While helium recovery from natural gas is not a new idea, the traditional separation methods – such as the most widely used cryogenic distillation process, followed by a pressure swing adsorption – are expensive and energy-intensive. Hence, novel adsorption- or membrane-based separation methods are in demand and have been an active area of research in recent years.1 Kadioglu and Keskin performed the first large-scale computational screening of the MOF membranes as the potential materials for He/CH4 separation. In their study, the adsorption and diffusion properties of helium and methane in 139 MOFs were examined *via* the grand canonical Monte Carlo and equilibrium molecular dynamics simulations, considering both the single-component gas as well as the binary CH4/He mixtures. Results were compared to the traditional polymer and zeolite membranes, where He selectivity of MOF membranes was found to be lower than most of the conventional membranes, but He permeability of MOF membranes was predicted to be much higher than those of the traditional materials. Three MOF membranes combining the high He selectivity and permeability were identified, suggesting a good alternative material for a membrane-based CH4/He separation.2 A year later, another study on the use of MOFs in helium recovery from natural gas emerged, focused this time mainly on the adsorbent-based approach. 500 MOFs were subject to a several-step computational screening (including GCMC and EMD simulations), leading to 10 structures identified as exhibiting the best performance for the He/N2 adsorption-based separation. The diffusion-based separation was also assessed, revealing the 10 best MOFs based on their membrane selectivity. Parameters studied included the geometrical properties, dilution and charge effects. The structure-property relationships which were established provided a useful information on the desired pore size, helium void fraction and surface area of MOF materials.3 Latest research on helium recovery also explores another class of materials – the zeolite-type ultra-thin MFI membranes. L. Yu *et al.* conducted an experimental study, evaluating the MFI membranes for the separation of equimolar CH4/N2/He mixture. Experiments were carried out at different pressures and temperatures, and in all the studied conditions membranes were found to exhibit high separation factor and high flux. A maximum separation factor of 152 was observed at temperature of 153 K, a feed pressure of 3 bar, and a permeate pressure of 0.2 bar.4

Helium recovery from the natural gas remains a very active area of research, and a topic in high demand. Pressing problems of helium deficit require novel solutions and approaches, and thorough studies of potential materials.

**References:**

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***Extra notes***

*“Recovery and purification of He using adsorption-based separation technique might be challenging because He is generally the component having the least affinity to the adsorbent in a gas mixture, which results in adsorption of other gases present in the mixture. Thus, the efficiency of the adsorption-based He separation process strongly depends on the type of materials used as adsorbents in addition to the composition of the feed gas. Similarly, the success of a membrane-based separation process for He recovery is highly dependent on the type of the material used as a membrane. Membrane should have high He selectivity for an efficient separation. Besides selectivity, permeability is another key factor that determines the efficiency of a membrane-based gas separation. A highly selective membrane would be useless if the [gas permeability](https://www.sciencedirect.com/topics/materials-science/gas-permeability" \o "Learn more about gas permeability from ScienceDirect's AI-generated Topic Pages) is low since a membrane with low throughput requires a large surface area and high capital cost. A membrane with high gas permeability but low selectivity is also undesirable since it would not achieve the separation with high purity.“*

* *Do we focus only on adsorbent-based methods or do we also look for potential membranes (which are more diffusion-based etc). In other words, do we examine only adsorption properties of gases of interest or the diffusion ones as well*