Energy Consumption Optimization

CO_2 Capture Facility

Kårstø, Norway

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	PAGE 1 of 4	

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Contents

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1.0 INTRODUCTION

Provided is a discussion of the major energy consumption reduction opportunities considered in this FEED Study.

2.0 DISCUSSION

2.1 Steam Consumption

The amine plant reboiler required steam consumption is influenced mainly by the following parameters:

- Inlet flue gas temperature
- Solvent (amine) concentration

Inlet flue gas temperature has an impact on steam consumption rate, because at lower gas temperature, CO_2 loading in amine solvent can be increased. At higher CO_2 loading, amine circulation rate is reduced, and the steam needed to regenerate the rich amine is also reduced.

Solvent concentration also plays an important role in steam consumption. At higher concentrations, CO_2 loading is increased per cubic meter of circulating solvent, and the heat needed to regenerate the rich amine is also reduced.

Contractor has performed simulation runs to document the effects of flue gas temperature at absorber inlet and solvent concentration on steam use rate. These simulation run results are:

Table 1 - Steam Consumption Rate

MEA %	Flue gas temp, °C	CO_2 capture eff., %	Steam rate Kg steam per kg CO_2	Case
35	50	85.3	1.56	Normal
35	35	84.4	1.46	Normal
36	35	85.5	1.44	Normal
38	35	85.7	1.39	Winter

The table shows that the reduction of flue gas temperature has a significant impact on steam consumption rate.

The Contractor design cools the flue gas to 50 C using a fogger system. To reduce the steam consumption rate further the flue gas temperature would need to be reduced further from 50 C to 35 C which requires a packed bed cooling section. This can be a separate vessel or a bed installed in the absorber tower below the first absorber bed, requiring additional capital expenditure and changing the design to a net producer of water. The Contractor design provides for a balanced water system and optimization between steam consumption (operating costs) and capital costs.

To increase MEA concentration is an approach that has a positive impact on steam rate, but its benefits are limited, and it increases the corrosiveness of the solvent. The Contractor's design employs a stainless steel (SS) clad vessel and SS piping systems so a concentration of up to 40% MEA is potentially feasible without negative impacts on equipment life.

2.2 Electric Power Consumption

A flue gas duct water injection system (fogger) to reduce the flue gas temperature has a positive impact on inlet blower power consumption. Another approach to further reduce the blower power consumption is to use a packed bed flue gas cooler to reduce the flue gas to 35 C in a separate column, and locate the blower between the cooler and the absorber tower. This configuration can further reduce power consumption on the blower, but increases the capital cost of the project.

Power savings opportunity is possible in the CO_2 compression design. The current compressor design employs a three casing design with intercoolers between casings. Isothermal compression has the best thermal efficiency, so if additional casings and intercoolers are used the power use can be further reduced. Based on the current state-of-the-art compression design available, the design being provided uses a three stage pressure compression design, which provides a good balance between power consumption, equipment and system complexity, capital and operating costs.

3.0 CONCLUSION

The design presented by the Contractor balances all the factors related to steam and electric power consumption to provide for an optimized design for both capital and operating costs.