Abstract

Owing to the increasing emphasis on Carbon Dioxide (CO$_2$) sequestration coupled with the acceptance that geological sequestration is perhaps one of the more promising carbon management strategy, the need to capture CO$_2$ at sources in a cost effective and safe manner is gaining widespread attention. This is justified as CO$_2$ capture is often one of the more expensive components of any geological sequestration capture, transportation and storage chain. As such, much emphasis is currently being place in increasing capture efficiency and reducing capture cost and to demonstrate these advancements, many pilot plants are being built worldwide.

Carbon capture essentially produces a concentrated stream of CO$_2$ at high pressure so that it can be readily transported to appropriate storage sites. While theoretically, the entire gas can be transported, the costs associated with doing this often deems that option impractical. Extracting the CO$_2$ in a more concentrated form and elevating this pressure is therefore an important component of the CCS chain.

For T&T, post combustion capture is most desirous as the targeted CO$_2$ sources emanate from existing plants. This is so because physical space at these plants are limited and does not readily allow for pre-combustion technologies. While oxyfuel combustion may be applicable to some of T&T existing plants, since the sources being evaluated in this paper are ammonia synthesis facilities, the concentration of CO$_2$ in these streams is already high and commensurate with that of oxyfuel carbon capture. Interestingly, most of T&T’s emissions (over 50%) emanate from the petrochemical sector and in particular from Ammonia production. There are eleven (11) Ammonia plants in T&T which contributes to the nation being the number one exporter of this commodity globally. During the synthesis of Ammonia, a relatively pure stream of CO$_2$ is produced in the process. Typically, this stream consists of over 90% CO$_2$ with some mostly water vapour as the other impurity. Once can therefore argue that to an extent the CO$_2$ is already captured. Further water vapour separation and pressurization is all that is needed for engagement in CCS projects.

There are multiple options in which that concentrated CO$_2$ alluded to can be further separated and pressurized. In this paper, we would conduct a qualitative assessment of these options based on strengths, weaknesses, opportunities and threats (SWOT) to select the given option. Once this is done, a further SWOT would be conducted to select the specific unit operations. Once these are selected, we would then use Aspen Hysys to simulate a capture facility for T&T for one of its Ammonia plants. This simulation would then be used as the primary tool to estimate CO$_2$ capture cost for T&T from Ammonia synthesis and this cost would be compared to other capture costs globally.
Of particular interest for T&T, this study illustrates an estimate of the costs for capturing 6 Mt/yr of CO₂ by amine solvents. It is expected that this information can be critical in evaluating overall CCS economics for T&T and can lend its way to a suitable pilot project for the country.

Keywords: Carbon Management, Economic Implications, CO₂ Capture, Post Combustion