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VALIDATION OF THE TARGET LIPID MODEL FOR TOXICITY ASSESSMENT OF RESIDUAL PETROLEUM CONSTITUENTS: MONOCYCLIC AND POLYCYCLIC AROMATIC HYDROCARBONS

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Abstract—A method is presented for developing scientifically defensible, numeric guidelines for residual petroleum-related constituents, specifically monocyclic aromatic hydrocarbons (MAHs) and polycyclic aromatic hydrocarbons (PAHs), in the water column. The guidelines are equivalent to a HC5 (i.e., hazard concentration to 5% of the tested species, or the concentration that protects 95% of the tested species). The model of toxicity used in this evaluation is the target lipid model (TLM) that was developed for assessing the toxicity of type I narcotic chemicals. An acute to chronic ratio is used for chronic expression and sublethal effects. The TLM is evaluated by comparing predicted and observed toxicity of these petroleum components. The methodology is capable of predicting both the acute and chronic toxicity of MAHs and PAHs in single exposures and in mixtures. For acute exposures, the TLM was able to predict the toxicity to within a factor of three to five. The use of toxic units was an effective metric for expressing the toxicity of mixtures. Within the uncertainty bounds, the TLM correctly predicted where sublethal effects of edemas, hemorrhaging, and other abnormalities were observed to occur in early life-stage exposure to PAHs. The computed HC5s were lower than no-observed-effect concentrations based on growth, reproduction, and mortality endpoints and sublethal effects. The methodology presented can be used by the oil spill community to compare residual concentrations of PAHs against defensible, numeric guidelines to assess potential ecological impacts.

Keywords—Polycyclic aromatic hydrocarbons Target lipid model Model validation Petroleum toxicity Guidelines