RAPID DEVOLATILIZATION AND HYDROGASIFICATION OF BITUMINOUS COAL.

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Rapid devolatilization and hydrogasification of a Pittsburgh Seam bituminous coal were studied and an approximate coal conversion (weight loss) model was developed that accounts for secondary char-forming reactions among volatiles. Approximately monolayer samples of small coal particles supported on wire mesh heating elements were electrically heated in hydrogen and hydrogen/helium mixtures. Coal weight loss was measured as a function of residence time (0.05-20 sec.), temperature (400-1100°C), heating rate ($10^2$ - $10^4$ °C/sec.), total pressure (0.001 - 100 atm), hydrogen partial pressure (0 - 100 atm), and particle size 50 - 1000μm). Rate of weight loss under these conditions appears to be controlled by thermal decomposition reactions that form volatiles and initiate a sequence of secondary reactions leading to char. Thermal decomposition is modelled as a large number of parallel first-order reactions having a statistical distribution of activation energies (20-89 kcal/mole). The contribution of secondary reactions to weight loss is described by a selectivity expression derived from the assumption that char formation by these reactions competes with hydrogenation reactions and diffusional escape of volatiles from the particle.