Summary of doctoral dissertation

Thesis title:	the effect of heat integration on the energy consumption of the CO_2 capture process from boiler flue gases
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One of the most advanced technologies for CO_2 capture in the power industry is amine based chemical absorption. However, it still requires efforts to reduce energy consumption. This dissertation analyses one of the ways to reduce the heat duty of this carbon capture method.

According to the state of the art, among many process modifications, a promising solution is Heat Integrated Stripper (HIS) using built-in heat exchangers in the stripper. However, there are no experimental results available to confirm the effectiveness of this solution.

The aim of the research in this study was to compare the effectiveness of the process using a modified stripper to the standard process. The comparative analysis covers pilot studies, simulation studies and cost analysis of the implementation of such a solution.

Pilot tests were carried out in Jaworzno Power Plant and Łaziska Power Plant using a mobile pilot plant for amine based CO_2 capture from flue gases with a nominal flow of 200 m^3/h, This research project was carried out by the Institute for Chemical Processing of Coal and TAURON companies.

The plant was designed to operate in several configurations. Tests were carried out according to a standard process configuration, double absorber feed and split flow configurations. Each of these was tested in comparative tests with and without HIS.

As part of the research programme, pilot tests were carried out using aqueous solutions of MEA 30% and AMP/Pz 30/10%. The test results were put through a data reconciliation procedure so that mass balances, heat losses and process heat duty could be prepared. All the presented test series showed a positive effect of the application of HIS, although the range of reduction of the heat duty depended on the type of solution and the process configuration. The impact of heat integration was mainly seen in the favourable effect on the temperature profile of the stripper, resulting in an increase in CO2 capture without additional heat input.

Simulation studies conducted with the ProTreat software confirmed the most important conclusions and observations taken from the pilot studies. Using the possibilities of the software, an analysis of the gas and liquid phase composition along the height of the stripper was carried out, which provided more detailed knowledge on the changes occurring in the desorption process after the HIS application.

A cost analysis of the implementation of the HIS showed an increase in capital costs for the industrial CO^2 capture plant. However, the benefits related to the reduction of the heat duty should bring savings in operating costs, so there is a possibility of return on investment in a reasonable time period.

The subject of the study is an important and timely area of the national economy due to the rising prices of CO^2 emission allowances. The presented results of the analysis may form the basis for design works of a modified CO^2 capture process with HIS on a larger scale.