



Catalysts for hydrotreating solvent refined coal (SRC-II)
by Ronald James Ramer

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Chemical Engineering
Montana State University
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Abstract:

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Ronald J. Ramon

Date

August 3, 1979

Patent Applied For.

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by

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A thesis submitted in partial fulfillment
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Bozeman, Montana

August, 1979

ACKNOWLEDGMENTS

The author wishes to thank the staff of the Chemical Engineering Department at Montana State University for their help and encouragement. Dr. Lloyd Berg, Dr. F.P. McCandless, and Angong Yeh have been particularly helpful with this research. Mr. Yeh fabricated the MSU type catalysts tested by the author.

The author would like to extend his thanks to the United States Department of Energy for their financial support.

A special thanks goes to Lyman Fellows and Jim Tillery for their assistance in the maintenance of the author's equipment.

Appreciation is extended to Joan Kessner, John Brown, and Sandy Hines with special thanks to Ron Novich and Bill Sampson for much of the analytical work done.

Finally, a special thanks goes to the author's wife, Janet, for her help with this research.

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ABSTRACT

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INTRODUCTION

As the United States heads toward the twenty-first century, its demand for energy grows (1). As crude oil supplies decrease while prices increase, alternate sources of power become more and more lucrative (2). As the existing proposed solutions to this problem are studied, coal seems to be the most promising, immediate, solution.

It is estimated that coal accounts for about 80 percent of the total energy from oil, coal, and gas in the United States (1). Much of this coal would be relatively easy to obtain, as it lies in relatively thick beds under less than 1000 feet of overburden (3). Because the transportation system of the United States is almost exclusively dependent on liquid fuels, converting coal to a liquid fuel becomes most favorable (4,5).

Coal liquefaction processes are being looked into: Solvent Refined Coal (SRC), Exxon Donor Solvent (EDS), H-Coal, and Synthoil are a few examples. But, in the United States, each of these is merely in the development stage. Coal processes require large capital investment, abundant water, and have environmental and social problems (6). Along with these problems, coal is not of consistent

composition ranging from sub-bituminous and bituminous, to anthracite. Therefore, a strong energy policy must be taken now, otherwise coal liquefaction processes will not be economically competitive by the year 2000(7)!

This research is an attempt to upgrade the tar-like material obtained from the modified PAMCO SRC process, (SRC-II). The SRC-II is catalytically hydrotreated to remove unfavorable heteroatomic molecules (sulfur and nitrogen specifically) and improve the overall product. The reasons for the removal is to prevent catalyst poisoning in further refining steps and to reduce pollution effects of any final fuel made from the SRC-II.

BACKGROUND

SRC Process

Of importance to this work is the SRC process operated by Pittsburg and Midway Coal Mining Company. A 50 ton per day pilot plant is operated at Fort Lewis, Washington. Figure 1 shows a schematic diagram of the SRC-I process (8).

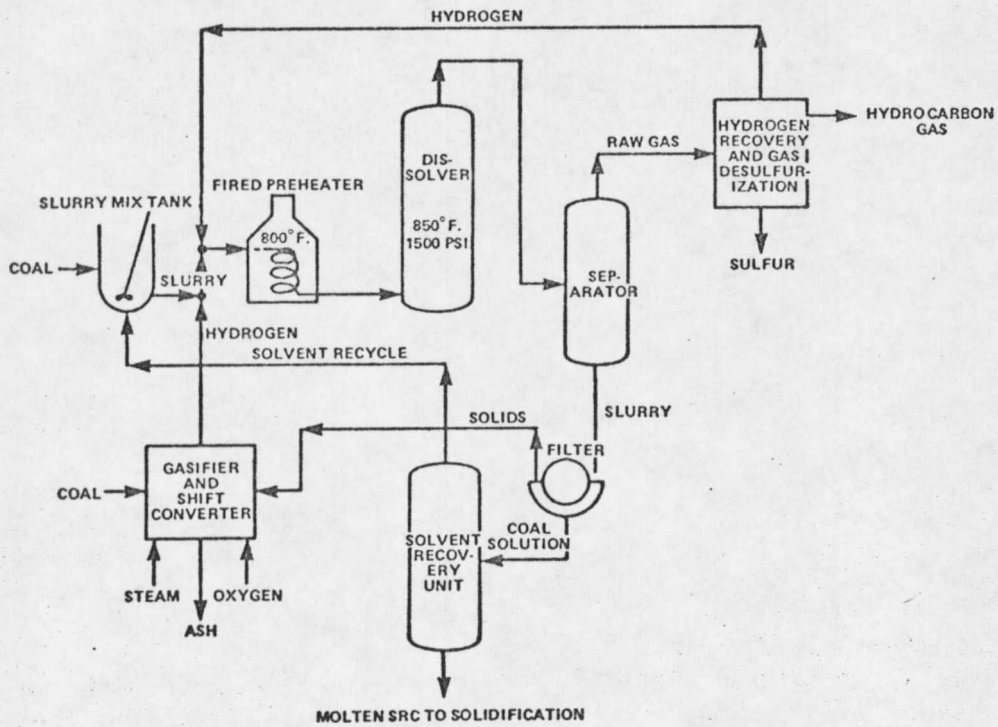


FIGURE 1. SRC-I PROCESS SCHEMATIC

The coal (Kentucky # 9) is pulverized and mixed with process-derived solvent in a slurry mix tank. The slurry is combined with hydrogen and is then pumped through a fired preheater and into a dissolver. In the dissolver, the coal is hydrogenated and thus depolymerized, leading to an overall reduction in product molecular weight and the dissolution of the coal. The solvent is also hydrocracked, yielding lower molecular weight hydrocarbons ranging from methane to light oils. The organic sulfur in the coal is hydrogenated to hydrogen sulfide.

After leaving the dissolver, the mixture passes to a separator where the gases are separated from the slurry of undissolved solids and coal solution. The raw gas is sent to a hydrogen recovery and gas desulfurization unit. The recovered hydrogen is then recycled and combined with the slurry from the slurry mix tank. Hydrocarbon gases are recovered and the hydrogen sulfide is converted to elemental sulfur.

The slurry of undissolved solids and coal solution is then separated in a solids separation unit. In a commercial scale plant, the solids would be sent to a gasifier-converter where they would react with coal, steam, and

