MEMBRANE CAPTURE OF CO2 FROM REFINERY EMISSIONS

FIELD OF THE INVENTION

This invention relates to the reduction of CO2 emissions from a Fluid Catalytic Cracker (FCC) regenerator via membrane capture of CO2.

BACKGROUND OF THE INVENTION

One of the biggest point-sources of CO2 emissions in a refinery is the FCC (Fluid Catalytic Cracker) regenerator offgas. In the FCC regenerator, spent catalyst is regenerated by burning the coke with air at high temperature. An FCC with 390 tonne/day coke will yield emissions of 0.46 million tonnes/year (MMTPA) of CO2 when burned with air based on 20% excess O2. The flue gas from a FCC regenerator is hot, dilute in CO2, and at low-pressure which renders separation and recovery of the CO2 challenging. One known-art process for capturing CO2 is based on amine absorption using solvents such as Fluor Econamine FG, 30 wt.% monoethanolamine (MEA), and Mitsubishisi Heavy Industry's KS-1. The flue gas is first cooled to a suitable temperature such as 50C, and then compressed in a blower to overcome the pressure drop from the downstream equipment. The gas then goes through an amine plant, which comprises an amine absorber (not shown) for removing the CO2 and an amine regenerator (not shown) for recovering the CO2 from the solvent. The amine plant reduces the direct CO2 emissions from the FCC unit down to 0.08 MMTPA, however, since power and steam are needed to circulate and regenerate the solvent, indirect emissions of 0.10 MMTPA are incurred. The net avoided CO2 emissions are thus 0.26 MMTPA. One of the disadvantages of the amine process is that the process equipment and footprint are significant, which often translate to high capital costs. High steam consumption leads to high operating costs and high indirect CO2 emissions from the steam boilers.

A method for capturing CO2 without high steam consumption and lower indirect CO2 emissions is therefore desired.

SUMMARY OF THE INVENTION

According to an aspect of the present invention, there is provided a method for capturing CO2 produced from a FCC regenerator flue gas including, cooling and compression of the flue gas to overcome the pressure drop in equipment downstream of the

FCC regenerator; operating a crossflow membrane at vacuum permeate pressure to remove the bulk of the CO2, followed by a membrane which operates with a counter-current air sweep on the permeate side to further reduce the CO2 amount; two stage compression of permeate from the crossflow membrane using vacuum pumps and then in 3 stages of compression to 48 bar; liquefying the CO2 using a CO2 liquefaction unit that liquefies CO2 out the bottom and produces a CO2-rich vapor which is sent to a high-pressure polishing membrane; recycling the permeate of the polishing membrane to the liquefaction unit feed while the retentate is recycled to the crossflow membrane feed.

Herein is disclosed a method for CO2 capture from refinery exhaust emissions or flue gas using crossflow and sweep-based membranes in series.

A further embodiment is a method of lowering the input of energy required to capture CO2 from an FCC regenerator using select membranes.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1 is a diagram of FCC emissions.