CARBON DIOXIDE CAPTURE FROM POWER OR PROCESS PLANT GASES

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PRIORITY

This invention claims priority from a provisional patent application No. 61/330,709 filed May 3, 2010 the contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention generally relates to flue gas cleaning and more particularly to carbon dioxide capture in industrial applications.

2. Background Information

The continued use of carbon based fuels continues to cause atmospheric pollution to rise at an unprecedented rate. While "cleaner" forms of energy have been explored, none of these other forms of energy have been sufficiently developed or disseminated to obtain wide spread use sufficient to replace the present carbon based methodologies. Therefore a variety of technologies and methodologies are currently being sought to attempt to address this issue. However, in attempting to address these issues a variety of other issues and practical and economic realities arise. One of the problems is the presence of varying constituents within a typical flue gas stream. The selective capture, sequestration and removal of these materials all depend upon differing characteristics which may conflict for the capture of other materials. As a result, many scrubbing technologies focus on one or two constituents but allow other pollutants to escape. Other problems arise as various technologies may not lend themselves to practical applications for scale up to millions of pounds of materials that are to be processed in relatively short periods of time (typically an hour). Furthermore, many configurations are economically unfeasible for a variety of reasons. This has led to confusion, disagreement and difficulty in configuring a system and employing a method for a comprehensive pollutant removal system.

Of particular concern in these arrangements is the ability to capture and sequester carbon dioxide. One of the problems with sequestering carbon dioxide is the requirement that carbon dioxide be captured in a relatively pure form before it can be sequestered. The existing CO_2 capture technologies are typically not efficient or cost effective when considered in the context of a typical coal-fired power plant. For example, to produce 550 MW of power from coal with 90% CO_2 capture using amine scrubbing reduces the power plant electrical generation efficiency from 39.1% to capture and 27.2%. (DOE NETL report 2007/1281 Cost and Performance Baseline for Fossil Energy Plants Volume 1: REV 1: August 2007). Reducing power consumption at a reasonable capital cost is a prerequisite to enable plants to capture and sequester CO_2.

The present inventions provide various methodologies for obtaining a resolution in addressing these matters. The present inventions provide methods and systems that offer a substantial reduction in cost and increases in efficiency compared to other proposals that are well known. Furthermore the present invention is more readily adaptable for use in existing industrial applications than many other proposed applications. Additional advantages and novel features of the present

invention will be set forth as follows and will be readily apparent from the descriptions and demonstrations set forth herein. Accordingly, the following descriptions of the present invention should be seen as illustrative of the invention and not as limiting in any way.

Various advantages and novel features of the present invention are described herein and will become further readily apparent to those skilled in this art from the following detailed description. In the preceding and following descriptions we have shown and described only the preferred embodiment of the invention, by way of illustration of the best mode contemplated for carrying out the invention. As will be realized, the invention is capable of modification in various respects without departing from the invention. Accordingly, the drawings and description of the preferred embodiment set forth hereafter are to be regarded as illustrative in nature, and not restrictive.

SUMMARY OF THE INVENTION

The present inventions are processes for removing pollutants including CO_2 from a flue gas stream. While the described preferred embodiments included herein describe for treating flue gas from a coal fired power plant, other flue gas streams and certain pollutant containing process streams may also be treated by the invention. Thus, this description is meant to be illustrative but not limiting to the invention.

In one embodiment of the invention a method for removing preselected substances from a mixed flue gas stream is described wherein a mixed flue gas is cooled by direct contact with a liquid quench to condense at least one preselected substance to a solid and form a cooled flue gas without substantial ice formation on a heat exchanger surfaces. Various target substances can be removed through such a process including CO_2, SO_2, NO_2, HCL, H_2SO_4, SO_3, Hg, As, Se in various forms and conjugates. Once cooled, in some embodiments solids can then be physically concentrated with a device such as a filter, sieve, hydroclone, or other similar device and separated by a process such as distillation, extraction, sublimation or some other traditional separation method. In order to preserve the energy efficiency of the system heat exchange between refrigerants and the quench liquid may be performed in order to cool the mixed flue gas.

The quench liquid and the manner of contacting the gas with the quench liquid may be embodied in a variety of forms. In one embodiment the contact between said mixed flue gas and said quench liquid is performed by a quench tower. Any of a variety of materials may be utilized as quench liquid provided that the quench liquid has a freezing point lower than the freezing temperature of water. Examples of quench liquids include alkaline water baths, 1-propanol, methanol, triethylene glycol, and SELEXOL (polyalkylene glycol dimethyl ether (PGDE). Depending upon the type of quench liquid utilized the formation of solids and densified liquids may cause some substances to sink in the quench. In some embodiments a slurry may be formed which can be pumped to increase its pressure to above the carbon dioxide triple point and delivering the slurry to a system of heat exchangers that melt the ice into liquid using condensing refrigerant as the heat source.

In one embodiment the invention is utilized in a process for removing CO2 from a flue gas stream, in such an arrangement the process includes directly contacting a flue gas stream with a quench liquid to form an ice containing CO_2, concentrating said CO_2 containing ices; and separating said CO_2; wherein said ice is not formed on a heat exchanger surface. The separation of materials in the invention may be accomplished in a