IEAGHG 6th Post Combustion Capture Conference

19th -21st October 2021 Fully Virtual Conference hosted from the UK

# Assessment of $CO_2$ capture from multiple point source with a single regeneration column for efficient operation in refineries

Andressa Nakao[a,*], Juliana G. M. S. Monteiro[b], Jasper A. Ros[b], Hanna K. Knuutila[a]

[a]*Department of Chemical Engineering, NTNU, NO-7491 Trondheim, Norway*
[b]*TNO, Leeghwaterstraat 44, 2628 CA Delft, The Netherlands*

**Abstract**

In recent years the interest in capturing $CO_2$ from multiple point sources on one industrial site has increased. According to Miracca et al. (2013), refineries are responsible for 6% of total emissions of $CO_2$ from stationary sources, reaching over 0.8 billion tons per year. The application of post-combustion $CO_2$ capture represents an alternative to reduce significantly $CO_2$ emissions from these sites. A standard refinery has diversified $CO_2$ emissions sources, such as process units, fired heaters, and boilers. In a multi-source environment, several strategies could be used to efficiently capture the $CO_2$. One could combine the largest $CO_2$ sources in a joined stack and create one point-source situation where one larger $CO_2$ capture plant is needed. This has been investigated previously by Straelen et al. (2009). Another option would be to have multiple $CO_2$ capture plants connected to the different point sources. A third option would be to use a multi-absorber/single stripper concept (Figure 1). Implementing a multi-absorber/single-stripper concept could reduce the operational complexity and capital cost of $CO_2$ capture compared to one large absorber/stripper plant where flue gases containing different amounts of $CO_2$ are mixed before entering the absorber. Routing various flue gas streams to a combined stack requires a large pipeline system to be installed on-site. As opposed to this, a multi-absorber would simplify the system interconnections, as only liquid (solvent) needs to be transported.

The multi-absorber/single stripper concept uses multiple smaller absorbers, which can be tailored to the given streams and easily be started and stopped e.g. during the maintenance, instead of one main absorber of fixed volume. This also has the potential to increase the total annual $CO_2$ capture rate, thus decrasing the specific cost of $CO_2$ capture.

This work focuses on the $CO_2$ removal process from the main stacks of a model refinery, creating different case studies using the multi-absorber/single stripper – concept to assess and compare each scenario. Additionally, the main equipment will be sized and will be used in an economic evaluation. In the study, we will compare a single absorber/single stripper concept to a multi-absorber/single stripper – concept and critically discuss the advantages and disadvantages of both cases.

We will discuss key parameters such as absorber size, energy consumption as well as equipment cost. In reality, the multi-source $CO_2$ capture at refineries is a complex optimization problem. In the study of its feasibility, it should be incorporated parameters and restrictions like (i) the ease of the operation; (ii) the distance between each stack to be treated; and (iii) the available area. In this work, a qualitative discussion about these features and their real-life limitations will also be given.

The study is carried out within the European REALISE project, and serves as basis for the evaluation of 3 real refinery use-cases.

* Corresponding author. Tel.: 47 47736222 *E-mail address:* andressa.nakao@ntnu.no

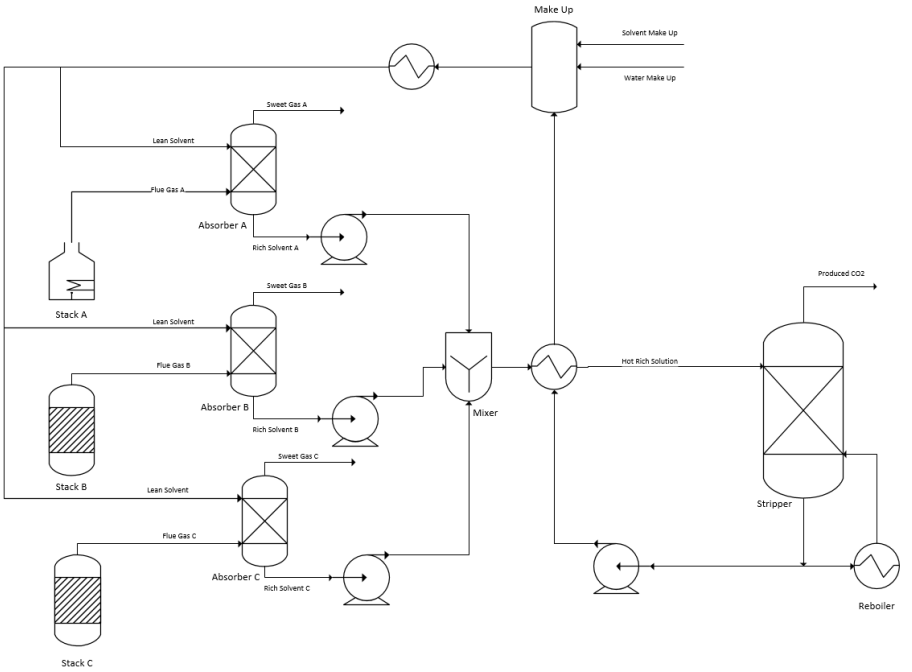


*Figure 1- Process diagram of multi-absorber/single stripper plant*

**References**

Daniella Johansson, P.-Å. F. (2013). $CO_2$ capture in oil refineries: Assessment of the capture avoidance costs associated with different heat supply options in a future energy market. *Energy Conversion and Management*, 127-142.

Ivano Miracca, M. C. (2013). The $CO_2$ Capture Project Status and Prospects of the Capture Program. *Energy Procedia*, 7825-7831.

Jiri van Straelen, F. G. (2009). $CO_2$ Capture for refineries, a practical approach. *Energy Procedia*, 179-185.

**Acknowledgements**

The work is part of REALISE-project. The project received funrding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 884266.

*Keywords:* $CO_2$ Capture; Refineries; Multi-absorber;