
4.0 ALTERNATIVES TO THE PROPOSED ACTION

The proposed action is to demonstrate commercial-scale production of methanol from coal-derived synthesis gas using the LPMEOH™ technology. This section provides a discussion of the DOE alternatives to the proposed action as well as the proposed site alternatives.

4.1 The No-Action Alternative

Under the no-action alternative, DOE would not provide cost-shared funding to design, construct and operate the LPMEOH™ Demonstration Unit at Eastman Chemicals' Kingsport facility. Without the DOE funds to support the design, construction and operation of the LPMEOH™ plant, the LPMEOH™ demonstration unit would not be built. The LPMEOH™ process technology would not be commercially accepted in its principal application as methanol co-production in an integrated coal gasification combined cycle (IGCC) power plant if this demonstration unit is not built and operated.

It must be noted under the no-action alternative that failure to build the LPMEOH™ unit in the space reserved for it at Eastman's Kingsport site would leave that site available for construction of another process facility. It cannot be assumed that the no-action alternative results in a non-use of the land, because the site is centrally located to facility utilities and offers economies of scale for another process plant modules. Within the next decade it is highly likely that an Eastman Chemical facility expansion would be built here for another purpose should the LPMEOH™ project not move forward.

Proceeding with the No-Action Alternative would not contribute to the objective of the CCT Demonstration Program which is to make a number of advanced, more efficient, economically feasible and environmentally acceptable coal technologies available to the U.S. Energy marketplace.

4.2 Alternative Sites

From a land use standpoint, it is likely that this site would be used for another process unit within the next decade if the LPMEOH™ unit were not built.

The Kingsport site is one of the four locations Air Products has evaluated for locating the LPMEOH™ demonstration unit. Two previous site locations were developed and submitted to the DOE for this program.

In December 1989, the LPMEOH™ technology was chosen by the DOE, under Clean Coal Technology (Round III) Program, to be demonstrated on a 500 ton per day (TPD) of methanol scale at Dakota Gasification Company's (DGC) Great Plains Synfuels lignite-to-SNG plant in Beulah, North Dakota. Negotiations toward a cooperative agreement between DOE and Great Plains Methanol (the proposed joint venture between Air Products and DGC) commenced in January 1990. However, due to the inability of DGC to obtain permission to divert a sufficient amount of synthesis gas from SNG production for the natural gas pipeline companies, the demonstration could not be sited at Great Plains. Therefore, alternative sites were evaluated and the Texaco Cool Water Project (TCWP) facility was deemed most appropriate for the LPMEOH™ Demonstration Project. Texaco Syngas Inc. (TSI) had secured the rights to purchase the coal gasification facility

with the intent to operate it as a coal/municipal sewage sludge gasification facility to produce electricity.

On October 16, 1992 the Cooperative Agreement was awarded to Air Products for the LPMEOH™ technology demonstration. Air Products proposed to perform a commercial-scale demonstration of the LPMEOH™ Process using coal-derived synthesis gas. A nominal 150-ton-per-day methanol demonstration unit, with maximum demonstration at up to 200 ton-per-day, was to be located at TSI's Cool Water Gasification Facility in Daggett, California. However, given the current economy and forecasts for natural gas price and availability in California, Air Products, TSI, and the DOE have recognized that the combined Texaco Cool Water/LPMEOH™ demonstration project, as proposed, could not successfully obtain an electric power contract in California.

Options to restructure the project needed to be considered. Therefore, Air Products and the DOE mutually agreed (Modification M002 of January 25, 1993) to suspend all work under the Cooperative Agreement until an acceptable alternative site proposal was developed. Air Products further agreed, that during the suspension period, it would pursue alternative LPMEOH™ Demonstration Projects with interested host site providers, preferably at existing, operating coal gasifier sites.

Air Products discussed the relocation of the project with Destec Energy, Inc. Operation of Destec's lignite gasifier in Plaquemine, LA is to be discontinued when funding runs out sometime before 1997; therefore the LPMEOH™ demonstration unit could not be located at this site.

Discussions with Eastman Chemical to locate the LPMEOH™ demonstration at their Kingsport, TN facility resulted in a revised technical proposal which was submitted to the DOE on July 30, 1993. The host site has a better infrastructure, including an operating coal gasifier with proven reliable performance.

The Eastman Chemical Kingsport site was selected because it can provide coal-derived synthesis gas at a rate high enough to demonstrate the LPMEOH™ process technology on a commercial-scale basis. Successful demonstration at this scale would enhance the acceptance of the LPMEOH™ technology into the IGCC market.

The Eastman Chemical Kingsport site would provide the coal-derived synthesis gas and ancillary facilities necessary to demonstrate the LPMEOH™ process as described above. This site is the only existing coal gasification site with synthesis gas available for this LPMEOH™ commercial-scale demonstration. The cost to build a coal gasification plant specifically to provide synthesis gas for the LPMEOH™ demonstration would be prohibitive.

4.3 Alternative Technologies

The majority of the world's methanol is currently produced by foreign technology, via either the ICI or the Lurgi gas-phase methanol synthesis process. Both of these processes require a feed gas to the reactor that is hydrogen rich. This requirement arises from the design to minimize the rate of catalyst deactivation while maximizing methanol production.

The composition of the reactor feed is also quite dilute with the total carbon monoxide concentration typically no greater than 6 to 9 volume percent. This imposes a severe limitation on the amount of methanol that can be made per pass through the reactor. The concentration of methanol in the reactor effluent is typically only 4 to 6 volume percent. The reactor effluent is cooled to condense the converted methanol and the unreacted synthesis gas is recycled back to the reactor. The reason for the use of a dilute reactor feed is catalyst deactivation. With higher concentrations of carbon oxides, the catalyst surface temperatures could increase to a level where deactivation is too high.

In the gas-phase process, the H_2/CO ratio must be adjusted to at least 2.1 to 1 before the CO-rich gas can be converted to methanol. This is accomplished by diverting a portion of the clean synthesis gas to a shift converter in which a fraction of the carbon monoxide is reacted with steam to form hydrogen and carbon dioxide via the water gas shift reaction. At this point, carbon dioxide is removed from the feed stream by one of several conventional absorption processes, leaving a clean synthesis gas that is on the H_2 -rich side of stoichiometric. Although shift and carbon dioxide removal are proven technologies, they are capital and energy intensive. In addition, the carbon dioxide reject stream can be over 10% of the methanol plant feed and represents a significant loss of potentially recoverable energy in the high pressure gas stream.

The crude methanol produced in both gas-phase processes contains nearly 20 wt% water and 1 wt% by-products and dissolved gasses. A major disadvantage is that the crude product needs substantial upgrading before it can be used. The crude product requires (as a minimum): 1) a stabilization step to strip unreacted dissolved

gases from the liquid; and 2) a methanol distillation to separate the alcohol products from the water by-products. This kind of purification section for fuel-grade methanol (max. 1 weight % water) in a gas-phase unit would be only slightly reduced in scope from a high-purity chemical purification system.

The biggest drawback for conventional technology, however, is that it cannot meet the load-following conditions imposed by coupling it to an IGCC power plant. The gas phase reactors are sensitive to rate changes and certainly could not operate in an on/off mode. The LPMEOH™ Process has demonstrated its ability to load follow as well as to operate in the on/off mode at the DOE's LaPorte Process Development Unit. This project will demonstrate these features at the commercial scale.

In summary, the LPMEOH™ technology is a novel process for methanol synthesis. Its key advantages are: 1) the feed to the reactor does not have to be H₂-rich; almost any combination of hydrogen, carbon monoxide, and carbon dioxide can be processed directly without adjusting the gas composition via the shift reaction; 2) there is no need to dilute the feed gas to the reactor in order to control catalyst surface temperature; and 3) highly concentrated gas streams can be processed directly. This allows much higher per-pass conversions to methanol than can be achieved with conventional technology, and finally (4) it can operate in a load-following and on/off mode.