Pilot Testing of a Non-Aqueous Solvent (NAS) CO_2 Capture Process

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Abstract

RTI International and SINTEF with funding from the US Department of Energy and Gassnova have been working on advancing RTI's non-aqueous solvent (NASs) technology for CO_2 capture from flue gases. The process technology has the potential to substantially reduce the regenerator heat duty to less than 2.0 GJ/t-CO_2 captured, a 30% to 50% reduction compared to state-of the-art post-combustion CO_2 capture processes using aqueous amine solvents. RTI and SINTEF have carried out pilot scale testing of NAS at SINTEF's Tiller CO_2 capture test facility coal burner derived flue gas. Figures 1 and 2 shows the pilot plants at RTI and SINTEF where the pilot testing has been carried out. This publication focuses on the NAS performances based on test results from SINTEF pilot test facilities

The substantial reduction in the regeneration energy is the result of reducing the contribution of the heat of absorption (ΔH_{abs}), essentially eliminating the heat of vaporization contribution due to the low water content and high boiling point of the NASs at the regeneration temperatures, and reducing the sensible heat contribution by lowering the specific heat capacity and increasing the working capacity ($\Delta\alpha$) under process conditions.

The NAS CO_2 Capture Process has been tested and benchmarked with monoethanolamine (MEA) based on a conventional CO_2 capture process at SINTEF's Tiller plant. The team has determined the optimal conditions and configurations to run the NAS at bench scale to realize the reduction in regenerator heat duty. A few, yet significant modifications, have been made to the conventional aqueous amine pilot test facility at Tiller to obtain optimal performance of the NAS. Several key aspects of the NAS CO_2 Capture Process have been extensively evaluated during pilot testing with emphasis on understanding the operation of the NAS process and the effect of water from the flue gas has on the NAS CO_2 capture process, specifically in terms of system operability, CO_2 capture efficiency, water balance, and energy consumption.

In this presentation, we will focus on discussing test results from the pilot test. We will show why and how the existing process equipment at Tiller was modified with NAS specific process equipment, and ultimately establish process feasibility and prove substantially lower solvent regeneration energy (<2.1 GJ/t-CO_2 captured) of the NAS CO_2 capture process. The overarching objective of the current development phase is to finalize the process design aspects that are specific to the NAS CO_2 capture process and reduce the uncertainty related to the process and economic variables and ready the NAS process for large scale testing and demonstration.

(a) (b)

Figure 1. a) Tiller CCS lab building. b) "Full height"CO_2 absorber and desorber inside the 30 m high tower.

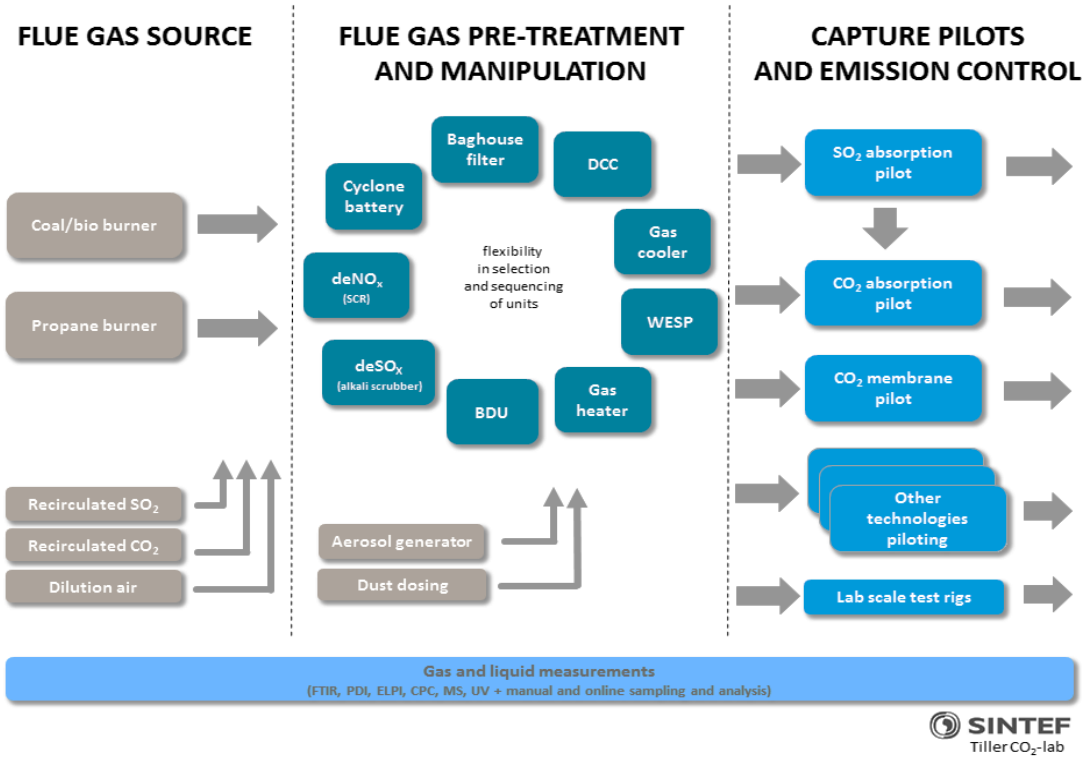

Figure 2. Tiller CO_2-lab pilot facility has flexibility in flue gas sources and pre-treatment. The scale of the pilot plants allow for easy modification and rebuild of test equipment.