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TITLE: A Novel Concept for High Conversion of Coal to Liquids

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OBJECTIVE: The overall objective of this work is to demonstrate conversion of coal to produce at least 70% by weight of the coal as liquids, with ratios of liquids to gases in excess of 10/1, resulting in low hydrogen consumption and a significant reduction in the cost of producing liquid hydrocarbon fuels from coal. Utilizing a small continuous-flow reactor designed and constructed for this research, the maximum ratio of liquids to gases will be defined, operating at short residence times of a few seconds, at the same time converting more than 70% of the carbon in the coal to liquids. The practical ability to attain coal particle centerline temperatures of 500 °C in one second or less, using hot hydrogen gas in turbulent flow, will be investigated. Particle heat-up rates for a few selected system pressures and particle sizes will be evaluated. Catalysts will be screened and selected for sufficient activity and selectivity to achieve the desired yields, with potential for operation within satisfactory economic boundaries as to cost, recoverability and regeneration.

ACCOMPLISHMENTS AND CONCLUSIONS: A continuous-flow reactor has been constructed, and following a few modifications now yields reproducible data. Catalyst is applied to the coal via impregnation, followed by drying to remove the solvent. Coal, with catalyst applied, is fed from a pressurized hopper, metered through a star feeder, and is fed to the reactor in a hot stream of hydrogen. Residence time in the reactor is controlled by the gas velocity. To achieve high conversions with limited time for liquids in the hot zone, a multipass concept is being investigated. Utilizing Catalyst A, the first pass yielded 55% conversion, with a ratio of liquids to HC gases of 8.5/1.0. Following removal of liquids from the solids, the solids were again impregnated with catalyst and passed a second time through the reactor. This pass yielded a conversion of 34% of the solids to the second pass, with ratio liquids/HC gases of 16.9/1.0. When the two passes are combined, the overall conversion is 72%, with ratio liquids/HC gases of 9.8/1.0.

Utilizing catalyst B, an inexpensive catalyst with throwaway potential, the first pass yielded 45% conversion, with ratio liquids/HC gases of 8.3/1.0. At this writing, the data from the second pass are not yet available. A bearing problem developed in the star feeder.

PLANS: Parameters are being adjusted, particularly temperature and residence time, and several additional catalysts are to be investigated.