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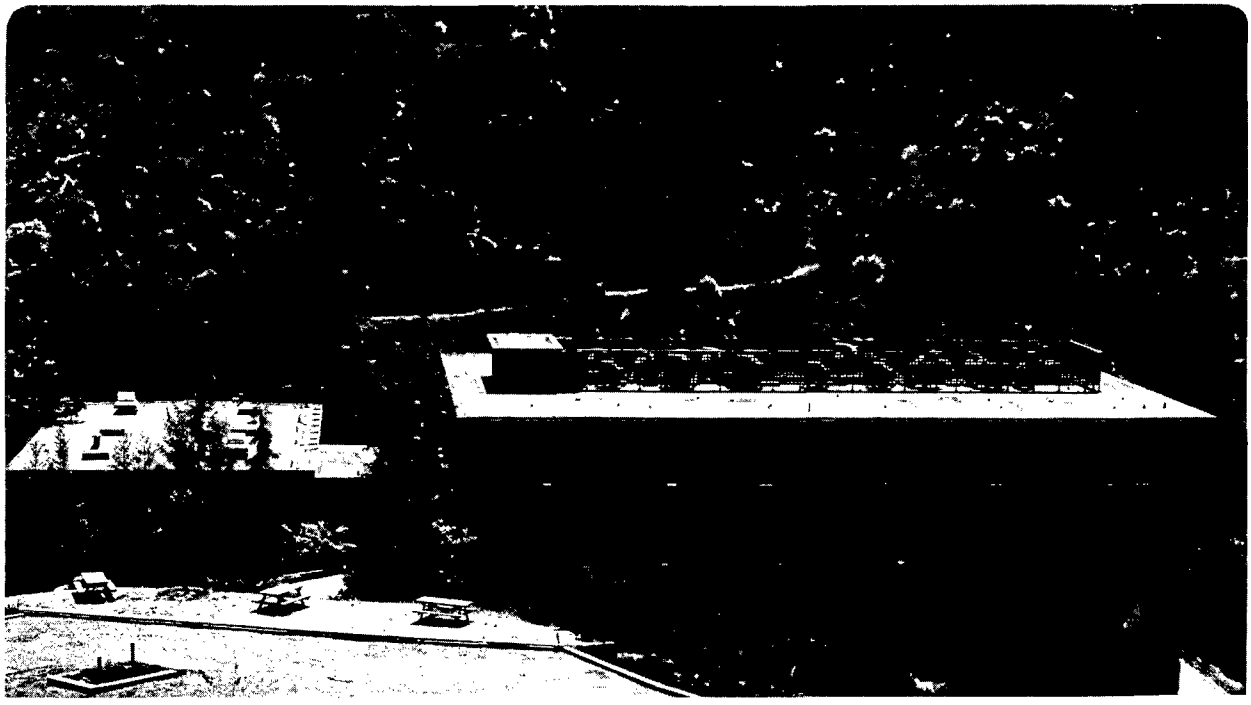

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FIRST QUARTERLY SUMMARY REPORT

October 1 - December 31, 1979

CHEMISTRY AND MORPHOLOGY OF COAL LIQUEFACTION

Principal Investigator: Heinz Heinemann

Lawrence Berkeley Laboratory, Bldg. 62

University of California

Berkeley, Ca. 94720

TASK 1: Selective Synthesis of Gasoline Range Compounds from Synthesis Gas

Task Manager: A. T. Bell

Mr. Ron Dictor (Ph.D. Candidate) and Mr. William Cannella (M.S. Candidate) have been selected to work on the indicated project. Since joining the project two months ago, these students have spent their time becoming familiar with Fischer-Tropsch synthesis and developing plans for the research as well as assembling equipment.

Mr. Cannella's efforts will be directed at evaluating the performance of iron and ruthenium catalysts prepared on different supports using a variety of preparative techniques. Catalyst testing will be conducted initially in a fixed bed reactor, but eventually it is planned to use a high-pressure slurry reactor. At present, components are being ordered for the construction of a high-pressure gas manifold and product collection system. It is planned that gaseous products will be analyzed by on-line gas chromatography. The liquid products will be collected and analyzed periodically, also by gas chromatography.

The purpose of Mr. Dictor's research will be to establish the influence of mass transfer on the activity and selectivity of Fischer-Tropsch catalysts. This effort will focus on mass transfer occurring both within catalyst particles as well as through the liquid film which surrounds a particle at high reactant conversion. The catalyst to be used in these studies will consist of a flat plate coated on one side by a thin porous layer of alumina. The catalyst metal will be impregnated into the porous layer. To simulate the presence of a liquid on the catalyst surface, it is proposed to create a thin film of oil on the surface of the plate. The liquid for this film will be supplied externally and moved over the catalyst surface gravity flow. Experiments will be performed to establish the influences of liquid film flow rate and thickness on the catalyst activity and selectivity. By spiking the liquid with product olefins, it will also be possible to explore the influence of the liquid film on secondary reactions. The effects of internal mass transfer limits will be explored by varying the thickness and porosity of the porous layer containing the catalyst metal.

TASK 2: Cancelled

TASK 3: Electron Microscope Studies of Coal During Hydrogenation

Task Manager: J. W. Evans and J. A. Little

The study of the chemistry and morphology of coal liquefaction will proceed via the joint observation of the morphological changes occurring during coal gasification and the simultaneous measurement of kinetic data by the measurement of the product gases of the reaction using a mass spectrometer system.

The morphological data will be obtained using an envioromental cell in the Hitachi 650kV electron microscope. This cell allows the introduction of various atmospheres into the sample environment at varying pressures and also allows a range of temperatures between room temperature and approximately 1000°C depending on the atmosphere. The gas analysis will be made using a residual gas analyzer attached to a vacuum system and thus acting like a mass spectrometer (Fig. 1). This instrument is due to arrive in January.

Preliminary investigations will investigate the reactions of graphite with carbon dioxide and the initial morphology of graphite has now been characterized (Fig. 2). Preliminary work has also been done on anthracite. Work in the presence of hydrogen and of steam at different pressures and temperatures is planned. The influence of catalysts may also be studied and as can be seen in Fig. 3, the catalyst particles (here zinc) can be easily observed and thus, changes in their shape and that of the substrate can be measured during the course of the reaction, while products can be analysed. The zinc particles were put onto the graphite by dipping the sample into an ultrasonically agitated mixture of fine zinc particles in acetone and quickly withdrawing it - a procedure which has been used previously to investigate the catalytic effects of zinc upon graphite.

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