ABSTRACT

Background: The atmosphere has become a major transport corridor for free radicals and particulate matter from combustion events. The motivation behind this study was to determine the nature of particulate emissions and surface bound radicals formed during the thermal degradation of diesel blends in order to assess the health and environmental hazards of binary transport fuels.

Methodology: Accordingly, this contribution explored the interactions that occur when Croton megalocarpus biodiesel and fossil diesel in the ratio of 1:1 by weight were co-pyrolyzed in a quartz reactor at a residence time of 0.5 s under an inert flow of nitrogen at 600 °C. The surface morphology of the thermal char formed were imaged using a Feld emission gun scanning electron microscope (FEG SEM) while Electron paramagnetic resonance spectrometer (EPR) was used to explore the presence of free radicals on the surface of thermal char. Molecular functional groups adsorbed on the surface of thermal char were explored using Fourier transform infrared spectroscopy (FTIR).

Results: FTIR spectrum showed that the major functional groups on the surface of the char were basically aromatic and some methylene groups. The particulate emissions detected in this work were ultrafine (~ 32 nm). The particulates are consistent with the SEM images observed in this study. Electron paramagnetic resonance results gave a g-value of 2.0027 characteristic of carbon-based radicals of aromatic nature. Spectral peak-to-peak width (ΔHp-p) obtained was narrow (4.42 G).

Conclusions: The free radicals identified as carbon-based are medically notorious and may be transported by various sizes of particulate matter on to the surface of the human lung which may trigger cancer and pulmonary diseases. The nanoparticulates determined in this work can precipitate severe biological health problems among humans and other natural ecosystems.

Keywords: Biodiesel; Co-pyrolysis; Free radicals; Nanoparticulates.