ENVIRONMENTAL ISSUES OF SYNTHETIC TRANSPORTATION FUELS FROM COAL

SUMMARY REPORT

INTRODUCTION

Environmental impacts from large-scale commercialization of coal liquefaction are important to government, industry, the public, and a variety of interest groups. This report reviews environmental issues associated with coal liquefaction processes by addressing the following topics:

- A comparison of the environmental differences among technologies;
- A comparison of the impacts among different coal regions;
- A description of the uncertainty of synfuels data and environmental effects; and
- An identification of problems aggravated by accelerated development schedules.

Section 1 summarizes expected environmental impacts from major steps in the liquefaction process--that is, mining, liquefaction, and end-use. The technologies are compared in Section 2, emphasizing how the differences may affect environmental issues. Section 3 identifies impacts affected by locational differences, while Section 4 explores institutional issues. The concluding section (5) discusses environmental risks intensified by rapid commercialization programs.

As indicated in Figure 1-1, after coal is mined, prepared, and shipped to a conversion facility, there are two basic methods of getting liquid fuels from coal--the direct and the indirect routes --both based on chemistry developed in Germany before World War II. The direct way (or hydrogenation method) involves fracturing the complex coal molecules and adding hydrogen to the fragments; the smaller the fragments and the more hydrogen added, the lighter the liquids produced. On the other hand, the indirect method first converts (by incomplete combustion) the coal to a medium-Btu gas, primarily carbon monoxide and hydrogen. After purification, the carbon monoxide and hydrogen are combined catalytically to produce the liquid fuel--either methanol (methyl alcohol) or hydrocarbons, depending upon the catalyst.

Today there are three direct processes in the advanced pilot plant stage:

- Solvent Refined Coal II (SRC II);[1]
- H-Coal; and
- Exxon Donor Solvent (EDS).

They differ mainly in their mechanical features (e.g., reactor design) and in whether or not the hydrogenation is done catalytically. Each requires:

(1) Preparation of a coal slurry--ground coal plus solvent;

(2) Preheating the coal slurry near reactor temperature;

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[1]The SRC I process also is a direct process producing liquid products. Because it has been developed to produce a clean solid fuel and because it is closely related to the SRC-II process, it is not emphasized in this report.

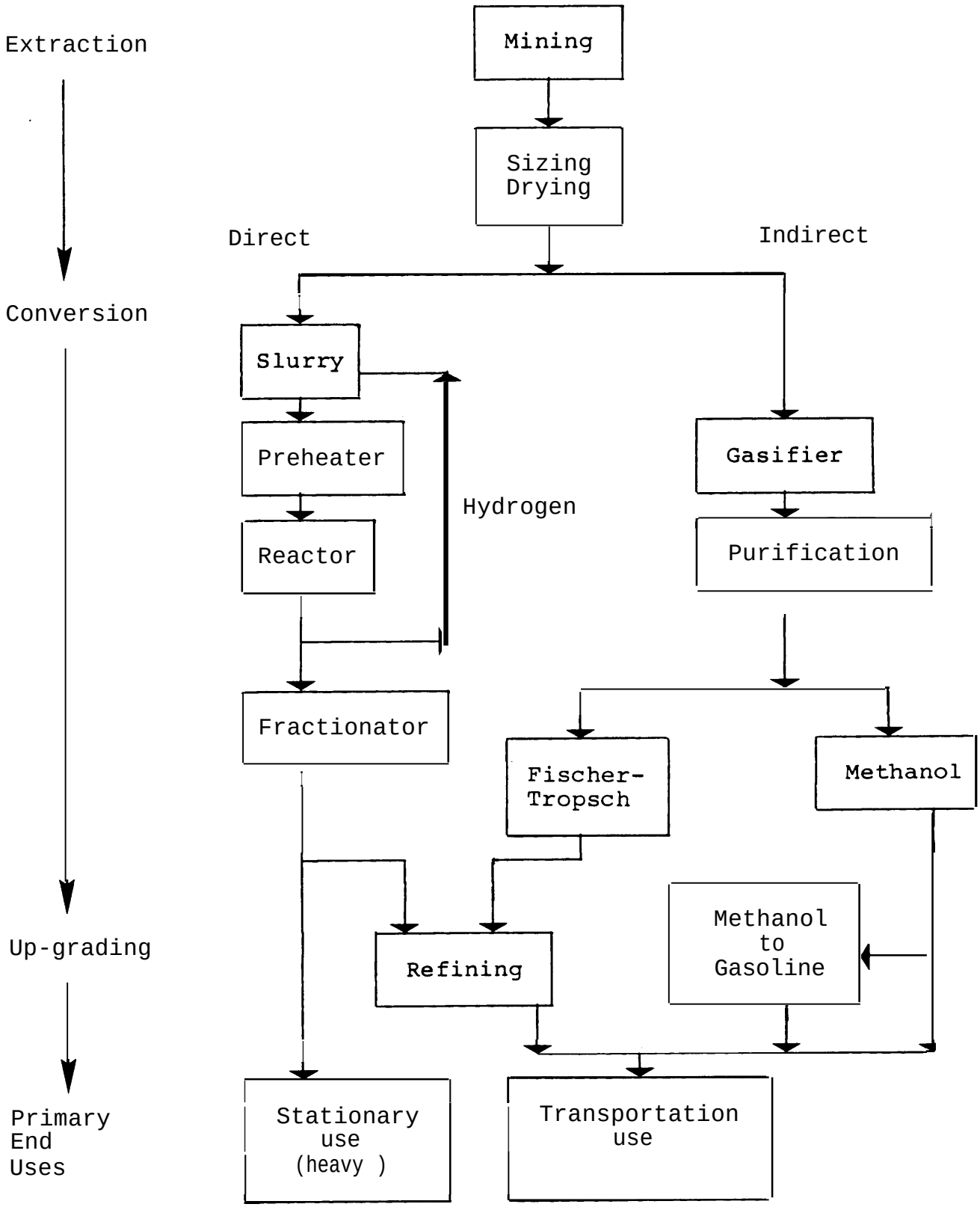

Figure 1-1: Coal Liquefaction Process Steps

(3) A liquefaction step in the reactor;

(4) The separation of hydrogen from the reactor effluent in order to recycle hydrogen; and

(5) Distillation of the liquid from Step 4 to provide products, recycle solvent, and an ash-laden liquid slurry.

They differ principally in that SRC II uses no catalyst, H-Coal has catalyst in the liquefaction reactor and EDS partially hydrogenates, catalytically, the recycle solvent in a separate step. Following the separation of the lighter liquids and distillate, the disposition of the heavy "bottoms" (which also contain most of the ash) is a common problem. It can be used as a fuel or, via partial combustion, as a hydrogen source; the choice depends upon the energy balance and economics of specific commercial plant designs.

There are three basic indirect processes for producing transportation fuels from coal:

(1) Methanol;

(2) Mobil's Methanol to Gasoline conversion; and

(3) Fischer-Tropsch.

All indirect processes first gasify coal to produce a synthetic gas --a mixture of carbon monoxide and hydrogen (plus impurities). After purification, the gas is fed to a catalytic converter. One type catalyst will produce methanol and is used commercially today on carbon monoxide/hydrogen mixtures obtained from natural gas (methane). Methanol can be blended with gasoline or, with certain engine modifications, can be used directly as motor fuel. A catalyst developed by Mobil can convert methanol directly into gasoline. The Fischer-Tropsch process employs catalysts that produce