COMPARATIVE TOXICITY OF COMBINED PARTICLE AND SEMI-VOLATILE ORGANIC FRACTIONS OF GASOLINE AND DIESEL ENGINES

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This study was conducted to: (1) evaluate a range of mutagenicity and lung toxicity parameters for testing collected emission samples and (2) compare the bacterial mutagenicity and non-cancer lung toxicity of combined particulate matter (PM) and semi-volatile organic compound (SVOC) fractions of emissions from normal- and high-emitting gasoline and diesel vehicles.

PM and SVOC samples were collected from in-use, light- and medium-duty vehicles, including: a composite group of five gasoline normal emitters; a composite group of three diesel current technology (1998-2000) normal emitters; and one each black smoker gasoline, white smoker gasoline, and high-emitting diesel. Vehicles were operated with fuel and crankcase oil "as received" on chassis dynamometers on the California Unified Driving Cycle. Both "normal emitter" groups were sampled while operating at either 72°F or 30°F. PM was collected on filters, and SVOC was collected in polyurethane foam/XAD resin traps.

Both fractions were extracted from collection media in solvent, sent to Lovelace Respiratory Research Institute for testing, recombined in their original collection ratios, and administered to the biological test systems in multiple doses. Bacterial (Ames) mutagenicity was tested using Salmonella strains TA98 and TA100 with and without metabolic activation. Rats were instilled intratracheally, and cellular and chemical constituents of lung washings and histopathology were evaluated at multiple doses and times after administration. The potencies of the samples were compared on the basis of the slopes of dose-response curves.

Most biological response parameters gave dose-response slopes that clearly demonstrated a range of potency among the samples. Mutagenic potency differed between the two bacterial strains, although they reflected similar general patterns of samples having greater and lesser potency. There was generally good agreement among the sample rankings indicated by multiple parameters reflecting cytotoxicity, inflammation, and lung tissue changes, allowing the selection of a more limited set of

parameters for future studies. The parameters selected for oxidative injury and macrophage function yielded little useful information.

Some important general conclusions could be drawn from the aggregate lung toxicity results: (1) the toxicity per unit PM+SVOC mass was similar for normal-emitting gasoline and diesel vehicles; (2) operating temperature did not appear to cause systematic differences in toxicity; (3) high-emitters not only emitted more mass, but the toxicity per unit of mass was also greater than that of normal-emitters.