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Commentary

Polymerized Room Temperature Ionic Liquid Membrane (Poly(RTIL)): An Advancement in Gas Separation Membrane Technology

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DESCRIPTION

Natural gas, after oil and coal, is the most important fuel source. These days, natural gas usage is not just confined to industry; it is also widely used in the production of electricity and the transportation sector. The conventional methods for treating natural gas included absorption, adsorption, and cryogenic distillation. However, because of the regeneration process, the enormous equipment, and the wide space required for the massive equipment, these approaches have substantial treatment costs. Membrane technology provides the finest natural gas treatment because of its inexpensive startup costs, simple operation, and high CO_2 removal rate. In order to meet the pipeline and commercial requirements, natural gas is anticipated to contain less than 2 vol% or fewer than 2 ppm of CO_2 following the natural gas treatment. This specification was created to ensure the pipeline's lifespan and prevent having to spend too much money replacing the pipeline. Membrane technology has received a lot of interest from a variety of companies, particularly those and academics who are researching it since it has the most substantial effect on lowering prices and environmental problems.

A membrane is described as a thin layer that divides two phases and selectively prevents the transport of different substances. Certain molecules with larger kinetic diameters cannot pass across membranes. The permeability and selectivity of the membrane's transport qualities, which are what give it its commercial worth, are determined. Low CO_2 loading (15 mol%) is the main weakness of the current systems. The ideal membrane would have high permeability and high selectivity, but most membranes exhibit high selectivity in low permeability and vice versa, making this a significant trade-off for membranes. Furthermore, none of these technologies have yet been developed to treat natural gas with high CO_2 concentrations (>80 mol%). Comparatively, the modular structure of RTIL, particularly those based on imidazolium, allows for the polymerization of a solid, dense, and thin film membrane. When the researcher discovered that polymer made from ionic liquid monomer had a larger CO_2 absorption capacity and faster absorption and desorption rate than the neat RTIL, it was a significant scientific advance.

Moreover, poly(RTIL) is said to have greater mechanical strength. These individuals have demonstrated the potential of polymerized ionic liquid (poly(RTIL)) as a material for membrane gas separation. When the n-alkyl group was prolonged during the polymerization of the RTIL monomer, it was found that the permeability of supplied gases such CO_2, N_2, and methane (CH_4) increased. Moreover, poly(RTIL) is capable of absorbing roughly twice as much CO_2 as its liquid cousin, making it much superior than molten RTIL. It appears that the substituent that is linked to poly(RTIL) also affects how well it performs. The separation selectivity appeared to improve in a study on the addition of a polar oligo(ethylene glycol) on the cation side of imidazolium-based RTIL. Improvement in separation performance is anticipated in an MMM including zeolite and poly(RTIL) (polymer matrix) (inorganic). The advantages of MMM have only recently been recognised by researchers working in the field of ionic liquid membranes.

Using poly(RTIL), RTIL, and zeolite, Hudiono and his colleagues have developed a three-component mixed matrix membrane. Their investigation was also supported by Bara and colleagues' encouraging discovery that the gas permeability of poly(RTIL) increased with the addition of RTIL. This is as a result of the fact that, when RTIL was introduced, gas diffusion happened more quickly as the free volume of membrane rose. On the other hand, Hudiono has utilised the RTIL to improve the interaction between the poly(RTIL) and zeolite as well as to raise the membrane permeability (SAPO-34). The outcome was encouraging because the permeability of the provided gases, such as CO_2, N_2, and CH_4, increased in line with it. The RTIL employed, emim[Tf2N], was allegedly not selective towards CO_2/CH_4 separation, which resulted in a minor decrease in selectivity. Yet, the outcome demonstrated that the inclusion of RTIL might improve the polymer-zeolite adhesion in MMM since RTIL also serves as the zeolite's wetting agent. In order to find the ideal

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conditions for the membrane, Hudiono carried out the same experiment again, constructing a three-component mixed matrix membrane while adjusting the amount of RTIL and zeolite added. With an increase in RTIL content, the CO2 permeability appears to increase. As long as there is enough RTIL as the wetting agent, SAPO-34 also increased the CO_2/CH_4 selectivity of the MMM as compared to neat poly(RTIL)-RTIL membrane. Also, the researchers used vinyl-based poly to conduct an evaluation of the separation performance (RTIL). RTIL is not required because they are structurally similar.