B101 Forensic Identification of Vehicle Fluids

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The attendees will learn what different fluids are found in a vehicle and their respective function. They will understand their chemical characteristics and the proper manner to identify them through chemical analysis.

On some occasions, forensic laboratories are requested to identify a fluid extracted from a vehicle. This situation is often encountered when a mechanical failure resulting in an accident or a fire may involve the contamination of a given fluid. Presently, there are multiple tests and methods developed to analyze and check the physical properties of different automotive fluids, but there is a lack of available literature regarding the chemical composition and characteristics of these fluids. Therefore, there is a need to develop an analytical scheme, using common instrumentation that will allow the forensic chemist to identify correctly an unknown fluid. Furthermore, it is also important to create a database of the different chemical properties of the fluids that may be useful to other forensic laboratories.

Various neat samples of engine coolants (EC), engine oils (EO), automatic transmission fluids (ATF), gear lubricants (GL), brake fluids (BF), power steering fluids (PSF), and washer fluids (WF), were obtained through automotive shops. First, a differentiation and classification on the visual inspection was performed and colors recorded. Second, gas chromatography-mass spectrometry (GC-MS) was used to analyze these samples. One percent solutions of each fluid were prepared in diethyl ether. Analyses were performed on a HewlettPackard 6890-5973 GC-MS with a column HP 5 (30 m, 0.25 mm, 1.0 um). The instrumentation used for this analysis is very similar to the one used for fire debris analysis and may, therefore, be accomplished by the same scientist with few changes. Third, Fourier transformation infrared analysis of neat fluids using a diamond cell was carried out. Finally, fluids were mixed by pair and the miscibility recorded. Analysis of fluids coming from a mixture was also done in order to check if their chemical properties were changed.

ATF are usually of a red color, EC are usually green and WF show different colors such as blue or pink. BF, GL, BF, and EO are more difficult to differentiate due the fact that they present a similar yellow tint. GC-MS of the different samples show that BF is mainly composed of glycols and alcohols from 120 amu. EC contains mainly ethylene, diethylene and/or propylene glycols while WF usually does not show any compounds besides methanol in some samples. ATF, PSF, GL, and EC are mixtures extracted from petroleum distillates and, therefore, show a wide range of hydrocarbon compounds usually starting around C18.

Different automotive fluids were collected and analyzed and their chemical characteristics recorded. It was possible to develop an analytical scheme that allows the clear discrimination and identification of vehicle fluids. This scheme includes three main steps: visual examination, GC-MS, and FTIR. Mixtures of these fluids have also been investigated and it has been shown that despite some interfering phenomena, it is still possible to identify the proper fluids.

GC-MS, Vehicle Fluids, Oils