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A comparative evaluation of produced water toxicity

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INTRODUCTION

Concern has increased in recent years regarding the potential effects of produced water discharged to marine and estuarine environments. Considerable work has already been accomplished using toxicity tests with produced water (Montgomery et al., 1987; Montgomery et al., 1988; Parrish et al., 1988). This study responded to the need for more information on toxicity tests with produced water, and the range of sensitivities "for different test organisms. The objectives were threefold: (1) evaluate produced water sample handling procedures and sample changes during storage, (2) compare different toxicity testing procedures using the mysid, Mysidopsis bahia, with produced water, and (3) test the suitability of other species in toxicity tests with produced water.

Mysid toxicity tests are currently one of the standard tests for evaluating the toxicity of produced water to marine and estuarine environments. The second task was designed to measure differences in mysid tests resulting from the use of various procedures and exposures. By using three different test systems, the effects of both pH/salinity adjustment and volatilization of toxic compounds could be investigated. One procedure used to test mysids followed Peltier and Weber (1985), which routinely adjusts salinity and pH for each test dilution. A second procedure did not adjust salinity or pH, but merely added 20 ppt seawater to produced water to prepare dilutions. Therefore, the use of a hypersaline produced water sample will result in varying salinities at different test dilutions.

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To determine if mysid toxicity is correlated with the concentrations of volatile aromatic hydrocarbons (BETX), open and closed containers were employed. In addition to the open, aerated system using the Peltier and Weber (1985) method, a closed-flask system described by Reish and Richards (1957) was used. Data on toxicity and BETX concentrations were used to determine the median lethal concentration (LC50 and the "Toxicity Index" for mysids in ppm-hours of BETX (Anderson et al., 1980).

The third task was designed to compare the toxic responses of five different species to three produced water samples. This comparison provided a wide range of information since these five procedures utilized various exposure times and endpoints. Two of the toxicity tests were "rapid" (1 hour), two were acute tests (96 hours), and one was a 7-day chronic estimator test, with daily replenishment of produced water dilutions

The five species used were: (1) *Mysidopsis bahia*, estuarine mysids currently being used for biological testing of produced water in the Gulf of Mexico, (2) *Strongylocentrotus purpuratus*, purple sea urchins, (3) *Menidia beryllina*, inland silversides, (4) *Neanthes arenaceodentata*, a polychaetous annelid, and (5) *Photobacterium phosphoreum*, a luminescent marine bacterium.

All five toxicity tests were performed on three separate produced water samples collected from different platforms in the Gulf of Mexico. A suite of chemical analyses characterized each produced water sample used in this task. These analyses were used to indicate the magnitude of differences between samples and reflect the type of variation observed in biological testing.