RELATIONSHIP BETWEEN COMPOSITION AND TOXICITY OF ENGINE EMISSION SAMPLES

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ABSTRACT

Differences in the lung toxicity and bacterial mutagenicity of samples from gasoline and diesel vehicle emissions were reported previously and have been published (Seagrave *et al*., *Toxicological Sciences* 70:212-226, 2002). Although the toxicity rankings provided important information, the ultimate goal was to determine the physical-chemical species responsible for the differences. The relationships between sample composition and toxicity have now been analyzed.

Filter and semi-volatile organic compound (SVOC) samples were collected from normal and high-emitter gasoline and diesel vehicles operated on chassis dynamometers on the Unified Driving Cycle. Seven vehicle-operating temperature conditions were tested. The composition of extracted filter and SVOC material was measured in detail. The filter and SVOC fractions were combined in their original mass collection ratios, and the toxicity of the seven samples was compared by instillation into rat lungs followed by measures of inflammation and tissue damage and by the Ames bacterial mutagenicity test. There was good coherence among multiple measured variables in ranking the samples and demonstrating a five-fold range in toxicity.

The relationship between chemical composition and toxicity was analyzed by principal component analysis (PCA) and projection to latent surfaces (PLS, also known as partial least squares). The stepwise PCA-PLS analysis revealed the chemical constituents co-varying most strongly with toxicity and gave predictions of relative toxicity with good accuracy. The results, which will be described in detail, suggest that selected, but not all, nitro-aromatic compounds most strongly influenced mutagenicity, and that organic compounds, especially particle-associated organics, most strongly influenced the lung inflammatory response.