Novel Low Energy Input Regenerable Desiccants for the Drying of Carbon Dioxide Streams

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Carbon dioxide (CO_2), the major source of greenhouse gas, is generated mainly by fossil fuel combustion used for electricity production and industrial heating. All of the CO_2 storage methods available require the compression of relatively pure CO_2. In addition, post combustion drying of CO_2 is necessary because wet CO_2 stream presents significant compression and corrosion concerns during transportation and storage. To avoid condensation the carbon dioxide must be dried to below 10ppmv moisture.

Different types of molecular sieves are used for water adsorption. The classical crystalline molecular sieves are able to substantially dry a gas stream at low concentrations of water but they need high energy for regeneration. On the other hand, amorphous gel desiccants can desorb water molecules at mild temperatures (maximum 100°C), however their capacity and volume of gas, which can be dried at low partial pressures of water, is limited. Titanosilicate molecular sieve desiccants have been shown to be able to substantially dry the gas stream at relatively low water concentration and being reactivated under mild conditions. The energy input for regeneration of these desiccants is much lower than for conventional molecular sieves.

An experimental apparatus was designed and built to evaluate the performances of typical desiccants (such as silica gel and activated alumina) and titanosilicate materials at various gas stream humidities. The desiccant bed was regenerated at a mild temperature for all the samples. The results confirm that titanosilicate materials have low energy requirement for regeneration during CO_2 drying.