Abstract

Despite the advancement of time, natural gas still plays a crucial role as a fuel and raw material for many productions. The rise of alternative energy sources has not diminished the demand for natural gas, because it is one of the most economically efficient fuel options.

Natural gas requires removing to extract harmful constituents before it is suitable for consumption. Hydrogen sulfide (H_2S), a component of "sour" gas, causes corrosion in equipment and poses a health hazard. It is also a primary precursor of SO_2, which is the main contributor to acid rain. Various methods exist for purifying natural gas from hydrogen sulfide, and finding more efficient one could substantially reduce costs and protect the environment.

Due to their unique characteristics, zeolites serve as both adsorbents and catalysts in numerous fields. They are essential in the natural gas purification process, effectively eliminating sour elements.

The objective of this work is to modify the commercially available zeolites such as 4A, 5A and 13X and synthesis of zeolites from kaolin for the removal of H_2S from natural gas and nitrogen.

A literature review on various hydrogen sulfide elimination technologies from natural gas mixture is presented. Adsorption processes have shown promising performance for gas separation due to design flexibility, high separation efficiency, low operational costs, and high-purity product. Therefore, for the removal of H_2S from natural gas, adsorption processes utilizing zeolites, and their modified forms were chosen in this work

Initially, Faujasite type zeolite (13X) and Linde type zeolite (5A) underwent treatment with a silver nitrate solution to enhance their capacity for adsorbing H_2S. The process of removing H_2S from natural gas took place in a lab-scale adsorption unit. The studies involved employing binary mixtures of H_2S/CH_4 and H_2S/N_2. The adsorber was packed with zeolite samples, and a mixture of natural gas with varying amounts of H_2S was passed through the adsorber column. The adsorption capacity of zeolite samples was determined based on the results of adsorption experiments. The results revealed that the alteration of 13X zeolite with silver presents a viable option for adsorbing and eliminating H_2S from natural gas.

Then, zeolite samples were synthesized from Angren Kaolin (Uzbekistan) to purify natural gas from H_2S. The synthesis process involved alkali-fusion following by hydrothermal and traditional hydrothermal procedures. Moreover, sodium silicate was added as a source of sodium to the kaolin to adjust Si/Al ratio. Effects of the aging and crystallization time as well as addition of sodium silicate were evaluated.

The adsorption performance of synthesized samples was assessed by separating H_2S from methane, and the results were compared with those of commercial zeolites. The findings indicated that the synthesized samples exhibited a high adsorption capacity relative to commercial zeolites.

KEY WORDS: hydrogen sulfide, natural gas, zeolites, adsorption, silver modification, halloysite, kaolin, zeolite synthesis, LTA type zeolites, FAU type zeolites.