FCR 10

Office of the President
May 8, 2015

Members, Board of Trustees:

PATENT ASSIGNMENT REPORT

Recommendation: that the Board of Trustees accept the Patent Assignment Report for the period January 1 – March 31, 2015.

Background: At its March 1997 meeting, the Board of Trustees authorized the University of Kentucky Research Foundation to conduct all future copyright and patent filings and prosecutions. Quarterly reports on patent and copyright applications are to be submitted to the Finance Committee of the Board.

Action taken: ☑ Approved ❑ Disapproved ❑ Other _____

PATENT ASSIGNMENTS
FOR THE PERIOD January 1 – March 31, 2015

Patents

The following assignment on behalf of the Board of Trustees of the University of Kentucky Research Foundation has been executed:

1. **U.S. Patent Application Serial Number: 14/591,466**
Filed: January 6, 2015
Title: Deep Removal of Sulfur Oxides from a Flue Gas Stream
Inventors: Kunlei Liu and Joseph E. Remias (Center for Applied for Energy Research)
Technical Description: This invention discloses an apparatus for removing sulfur oxides from a flue gas stream.
Summary: Flue gas desulfurization (FGD) was implemented on a commercial scale in the early 1970s, and interest in the technology has increased both here and abroad as utilities are under pressure from their governments and customers to reduce emissions from power plants. The most common method of FGD is a calcium-based FGD process that includes a limestone-based wet FGD and a lime-based, semi-dry FGD. Most wet systems operate around 97% capture efficiency, though state-of-the-art systems achieve up to 99% SO_x removal. This invention discloses a new method that integrates traditional wet calcium FGD (Ca-WGD) for coarse removal with an additional sodium-based packed bed absorber (Na-PBA) for deep SO_x removal. The apparatus is an absorber tower with an upper and a lower chamber separated by a liquid collection tray. The upper chamber contains a packed bed unit. Flue gas enters the lower chamber and encounters a solution of limewater, limestone slurry, or a combination of the two. The flue gas passes through the liquid collection tray into the upper chamber. The flue gas then passes through a packed bed unit while encountering in the upper chamber a caustic solution of a soluble calcium compound such as limewater or limestone plus an alkali caustic reagent. The treated flue gas stream is then discharged from the absorber. Pilot tests were performed to measure SO_2 removal and calcium oxide SO_x precipitation. The apparatus removed 98% to 99.5% of SO_2 and approximately 90% of sulfite.

2. **U.S. Patent Application Serial Number: 14/591,392**
Filed: January 7, 2015
Title: Hybrid Process Using a Membrane to Enrich Flue Gas CO_2 with a Solvent-Based Post-Combustion CO_2 Capture System
Inventors: Kunlei Liu and Reynolds A. Frimpong (Center for Applied Energy Research)
Technical Description: This invention relates to removal of CO_2 from post-combustion gases.
Summary: CO_2 absorbers and CO_2 scrubbers are used to capture CO_2 from post-combustion gases, such as at utility plants where coal is burned to generate electricity. The Department of Energy has established goals for the utility industry of 90% CO_2 capture with 95% CO_2 purity at a cost of no more than $40/ton of CO_2. This invention discloses a membrane-based CO_2 enrichment of post-combustion gases coupled with a heat-integrated aqueous CO_2 capture system and a two-stage solvent generation process.

The four basic components of this system are (1) pre-concentrating a CO_2 component of the boiler exhaust gas by passing the gas through a CO_2-selective membrane module to provide a CO_2-enriched post-combustion gas and a CO_2-lean stream gas; (2) feeding the CO_2-enriched post-combustion gas to the bottom of a CO_2 absorber, exposing it to a scrubbing solvent to absorb CO_2, and providing a carbon-rich scrubbing solvent; (3) feeding the CO_2-lean stream to the CO_2 absorber at an intermediate height to remove more CO_2; and (4) stripping CO_2 from the carbon-rich scrubbing solvent using a two-stage system. Pilot tests examined various liquid/gas ratios and produced impressive results. Compared to conventional equipment and a benchmark solvent, this invention increased carbon loading by 8%, reduced liquid recirculation by 19%, and reduced energy consumption by 15% while maintaining the same loading constant of the lean system and generating 90% overall CO_2 capture efficiency.

3. **U.S. Patent Application Serial Number: 14/593,399**
Filed: January 9, 2015
Title: Method and Catalysts for Increasing Mass Transfer Rate of Acid Gas Scrubbing Solvents
Inventors: Cameron A. Lippert, Kunlei Liu, Christine Marie Brandewie, Joseph Eugene Remias, Moushumi Sarma (Center for Applied Energy Research)
Technical Description: This invention discloses a more cost-efficient method of removing CO_2 from the acid gasses resulting from natural gas and oil refining, as well as various formulations for a new family of catalysts to use in the method.
Summary: The cleanup of acid gases or sour gas, such as CO_2 in particular, from natural gas and in oil refining has been practiced for more than 70 years. One component of CO_2 scrubber systems is the CO_2 absorber. The mass transfer rate in the absorber column dictates the size of the column and thus substantially impacts capital cost. This invention discloses methods to maximize the overall mass transfer rate of acid gas scrubbing solvents and discloses catalysts compounds useful in those methods. The method consists of adding a catalyst compound to a fluid stream including an acid gas and an acid gas scrubbing solvent. This invention results in an increase in overall mass transfer rate resulting in both a decreased cost due to a small absorber tower and a decreased energy cost in the stripper from obtaining a more carbon-rich solution. This invention also discloses the general chemical structure plus variations for the catalyst and methods of manufacturing representative compounds. The catalysts have been shown to be stable under the relatively high-temperature conditions found in the stripper component of the CO_2 scrubber system. This new family of CO_2 hydration catalysts are less synthetically demanding than previous catalysts and thus more cost effective.

Patent Activities
Fiscal year to date as of March 31, 2015

Number of Patent Applications	6
Number of Patents Issued	26
Patent Gross Revenue	$ 988,194.13