CONFIDENTIAL

CO_2 Capture using Amine PRocesses: International Cooperation and Exchange

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REPORT ON THE HEAT INTEGRATION OPTIONS

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Author(s): T. Sanpasertparnich, R. Idem & D. DeMontigny (UofR), J. Alin, R. Drew, D. Peralta-Solorio, A. Trunkfield & N. Booth (EON)

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0 PUBLIC SUMMARY

The main aims of CAPRICE WP 3.2 were to apply a CO_2 capture plant model together with whole power plant models in order to calculate the efficiency penalties arising from introducing a CO_2 capture and compression system to a set of power plant cases, and optimise positions from which steam was drawn and low grade heat/condensate re-introduced to the power plant steam/feed water cycle. The cases covered in this work were a new-build 800MW$_e$ supercritical bituminous coal-fired plant and a new-build 300MW$_e$ supercritical lignite fired power plant.

The E.ON Engineering whole power plant simulation tool PROATES was used to construct detailed boiler, turbine, feed heating train and cooling water models featuring modules to represent the interactions with the CO_2 capture plant. Detailed modelling of the industrial benchmark 30%wt monoethanolamine (MEA) CO_2 capture process was carried out by the University of Regina using the ProMax modelling software and output data concerning heating and cooling duties and works power demands were imported into the PROATES power plant models. This paper describes and discusses the results of this work.

- A solvent regeneration specific heat duty of 3.6 GJ/tonne CO_2 was predicted for all three cases by the University of Regina based upon their pilot plant operating data.
- The study identified steam off-take from the crossover section between the intermediate pressure and low pressure stages of the power plant steam turbine as being the most favourable for powering the capture plant reboiler. This was based upon the availability of steam at the required quality over the operating load range and the accessibility to extract the required quantities at this location.
- The preference to match the temperature of a heat source from the capture plant to a point of similar temperature in the power plant feed heating train defines the optimum heat return location for each return stream.
- Power plant optimization modelling showed an inverse proportionality between power plant efficiency and CO_2 capture rate in the range between 75 and 90% capture. Above 90% capture power plant efficiency decreased more rapidly with increasing capture rate.
- For the 800MW$_e$ and 300MW$_e$ cases the efficiency penalties were predicted to be 9.7 and 9.9 percentage points respectively, when comparing capture optimised power plant with 90% CO_2 capture and compression in operation to the base line power plant optimised without CO_2 capture.
- The modelling work undertaken in this study shows the benefit of designing power plant for capture from the outset. For an 800MW$_e$ plant optimised without capture (a retrofit case) a greater baseline power plant efficiency would be achieved (additional 1.1 percentage points), but the efficiency penalty would be more onerous when the capture plant is put into operation (additional 0.7 percentage point penalty).

The rest of this document is project confidential.