

Detailed Sensitive Detection of Impurities in Waste Engine Oils Using Laser Induced Breakdown Spectroscopy, Rotating Disk Electrode Optical Emission Spectroscopy and Surface Plasmon Resonance

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Abstract : The laser based high resolution spectroscopic experimental techniques such as Laser Induced Breakdown Spectroscopy (LIBS), Rotating Disk Electrode Optical Emission spectroscopy (RDE-OES) and Surface Plasmon Resonance (SPR) have been used for the study of composition and degradation analysis of used engine oils. Engine oils are mainly composed of aliphatic and aromatics compounds and its soot contains hazardous components in the form of fine, coarse and ultrafine particles consisting of wear metal elements. Such coarse particulates matter (PM) and toxic elements are extremely dangerous for human health that can cause respiratory and genetic disorder in humans. The combustible soot from thermal power plants, industry, aircrafts, ships and vehicles can lead to the environmental and climate destabilization. It contributes towards global pollution for land, water, air and global warming for environment. The detection of such toxicants in the form of elemental analysis is a very serious issue for the waste material management of various organic, inorganic hydrocarbons and radioactive waste elements. In view of such important points, the current study on used engine oils was performed. The fundamental characterization of engine oils was conducted by measuring water content and kinematic viscosity test that proves the crude analysis of the degradation of used engine oils samples. The microscopic quantitative and qualitative analysis was presented by RDE-OES technique which confirms the presence of elemental impurities of Pb, Al, Cu, Si, Fe, Cr, Na and Ba lines for used waste engine oil samples in few ppm. The presence of such elemental impurities was confirmed by LIBS spectral analysis at various transition levels of atomic line. The recorded transition line of Pb confirms the maximum degradation which was found in used engine oil sample no. 3 and 4. Apart from the basic tests, the calculations for dielectric constants and refractive index of the engine oils were performed via SPR analysis.

Keywords : surface plasmon resonance, laser-induced breakdown spectroscopy, ICCD spectrometer, engine oil

Conference Title : ICOLS 2018 : International Conference on Optics, Lasers and Spectroscopy

Conference Location : Paris, France

Conference Dates : November 08-09, 2018