

## ABSTRACT

Toxicity Identification Evaluation of Produced Water  
using *Metamysidopsis insularis* (Brattegard, 1970b)

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Culture techniques, life history, and suitability for use in toxicity testing of, the tropical estuarine mysid *Metamysidopsis insularis* (phylum: Arthropoda, class: Crustacea, order: Mysidacea, family: Mysidae) was determined. Toxicity Identification Evaluation or TIE [Burgess *et al.*, 1996; Marine Toxicity Identification Evaluation (TIE), Phase-1 Guidance Document] was carried out on produced water (PW) effluents from seven inland petroleum installation discharge sites in Trinidad and Tobago. The TIE Phase-1 procedure was used to characterise the cause(s) of toxicity in the produced water effluents, using an untested tropical mysid.

The optimal laboratory conditions for culturing *Metamysidopsis insularis*, was a salinity of 25 to 30‰, temperature (25 to 27°C) and dissolved oxygen (7.0 mg/L). *Metamysidopsis insularis* reared in the laboratory were harvested daily (10 individuals per day) for a period of 26-days. The standard body length was used to determine the growth phases and moult cycles. Any distinguishing characteristics of these phases were recorded.

During the 26-day period, five major growth phases and eleven moults were identified. These growth phases were, early juveniles (days 0 – 1), juveniles (days 2 – 5), late juveniles (days 6 – 10), early adults (days 11 – 17) and adults (> 17 days old). The first moult occurred within 24h (day 0 – 1) of release from the brood pouch. The moulting activity continued at regular intervals until sexual maturity (day 11 – 17), after which it became infrequent. Distinguishing morphological features such as pleopods in males and reproductive structures in males and females became visible in the late juvenile phase.

Toxicity Identification Evaluations using juveniles (48h old at the beginning) were conducted to establish an acute (24h-LC50) toxicity test response for the whole produced water and its fractions. The TIE procedures involve various manipulations such as aeration, filtration, ethylenediaminetetraacetic acid (EDTA) addition, sodium thiosulphate addition, C<sub>18</sub> Solid Phase Extraction (SPE) procedure and graduated pH procedures. The whole effluent toxicity for the produced water effluents ranged from 5.9 to 12.3% (initial 24h-LC50) and 0.09 to 17.5% (baseline 24h-LC50). The whole effluent acute toxic-unit response (TUa) for all sites ranged from 8.1 to 17.0 TUa (initial toxicity test) and 5.7 to 1,111 TUa (baseline toxicity test).

The Phase-1 effluent toxicity characterisation procedures revealed that the primary cause of toxicity in all samples were nonpolar organic compounds and sulphides. Other potential toxicants identified were ammonia, volatile organic compounds, metals, particulate matter, oxidants and pH dependent toxicants. Whole effluent toxicity can also be due to ionic composition and the stable

oil-in-water emulsion, which consists of fine oil droplets ( $< 0.1 \mu\text{m}$  to  $10 \mu\text{m}$  with an average diameter of  $2.5 \mu\text{m}$ ).

These results show that the TIE procedure can be successfully applied to determining and characterizing the toxicity of effluents in the Caribbean using the indigenous mysid species *Metamysidopsis insularis* (Brattegard, 1970b).

**Key Words:** *Metamysidopsis insularis*, produced water, life cycle, toxicity identification evaluation, whole effluent toxicity, toxicity test