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Removal of Acid Gas Emissions Using Hollow Fiber Gas Absorption Membrane Contactors

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Abstract

It is important to devise techniques which would remove acid gases like CO2, H2S and other sulphoric components present in natural gas and industrial gas. They may have to be removed from the gas streams for environmental, economical and operational reasons. This paper provides a general review of hollow fiber gas absorption membrane contactor, including liquid absorbents, membrane characteristics, combination of membrane and absorbent, mass transfer, modules and model development. And also, areas of future potential in gas absorption membrane contactors for acid gas removal were briefly identified. In this device, separation of a gas mixture is achieved by the liquid absorbent, which selectively absorbs one of the components of the permeating gas mixture. The microporous membrane used in this process act as a fixed interface between the gas and the liquid phase without dispersing one phase into another that offers a flexible modular and energy efficient device. The absorption process can offer a high selectivity and a high driving force for transport even at low concentrations. Therefore, using hollow fiber gas absorption membrane contactors for acid gas removal from gas streams can be a promising alternative to conventional gas absorption systems.

Keywords: acid gas, gas absorption, membrane contactors, microporous membranes

1. Introduction

Natural gas contains acidic components such as H_2S, CO_2, etc., which must be reduced to acceptable levels before the gas is suitable for use, in addition the stack gas emission known to cause greenhouse effect and acid rain consisting acid gases are coming under increased regulations. Therefore, with increasing concern about gaseous emissions, the demand for improved and economical gas purification devices is expected to grow in the near future.

Conventional industrial methods to reduce acid gases employ gas absorption devices like packed towers, spray towers, venture scrubbers, bubble column etc. In these devices gas-liquid contacting is achieved by dispersing the gas phase in the liquid phase to achieve large contact areas thereby increasing the mass transfer rate. Even though these contacting methods are very popular in industry they have several drawbacks. Two main drawbacks are including difficulty to obtain an accurate estimate of the gas-liquid mass transfer area and a limited range of gas and liquid flow rates due to operational problems.

Polymeric membranes which are usually nonporous have been used for separation of gases. Commercial utilization of separation of gases through solid membranes is still somewhat limited due to low permeability and low separation factors. To overcome these problems membranes are being developed which are thinner, more selective and can withstand high temperatures.

In recent years, an alternative technology that overcomes the disadvantages of conventional gas absorption approaches and membrane gas separation is non-dispersive gas-liquid contact via a microporous membrane. By using a suitable membrane configuration such as a hollow fiber, fluids can contacted on