

57. LABORATORY GENERATED BITUMEN FUMES UNDER STANDARDIZED CONDITIONS AND EMISSION LEVELS FOR VOC, SEMI-VOLATILE AND PARTICULATE PAH AND PASH: ION TRAP GC-MS ANALYTICAL METHOD DEVELOPMENT AND CLEAN-UP SCHEME

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Concern regarding the hazardous health effects from exposure to chemicals in bitumen fumes has been expressed and there is a great deal of interest for data on profile of individual compounds in the gas and particulate phases. The purpose of the study was to evaluate a method for the determination of volatile organic compounds (VOC), semi-volatile and particulate polycyclic aromatic compounds (PAH) and sulfur poly-heterocyclic (PASH) compounds in bitumen fumes. The methylated derivatives of PAH are of particular interest since many of them exhibit carcinogenic activities while the parent compound does not. Bitumen fumes were laboratory generated at 170°C using a fume generator with controlled characteristics. Sampling of bitumen fumes was carried out with XAD-2 Orbo tubes for the gas phase chemicals and semi-volatile PAH or PASH. Glass Fiber GF/B were used to sample the fumes aerosol particulates at a flow rate of 1.2 L/min. PAH profiles and PASH in bitumen fumes were determined by GC-MS further to a multi-step sample treatment and automatic clean-up procedure. The internal standard was added to 0.1 to 0.3 g of raw bitumen or bitumen fumes filter samples which were then extracted twice with 25 mL toluene by sonication for 10 min each. The reduced extract was partitioned between cyclohexane and dimethylformamide before elution on a SiO₂ micro column. The eluent was reduced and fractionated by HPLC. The PAH fraction of interest which also contained PASH was separated by capillary column GC-ion trap MS. Quantification was made relative to the respective calibration curves between compounds of interest and the internal standard. The semi-volatile SVP AH and SVPASH were determined by separate desorption of the two distinct parts of the XAD-2 by 5mL CS₂ and sonication for 30 min. Microliters of the combined filtered extract were then injected into a GC column and quantified by ion trap MS. Standard reference compounds were used for comparisons of respective spectra. The purified extract enables the determination of PAH profile from 2 to 7 rings including their methyl derivatives and 3 carcinogenic benzonaphthothiophene isomers. The reproducibility of the method was estimated by analyzing 6 bitumen replicates and is around the 30% overall uncertainty or less. In bitumen fumes generated at 170°C under standardized conditions, VOC and semi-volatile PAH were sampled with XAD-2 tubes and were also determined in six replicates. The VOCs are mainly monoaromatic derivatives (4% of fumes) and aliphatics essentially from C6 to C17 (27%). With regards to the particulate phase PAC, the coefficients of variation from 6 replicates are 5-24 % for PAH and 6-10% for PASH. Data on VOC and PASH represent new contribution in the characterization of bitumen fumes.

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