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NOVEL PROCESS FOR DEPOLYMERIZATION
OF COAL TO C₂-C₄ HYDROCARBONS

Progress Report No. 3
(Covering the period March 1, 1990 - May 31, 1990)

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PERSONNEL

In addition to the Principal Investigators, research personnel participating in this project during the reporting period are:

Mr. Annapragada Rao, Graduate Student

Dr. Ke Shieng Yang, Part time Post Doctoral

OBJECTIVES AND SCOPE OF THE RESEARCH PROJECT

An envelope of parameter values has been experimentally identified in our laboratory, heretofore unexplored, for the catalytic depolymerization of coal which leads to yields of C_2-C_4 hydrocarbons in excess of 50 weight percent of the coal, in a direct, single stage process under mild conditions. The chemistry observed is fundamentally different from all previous coal conversion processes reported in the literature, requiring

reactor system embodying several new features never incorporated into a coal reactor system. The recycle liquid solvent will be characterized, and is expected to constitute a super-critical phase under conditions of temperature and pressure imposed by the chemistry of the system. Using a special reactor incorporating windows for visual observation, the operation of a catalyst bed fluidized by super-critical, coal-derived fluids will be examined. The capability of such a super-critical, coal-derived fluid to control agglomeration of a strongly caking coal, in the catalyst bed, will be evaluated, and satisfactory control developed. Solvent upgrading of the recycled liquids will be applied as may be required. Finally, a continuous reactor system will be designed, constructed and operated, based upon the information obtained from the experiments identified herein, as well as from a companion research project, coupled with our extensive experience and knowledge with related systems, as well as information to be found in the current literature.

ACTIVITY FOR THE REPORTING PERIOD

An order has been placed with a Salt Lake City engineering firm for construction of the reactor system mentioned in the previous report. The design engineer is the same person who designed and fabricated a similar reactor for us 19 years ago. We have conducted discussions with him concerning the specific experiments we wish to perform in the reactor. Modifications to the reactor design have been minimal.

The ultimate objective of this research program is to design, construct and operate a reactor configuration which will serve as a prototype for scale-up, if the technology proves to be successful and if the preliminary economic projections are favorable. As part of the preparations for that design, two reactor concepts are being evaluated in another research project in our department, one a single-stage reactor and the second a two-stage reactor. Both reactor configurations involve fundamental scientific studies and engineering design. The project involving those fundamental studies was initiated one year ahead of this project, with the intent that the fundamental scientific and engineering data will help to form the basis for the design of the prototype reactor.

Additional information will be required for the prototype design, not yet available either from the literature or from the results to be obtained in our fundamental studies project. That needed information involves the behavior of a strongly-caking coal, heated to a temperature above its softening temperature (above about 375 °C) as a slurry in a coal-derived solvent which may normally exhibit hydrogen-donor capability while in the liquid state, but which solvent will be at a temperature above its critical temperature at reactor conditions. Answers must be obtained to two important questions, namely (1) how will the supercritical fluid perform as the continuous medium in fluidizing the bed

of coal, or coal and catalyst? and (2) how effectively will the supercritical fluid, as here identified, control agglomeration of the caking coal particles, to permit fluidization of the bed of coal, or coal and catalyst? The addition of the windows in the top of the reactor now being fabricated is to permit us to visually observe what is occurring in the reactor. These visual observations will be combined with measurements of pressure drop across the bed, and other operational factors affecting the behavior of the system. A fiber optic system is to be installed, to permit remote visual observation through the quartz glass windows in a safe manner.

It is expected that the reactor with windows will be delivered to us during the next reporting period.

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