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Size distribution of ultrafine particles from residential fixed-bed coal combustion

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Ultrafine particles of small mean diameter released from domestic coal combustion is an important parameter to consider as it affects air quality, climate modeling and health. It is suggested that poor combustion conditions releases particles of different sizes enriched with health damaging chemicals such as polycyclic aromatic hydrocarbons. Information on fixed-bed domestic coal combustion char or soot Particle Size Distribution (PSD) is limited, with many studies reporting on wood combustion. This study was aimed to investigate the influence of coal combustion phases (ignition, flaming and coking) on particle size distribution of ultrafine particles. Experiments were carried out using the reduced smoke top-lit updraft method. The tests were carried out in a laboratory controlled environment and repeated three times to ensure reproducibility of the data at each combustion phase. Particulate matter was monitored using a NanoScan Scanning Mobility Particle Sizer (SMPS). Particles from the Top-Lit Updraft (TLUD) showed an ultrafine geometric mean diameter centered at approximately 110±3.7 nm for the ignition phase, 55±2.9 nm for the pyrolysis/flaming phase and 33±3.9 nm for the transition phase. The particle mode diameter rapidly increased during the ignition phase (145±2.2 nm) and gradually decreased during the flaming phase (35±1.3 nm) and the transition phase (31±1.5 nm). This study shows that during smouldering combustion conditions (ignition): Particle diameter increases, while as temperature increase the particle size decreases. The information is essential in estimating particle lung deposition and radiation forcing efficiency.

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