

AN ASPHALT INHALATION EXPOSURE SYSTEM WITH FEEDBACK CONTROL. Travis Goldsmith*, Sam Stone, Ali Afshari, Seth Tomblin, Jeff Reynolds and Dave Frazer, Engineering & Controls Technology Branch, Health Effects Laboratory Division, National Institute for Occupational Safety and Health, 1095 Willowdale Rd., Morgantown, WV 26505.

A feedback system was developed to control the asphalt aerosol and gas (AG) produced by a generator purchased from Heritage Research Group to be used for small animal inhalation exposure studies. Up to three five gallon pails of hot performance grade asphalt (PG 64_22, Asphalt Materials, Inc.) were opened, inverted, placed in an oven, heated and collected in a holding tank. The contents were pumped into a heated kettle reservoir equipped with an ultrasonic level monitor. A computer controlled needle valve was used to regulate the flow of asphalt through a heated 1/2" pipe attached to the base of the kettle. Asphalt from the pipe was spread onto a tilted (1.3 degrees from horizontal) plate, 6" wide by 24" long, housed in a stainless steel chamber. A temperature gradient was maintained along the plate to mimic conditions encountered during a paving operation. An electronic scale measured the weight of the asphalt as it left the plate. Asphalt flow was calculated by examining the weight change over time. This signal was fed back to a computer which controlled a stepper motor that turned the needle valve governing the asphalt flow. Conditioned and filtered air was passed over the heated plate to "generate" AG. Additional diluent air could be introduced through a needle valve to decrease the AG concentration. The mixture of AG and air was then delivered into a small animal inhalation exposure chamber. Air sampling was conducted to determine aerosol concentration and particle size distribution in the exposure chamber. Light scattering measurements were compared to gravimetric measurements over the same time periods and a calibration factor was calculated to attain an estimate of mass concentration. The light scattering signal was used in a feedback loop to control a stepper motor which turned a valve regulating the diluent air and AG concentration. Thermocouples, heaters and temperature controllers were present in the oven, kettle, plate, and associated piping. Humidity and system pressures were also measured to determine their effects on AG generation. To isolate the system, the AG generator was enclosed in a separate ventilation chamber whose exhaust was passed through active charcoal and HEPA filters.

A software virtual instrument was designed for data acquisition and control during exposures and testing. The graphical user interface enabled visual examination of environmental conditions and allowed parameter modification. Custom PD control laws were implemented in the software to control the stepper motors which governed asphalt flow and exposure chamber concentration.

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Abstracts



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