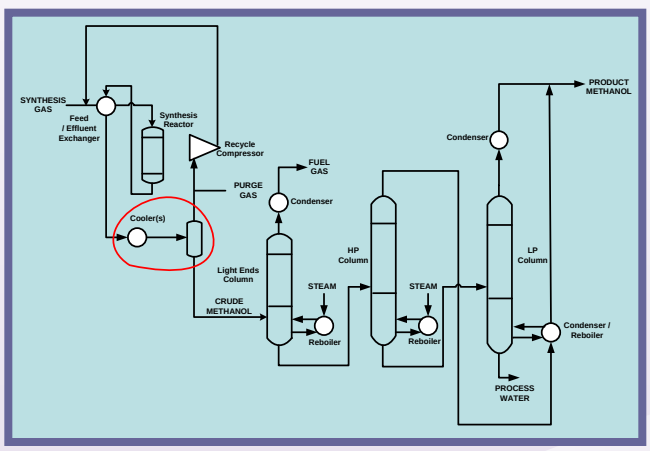
COPRODUCTION OF ELECTRICITY AND CHEMICALS

OVERVIEW

There are a number of advantages of coproducing a chemical such as methanol and higher alcohols along with electricity: (1) the relative amounts of syngas used for power generation or converted to the coproduct can be varied depending on market demands, (2) a gasification power plant incorporating CO_2 emissions control lends itself especially well to coproduction since CO_2 removal from the syngas is required, (3) once-through synthesis or synthesis with minimum recycle may be employed which eliminates or reduces the compression power and equipment required for recycling the unconverted syngas to the synthesis reactor, and eliminates or reduces the buildup of inerts and other unwanted trace components, (4) sharing of equipment or plant subsystems required to generate electricity and the coproduct allows realizing economies of scale, and (5) efficient heat integration between the power block and the synthesis unit is possible, especially since synthesis processes are typically exothermic. Conventional process schemes for methanol production consist of cooling the synthesis reactor effluent to condense out primarily a mixture of methanol and water which is then supplied to a distillation unit for separation of the methanol while the gas is recycled to the reactor.



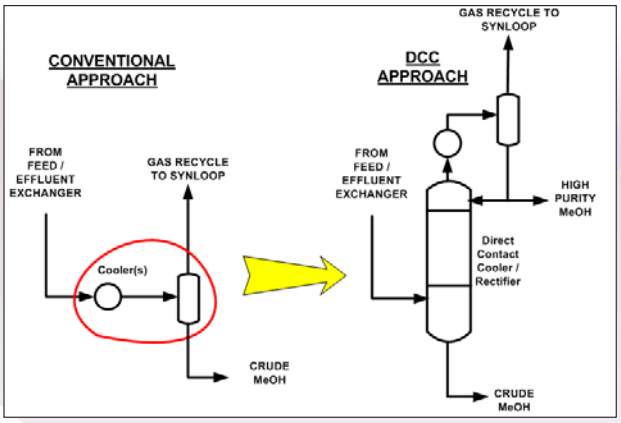
CURRENT APPROACH FOR METHANOL SYNTHESIS/PURIFICATION AND OPPORTUNITY FOR IMPROVEMENT

GOALS

- Identify technology options and innovative design concepts that synergistically integrate plant subsections
- Develop steady state system simulations to predict plant efficiency and environmental signature
- Perform techno- economic analyses for the improved coproduction facility concept

RESULTS

Natural separation of methanol and water can occur within the synloop as the reaction products are cooled below the dew point but current approaches do not take advantage of this potential. Replacing the lower temperature heat exchangers within the synthesis loop with a high pressure a direct contact cooler (DCC) which also functions as a rectifier, leads to pre-separation of a significant amount of methanol and a reduction in overall steam consumption and size of the downstream distillation unit. Detriments are that the additional column (DCC) operating at a high pressure (synloop pressure) is required. Reduction in energy consumption is substantial, however, of the order of 40%. Refluxed methanol flowing down this DCC provides the mass-transfer gradient to produce a high purity methanol stream withdrawn from top of the column while a low purity methanol stream leaves as bottoms. This low purity stream may then be supplied to a conventional distillation unit consisting of high and low pressure columns. The improved design configuration requires additional capital cost but is more than off-set by the additional electric power generated due to savings in steam consumption in the distillation operation. Furthermore, the additional power is generated with zero fuel costs and zero plant emissions. These advantages increase with increasing moisture content in the crude methanol. High pressure experimental vapor-liquid equilibrium data for the methanol-water system as well as partitioning of trace components is required, however, to substantiate and verify results and validate the conclusions. This design concept may also be applied in other applications such as the synthesis of ethanol, mixed alcohols and dimethyl ether.



REPLACE COOLER/SEPARATOR WITH DIRECT CONTACT COOLER/RECTIFIER

RESULTS (continued)

RECENT PUBLICATIONS/PAPERS

Rao, A.D. and V.J. Francuz, *Reduction of Energy Consumption in Methanol Distillation*, Proceedings of the Gasification Technologies Council Annual Meeting, Washington D.C., October 2008

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