1st Post Combustion Capture Conference

Novel Non-Aqueous CO_2 Solvents and Capture Process with Substantially Reduced Energy Penalties

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1. Introduction

The significant reduction of carbon dioxide (CO_2) emissions from existing and new, upcoming fossil fuel fired power plants and other large flue gas sources presents an enormous opportunity for mitigating greenhouse gas emissions and ultimately global climate change. The commercial availability of next-generation technologies that cost-effectively reduce CO_2 emissions from CO_2 emitting power generation and chemical production facilities is very important for these industries to prepare for climate change regulations. Currently, conventional CO_2 capture technologies, such as aqueous-monoethanolamine (MEA) based solvent systems, are prohibitively expensive and if implemented could result in significant increases in the cost of electricity and essentially all other products of these industries. Technologies that reduce or eliminate the release of CO_2 from industrial facilities with a minimal energy penalty represent an economical and environmentally-friendly option for these industries to meet climate change regulations.

RTI International, one of the U.S.'s leading independent research organizations, has partnered with BASF, the global leader in gas treatment solutions, to develop novel non-aqueous solvent systems that remove CO_2 from flue gas via an alternative, lower energy CO_2 – solvent reaction pathway that has the potential to substantially reduce the parasitic power load associated with solvent regeneration and reduce the capital cost of the process. The project is funded by the Advanced Research Projects Agency-Energy (ARPA-E) within the U.S. Department of Energy as a technology with potentially transformational impact. The partnership between RTI and BASF will allow rapid

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commercial development and deployment of the proposed novel non-aqueous solvents technology once fully developed.

2. Novel Solvent Systems

Absorption-based amine scrubbing processes are the only currently available technologies that approach the scale required for post-combustion CO_2 capture from power plants or other large industrial CO_2 point sources. The major drawback of these technologies is the high-energy penalty (2.8-3.5 GJ/tonne CO_2) for solvent regeneration, which requires low-pressure steam in the reboiler. The goal of the collaboration between RTI and BASF is to develop a more energy-efficient process for post-combustion CO_2 capture that utilizes novel non-aqueous solvent systems. These non-aqueous CO_2-absorbing solvents take a distinctly different approach that overcomes certain physico-chemical and process challenges that limit the potential of commercial monoethanolamine (MEA) solvent-based processes to lower the total regeneration energy. RTI International has recently discovered a new class of non-aqueous CO_2-absorbing solvents that have higher dynamic capacities for CO_2, lower regeneration temperatures, and the potential for significantly lower regeneration energies compared to aqueous-MEA systems. In addition, these non-aqueous solvent systems appear to be robust with regards to typical flue gas contaminants. First process modeling results for 90% CO_2 emissions capture indicate that the proposed non-aqueous solvent systems have the potential to reduce the parasitic power load to $\leq$ 2 GJ/tonne CO_2, which represents a 40% reduction compared to conventional, aqueous amine-based solvent processes.

The presentation will report on the current status of solvent development, discuss process design aspects and touch upon the pathway taken by RTI and BASF for pilot-scale demonstration.