Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 63 (2014) 676 – 686

Energy Procedia

GHGT-12

Validation, operation and smart full-scale design of an efficient reclaiming system for carbon capture solvents based on amino acid salt

Dr. Berthold U. Melcher[a], Dr. Albert E. Reichl[b], Dr. Ralph Joh[b], Dr. Markus Kinzl[b], Dr. Ansgar Kursawe[b]

[a]*Siemens AG, Freyeslebenstraße 1, 91058 Erlangen, Germany*
[b]*Siemens AG, Industriepark Hoechst, 65926 Frankfurt am Main, Germany*

Abstract

This paper describes the development of an efficient reclaiming system for post combustion carbon capture technology. Impurities are emerging from the combustion of common fossil fuels (oil, coal or natural gas) such as SOx and NOx. They react with the CO_2 capture solvent by forming complexes, which will accumulate in the aqueous solvent solution and reduce its performance. Consequently they must be removed through a reclaiming system. In contrast to conventional thermal based reclaiming systems the reclaiming system described in this paper features a selective process based on crystallization to maximize solvent recycling and minimize residue disposal, hence minimizing operating costs. On the one hand it converts part of the component formed by SOx-absorption into a commercially reusable product (whilst simultaneously unblocking and recovering the solvent) and on the other hand it removes the formed heat stable salts and other impurities from the liquid solvent with a high efficiency. Experience has been gathered from pilot operation and the process has been validated and optimized. With this, a continuous full-scale design has been developed.

Peer-review under responsibility of the Organizing Committee of GHGT-12

Keywords: carbon capture and storage (CCS); reclaiming; CO2 capture; amino acid salt; PostCap™

Peer-review under responsibility of the Organizing Committee of GHGT-12
doi:10.1016/j.egypro.2014.11.075

1. Introduction

The world's demand for electricity is continuously rising caused by a rapidly growing population and furthermore by a progressing electrification of the world. Besides an increasing capability of renewable sources for electricity and an adherence to nuclear power, fossil fueled power plants remain the backbone of power generation [1]. To satisfy this demand, numerous new-builts are planned all around the world. Keeping the max. 2°C-goal for global warming in mind, this development longs for mature carbon capture techniques that reduce the climate impact of fossil fueled power stations [2].

Among the most advanced and engineered solutions for carbon capture are post combustion absorption-desorption processes with aqueous amine solutions as solvents. These processes are well-known to the chemical and oil and gas industry and are reliably scale-able to required sizes. However, for power stations this CO_2 capture approach is rather new, and the reluctance of operators to introduce a "chemical plant" into their power station is understandable. For that reason, Siemens has developed the PostCap™ process utilizing an amino acid salt (AAS) dissolved in water as solvent instead of an aqueous amine solution [3].

The advantages are inevitable. AAS are salts and are therefore non-volatile, which eliminates the threat of inhalation and of solvent loss via gas phase. Moreover many AAS are naturally occurring substances that are non-toxic, non-explosive, odorless and bio-degradable. This leads to exceptional benefits for the operability of AAS-based carbon capture units, so that they practically can be regarded as just another process unit and not as a chemical plant.

However, due to the AAS' non-volatility and salt character, distillation is not an option for the unavoidably necessary solvent purification, the so called reclaiming. By reclaiming, flue gas impurities and solvent degradation products can be specifically withdrawn from the solvent, which considerably reduces the refill demand of fresh solvent and thus the capture plant OPEX.

One of the most common unit operations for solid separation is crystallization. Therefore Siemens has developed a proprietary reclaiming process for AAS-based solvents utilizing crystallization, which minimizes solvent consumption. Within this paper we present the core steps of the Siemens PostCap™ reclaiming process, go into detail of development and validation and show a thoroughly engineered full scale design.

Nomenclature

AA	Amino acid
AAS	Amino acid salt
BMWi	German federal ministry for economic affairs and energy
CAD	Computer aided design
CCM	Carbon capture Mongstad project
OPEX	Operating expenditures
PFD	Process flow diagram
PostCap™	Siemens' proprietary carbon capture process