CONTROLLED ATMOSPHERE PYROLYSIS APPARATUS II (CAPA II):

A new tool for analysis of pyrolysis of charring polymers

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A new gasification apparatus has been developed to enable a comprehensive analysis of pyrolysis of charring and intumescent materials. This apparatus provides well defined boundary conditions and highly resolved measurements of mass, temperature and geometric dimensions of a disk-shaped 0.07 m diameter material sample. The oxygen concentration in the pyrolysis zone can be reduced below 1 vol.% to ensure that the measurements are free of oxidation effects. The radiation from an external conical heater has been carefully characterized to account for changes in the sample surface position, including its angular orientation. Using an empirical expression, this radiation can be predicted with less than 2% error based on the known surface position and heat flux set point. The NIST Fire Dynamics Simulator employed in the direct numerical simulation mode was utilized to investigate convective losses from the sample surfaces. The heat transfer coefficient computed for the top surface was found to be dependent on the surface position; its space-averaged value was validated against experimental measurements. The mass, temperature and shape of the sample are measured simultaneously as a function of time using a high accuracy balance (1 mg resolution), an infrared camera focused on the bottom sample surface and a high definition camcorder providing a side view of the sample, respectively. The new apparatus is shown to provide repeatable data necessary for modeling of transport processes inside pyrolyzing solids.