B122 Carbon Disulfide vs. Dichloromethane for Use of Desorbing Ignitable Liquid Residues From Activated Charcoal Strips

Gretchen D. Hicks, BS, BA, Maine State Police Crime Laboratory, 26 Hospital Street, Augusta, ME; Alyson R. Pontbriand, University of Maine - Farmington, Main Street, Farmington, ME; and Jillian M. Adams, BscH, Maine State Police Crime Laboratory, 26 Hospital Street, Augusta, ME*

After attending this presentation, the participant will understand the advantages and disadvantages of using dichloromethane instead of carbon disulfide for desorption of activated charcoal strips in fire debris analysis.

Passive diffusion headspace extraction is a widely used method for extracting ignitable liquid residues from fire debris utilizing activated charcoal strips. This procedure requires a solvent to remove the ignitable liquid residues from the activated charcoal in order to conduct the necessary instrumental analysis. A suitable solvent is one in which the organic compounds commonly identified in ignitable liquids would be readily soluble. The solvent would also have sufficient ability to bind to the adsorption sites of the charcoal, thereby desorbing the ignitable liquid residues from the charcoal.

In forensic fire debris analysis, carbon disulfide is generally used for desorbing the activated charcoal strips due to the strong adsorption of the solvent to the charcoal. However, the health and safety risks associated with carbon disulfide make it undesirable for daily use. The effect of carbon disulfide on the reproductive systems of both males and females is a significant concern. The explosive nature of carbon disulfide and consequently the long-term storage of the solvent are also considerable issues. Therefore, other solvents should be explored to determine if one exists which would provide the same level of desorption without the safety hazards.

A carbon disulfide substitute would be a comparable non-polar solvent with solubility characteristics similar to that of carbon disulfide. The substitute would also effectively bind to the charcoal desorbing ignitable liquid residues from the strips. A significant aspect of forensic fire debris analysis is pattern recognition and comparison of all components in the product and also the various classes of compounds which make up the ignitable liquid. These classes include: alkanes, aromatics, isoparaffins, cycloparaffins, and naphthalenes. The substitute solvent would perform without selective preference for specific functional groups or molecular weight. The substitute would also be relatively safe to handle and be exposed to on a daily basis. Finally, the substitute would be priced so as to be financially feasible to purchase in large quantities.

Dichloromethane is a non-polar solvent widely used for desorbing organic compounds from charcoal strips or tubes in a variety of fields, including environmental analysis laboratories identifying petroleum products. A number of Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) methods have been identified which utilize dichloromethane as opposed to carbon disulfide. However, there appears to have been little or no work presented or published regarding the use of dichloromethane in the field of forensic fire debris analysis. Dichloromethane is comparably priced. Finally, dichloromethane does not carry the same level of health risk given the exposure limits of the solvent, however it is a suspected carcinogen. Dichloromethane is also an easier solvent to store, since it does not present an explosion hazard. Although safe laboratory practice minimizes exposure to solvents during the extraction procedure, clearly the safest appropriate solvent is preferred.

Dichloromethane should be considered as a possible substitute for carbon disulfide in passive diffusion headspace analysis of fire debris samples. Valuable information can be obtained from a comparison of the total ion chromatograms and extracted ion chromatograms of ignitable liquid samples eluted with dichloromethane and carbon disulfide. Calculating percent recovery of the various classes of chemical compounds would assist in an understanding of preferential desorption, if any exists, of both solvents. By examining both sets of data and taking into consideration the health and safety risks involved with both solvents, a laboratory would be able to make a decision as to the applicability of dichloromethane to forensic fire debris analysis.

Approximately ten commercially available products and two laboratory created standards were extracted using activated charcoal strips and normal passive diffusion headspace extraction procedures. Some of the strips were eluted with carbon disulfide and a portion eluted with dichloromethane. The results were then compared. With some limitations, dichloromethane appears to give comparable results to those of carbon disulfide.

Fire Debris Analysis, Adsorption, Dichloromethane

 ** Presenting Author*