accepted method. This test requires the use of both a dissection microscope as well as a microscope that can capture digital images. The ability to capture images via the microscope makes data analysis easier and enables exposure photographs to be kept for later reference.

This exposure method, however, has a long lead time, as it takes the cysts 52 hours to hatch before a test can commence. In addition, experience is required to ensure that the correct number of H. incongruens individuals are transferred into the exposure wells and therefore determine the success of the tests.

The *C. caffrarius* was the only laboratory cultured organism included in the validation project. This is due to increased cost and time associated with culturing test organisms in a laboratory. This test is a newly developed test and to that end will require refinement as the test continues to develop.

However, the successful completion and replication of results has shown that this test organism has the potential to be used to assess sediment toxicity. With the validation data it will be possible to determine the sensitivity of this species in comparison to the international species.

With minimal training and equipment purchases it would be possible to conduct these three tests in laboratories in South Africa. The Excel-based spreadsheets will ensure that the correct data calculations are conducted with minimal effort and training, and are available for monitoring agencies to assist with data capturing, manipulations and interpretations.

Further reading:
To order the report, ***The selection and validation of sediment toxicity test methods to be included in the national toxicity monitoring programme*** (**Report No. 2160/1/15**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.