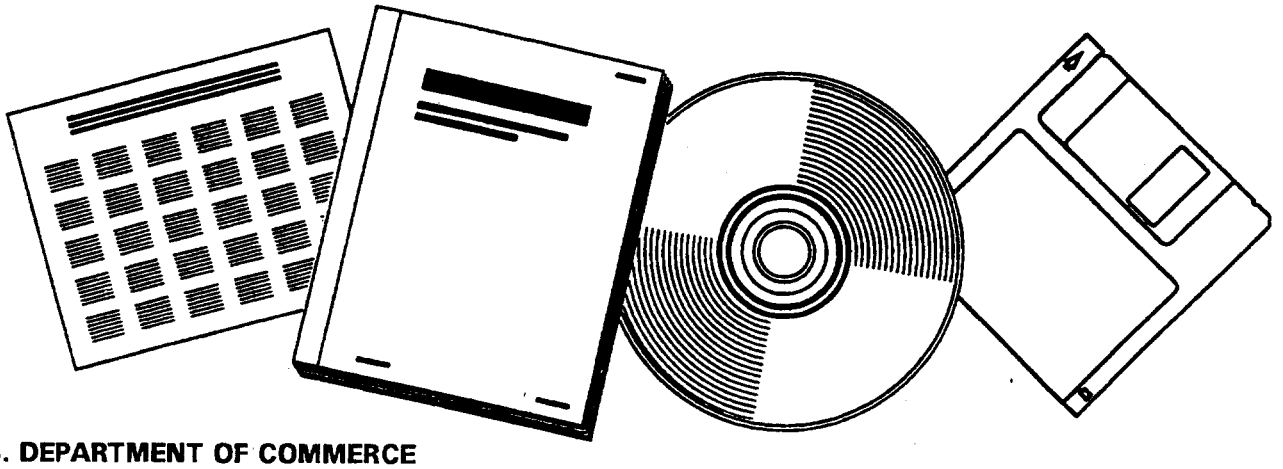
LIQUID-PHASE METHANOL. FINAL REPORT

CHEM SYSTEMS, INC.
FAIRFIELD, NJ

DEC 1979



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ABSTRACT

This report is the final report in the RP317 series. This project dealt with the development of the Liquid-Phase Methanol Reactor. The concept of this reactor involves carrying out the synthesis of methanol in an ebullated bed of catalyst in the presence of an inert liquid heat carrier. Work was carried out on laboratory, continuous bench-scale, and a process development unit.

Previous reports on this project included AF202 and AF693.

EPRI PERSPECTIVE

PROJECT DESCRIPTION

This is the final comprehensive report in a series of reports, including EPRI Annual Report AF-202 and EPRI Interim Report AF-693, that have been published under EPRI Research Project (RP) 317. This project involved bench-scale and process development unit (PDU) testing of a new liquid-phase reactor, conceived by Chem Systems Incorporated for producing methanol from synthesis gas. Data were collected at two levels of reactor size to determine scale-up effects in a liquid-phase ebullated catalyst bed. Compositions of synthesis gas (a mixture of carbon monoxide and hydrogen) that closely simulated gases which would be obtained from either a Koppers-Totzek or a Lurgi coal gasifier were tested. An ebullated-bed reactor has the advantage that it allows for the operation of an isothermal reactor with the heat of reaction being removed essentially by an inert oil, thereby reducing the quantity of recycle gas required for reactor cooling. For this reason and others, the technology proposed by Chem Systems, while still at a developmental stage, has some potential for improvements over the commercially available methanol synthesis processes.

PROJECT OBJECTIVE

The underlying objective is to develop lower cost technology by which methanol can be produced from coal gasification products. The technology for converting synthesis gas derived from natural gas to methanol has been highly developed commercially. Processes licensed by Lurgi and Imperial Chemical Industries (ICI) have dominated the field in recent years. In the production of methanol from coal, the actual preparation of methanol from synthesis gas represents less than 10% of the total plant investment.

However, the Chem Systems reactor has the potential for energy savings as well as capital savings. This process is also of particular interest to the electric utilities because methanol has excellent combustion properties and because it is conceptionally possible to integrate this process to co-produce some amount of clean peaking fuel with a gasification-combined-cycle for electric power generation.

EPRI has helped support a large-scale combustion turbine test at Southern California Edison Company to demonstrate the use of fuel (RP990-1). EPRI has also conducted several engineering evaluations regarding methanol production (e.g., RP1715, RP832-1, and RP832-3). The Chem Systems' reactor is the only major experimental effort supported by EPRI to improve methanol fuel production economics. Lehigh University (RP779-12) performed some catalyst deactivation analyses in support of the development.

PROJECT RESULTS

The project was divided sequentially into two parts. The first part, reported in EPRI AF-202, demonstrated the basic process concept without particular concern to catalyst life. In the second part of the program, an attempt was made to develop a catalyst that would be suitable for the process and to test that catalyst in a process development unit producing about one gallon of methanol per hour. Here problems were encountered. Attempts to produce an active, attrition-resistant catalyst were not completely successful. This work has been reported in EPRI Interim Report AF-693. The best catalyst formulation available was 3/32-inch mini-tablets. A 30-day side-by-side test run was conducted using both the bench-scale and process development units. These results discussed in this report showed not only a catalyst attrition problem but also a catalyst deactivation problem.

This problem has shown that methanol from coal-derived synthesis gas can be produced via Chem Systems' process. However, development of an abrasion-resistant, active, low-cost catalyst still remains one of the unsolved problems. In an effort to develop such a catalyst, EPRI has contracted with United Catalyst (RP1656). That work should be completed by mid-1980. Other suggestions have been made to circumvent the catalyst attrition problem. The most significant one is to revert to a slurry catalyst system in place of the particulate catalyst system. Still, additional research is needed to resolve the catalyst deactivation problem.

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