1st Post Combustion Capture Conference

Experience from post-combustion capture pilot plant operations in Australia

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Australia is highly dependent on coal for power generation and also for income and job creation through its significant exports. With this it is essential that Australia has an active program for investigating the implementation of coal combustion CO_2 reduction technologies. CSIRO is a national, government funded research organization that has been tasked with challenge of addressing the issues associated with the reduction of CO2 emissions through application of post-combustion capture technologies for coal fired power stations. PCC program at CSIRO investigates many aspects of the technology and part of that has been through construction and operation of three PCC pilot plants located at Australian power station sites treating real flue gas. This paper will discuss learnings that have come from the operation of the plants. Australia is highly dependent on coal for power generation and also income and job creation through its significant exports. With this it is essential that Australia has an active program for investigating the implementation of CO2 reduction technologies as a result of the combustion of coal. CSIRO is a national, government funded research organization that has been tasked with challenge of addressing the issues associated with the reduction of CO2 emissions through application of post-combustion capture technologies for coal fired power stations. PCC program at CSIRO investigates many aspects of the technology and part of that has been through construction and operation of three PCC pilot plants located at Australian power station sites treating real flue gas. This paper will discuss learnings that have come from the operation of the plants.

Keywords: post-combustion capture; pilot plant; Australia; amine; ammonia

1. Introduction

Greenhouse gas mitigation strategies are becoming one of the dominant items on global political agendas as greenhouse emission rates continue to rise. During the last 5 years Australia has seen the implementation of numerous initiatives from lab based research through to large scale demonstrations all aiming to develop technologies and frameworks to bring about greenhouse gas emission reductions. Capture and storage of CO2 has been an integral part of this.

Cost effective capture of CO2 from power station flue gases with geological storage is an imperative for Australia due to our dependence on, and investment in, coal fired power stations. Post-combustion capture (PCC) is

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the preferred technology for CO2-capture from existing power stations. CSIRO is executing a pilot plant research programme which aims to demonstrate PCC at small scale on real flue gases from power stations. Overall the program is designed to create expertise and technologies based upon Australian operating conditions.

Importantly, the program will address capture of CO2 in installations which do not have the SOx and NOx capture technologies which are commonly deployed in Europe, the US, and Japan, where most PCC development work is being undertaken. The operating conditions found in Australia are also common in many other nations, notably India and China, and these also form potential markets if this program is successful.

2. Australian pilot plant experience

By the end of 2010 CSIRO will have completed two pilot plant experimental programmes and will be nearing the completion of a third. The three pilot plant programmes have been designed to investigate different aspects of post combustion capture to develop an understanding as to the best implementation strategy for Australian power stations based on cost, efficiency, water usage and environmental impacts. Australian CO2 capture technologies have the potential to be quite different from those of our international counterparts, due to the abundance and low price of coal in Australia, the lack of desulphurisation and denitrification installed on existing power plants CO2 capture technology and the dry nature of the continent, all issues which can impact on the design of CO2 capture plant.

The pilot plants are located in three different Australian states with capture capacities up to 3000 tonnes per annum of CO2 using flue gases from brown and black coal firing. All pilot plants have a flexible configuration and incorporate a flue gas conditioning stage to reduce gas temperature with the ability to remove other acid gases prior to CO2 removal, followed by multiple absorption stages which can be changed depending on the desired operation requirements The flexible design allows a wide range of chemical absorbents with different performances to be tested. All pilot plants are stand-alone, i.e. utilities like steam and cooling water are generated separately on site and are heavily instrumented to enable the collection of large amounts of data.

Within the Latrobe Valley Post-combustion CO2 capture Project, Loy Yang power station in Victoria has been equipped with a technology based on amines. Loy Yang power station is the largest brown coal fired power station in Australian and produces flue gases that are at high temperature (170°C), have high water content and contain alkaline ash. This provides a challenging environment for chemical absorption processes. A focus of this pilot plant has been to investigate the impact on operation with different solvents. Furthermore the atmospheric emissions from amine based processes have been investigated with this plant.

The two other pilot plant projects are being conducted with funding from the Commonwealth Government under the Asia Pacific Partnership on Clean Development and Climate. Both pilot plants are treating black coal flue gases. In NSW a pilot plant has been operated in conjunction with Delta Electricity at the Munmorah power station site to investigate the potential of aqueous ammonia based CO2 capture. The ammonia based process has the potential to recover CO2, SO2 and NO2 within the one process but has some disadvantages such as a high vapour pressure and lower reaction rates.

In Queensland, CSIRO have worked with Tarong Energy to operate a pilot plant at Tarong power station. While this plant is once again based on amines it has been designed to enable process reconfiguration to allow for determination of optimal configurations for energy and resource efficiency.

Each pilot plant gives a unique insight into the application of CO2 capture technology to Australian power stations and allows the Australian power generation industry to gain some first hand experience with CO2 capture operation so that they can make informed decisions on CO2 capture into the future.