

# **2005 Investigations into the Fraction-specific Toxicity of PHC in Soil: Evaluation of the Toxicity of Fraction F3 on the Exposure, Uptake and Toxicity of Individual and Binary Mixtures of CCME PHC Fractions**

A study investigating the toxicity and accumulation kinetics of individual and binary combinations of oil distillates, funded by the Canadian Association of Petroleum Producers (CAPP) and Imperial Oil Ltd., was initiated in 2002. The project was undertaken to investigate identified data gaps in our understanding of PHC ecotoxicity, as it relates to the distillate ranges of the Canada-wide Standard for Petroleum Hydrocarbons in Soils (PHC CWS) (CCME, 2001a). The project had three main objectives:

1. to investigate the ecotoxicity of two subfractions of Fraction 3 to selected biota to determine if the toxicity of Fraction 3 can be attributed to a smaller boiling point range;
2. to investigate the ecotoxicity of mixtures of the CCME distillates to earthworms to determine if their toxicity is additive; and
3. to explore and describe the uptake and elimination kinetics of the aliphatic and aromatic chemical class fractions of individual distillates and mixtures of distillates by earthworms.

This report summarizes the findings of these studies to date and supersede those contained in all previous reports and presentations. The results of this project are the basis of a doctoral thesis and future scientific publications. Should new information become available during the preparation of the thesis or publications, the interpretation of the results and conclusions discussed herein might change.

Crude oil and a clean reference soil similar to those used in other studies investigating the toxicity and behaviour of CCME oil distillates (ESG, 2003; Tindal, 2005) were used.

The soil was a fine-textured, clay-loam, black Chernozem with an organic matter content of 10%. It was free of pesticides and had acceptable metal levels. A low concentration of long-chain alkanes,

thought to be biogenic in origin, was found within the CCME Fraction 3 and 4 ranges.

Crude oil from the Federated Pipelines was provided by Environment Canada. This oil was fractionated into five boiling point distillates (Fraction 1 [ $>nC_5$ - $nC_{10}$ ], Fraction 2 [ $>nC_{10}$ - $nC_{16}$ ], Fraction 3a [ $>nC_{16}$ - $nC_{23}$ ], Fraction 3b [ $>nC_{23}$ - $nC_{34}$ ], and Fraction 4 [ $>nC_{34}$ ]) by Imperial Oil Ltd. using combined ASTM methods D2892 and D5236 (ASTM, 2002a; ASTM, 2002b), that produced fairly clean cuts (87% of each distillate was within the desired boiling point range). The one exception was Fraction 4 in which there was considerable overlap (40%) with Fraction 3b.

The distillates were characterized by the Emergency Science and Technology Division of Environment Canada (Ottawa, ON) and EnviroTest Laboratories (Edmonton, AB). They consisted primarily of aliphatic (80%) and aromatic (6-20%) compounds, with minor (<3%) amounts of N-containing heterocyclic and polar materials. Of the aromatic hydrocarbons identified by GC-MS, the majority were alkylated.

Stantec and UoWaterloo\_PHC Fraction 3 Phase 3 Presentation

2005 Stantec\_CCME F3 Binary Yr 2 Presentation

2006 Stantec and UoWaterloo\_F3 Report