Coal combustion in a domestic device: Spectrometric characterization of fly ashes

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Coal continues to be the major energy source not only in developing countries such as China and India but also in coal producing countries in the European Union. These countries often suffer from severe air pollution due to coal consumption (Wang et al., 2012). Coal combustion is a major source of ambient particulate matter (PM) pollution. Particles thus emitted affect significantly to health, including cardiovascular disease, respiratory illnesses, and acute respiratory infection (Gasparotto and Da Boit Martinello, 2021).

Despite industries has often dust control systems, it is not the case for residential coal devices. The characterization of particles from coal combustion is helpful for developing its control policy and evaluating its contributions to environmental issues. León (NW Spain) continues to be one of the Spanish provinces with the highest consumption of mineral coal in domestic installations (heating and kitchens) due to its past as a producer of this fuel (Blanco-Alegre et al., 2022).

Coal fly ashes are generated in large amounts worldwide (González et al., 2009) in combustion processes. The composition of the particles produced by this process is not easily characterized since they are generally complex chemical mixtures.

This study focuses on combustion experiments designed to mimic realistic household coal burning practices. Mineral coal was acquired from local suppliers and burned in a stand-alone cast-iron stove, traditionally used in NW Spain. In order to initiate the combustion, small wood chips and newspaper sheets were used. After combustion, fly ashes were collected from the top of the stove and from the walls of the stove and the chimney.

Vibrational spectroscopies (FT-IR and Raman), Energy Dispersive X-ray spectroscopy and Scanning Electron Microscopy (SEM-EDX) have been used to chemically and morphologically characterize the fly ashes obtained in the controlled burning of mineral coal.

Figure 1 shows Raman spectra from one of the samples. Two main peaks at 1325 and 1600 cm^{-1}, attributed to a carbonaceous matrix, have been identified. This spectrometry is very sensitive to the unburned carbon in coal ash and can be detected even if fluorescence is present.

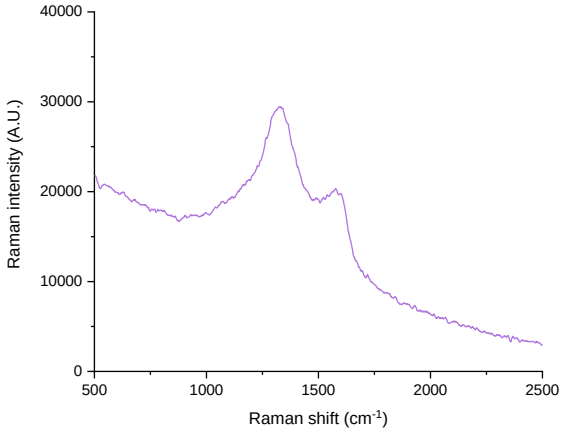

Figure 1: Raman spectra of one of the samples of fly ashes from coal combustion.

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