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Potential of adsorbents and membranes for SF_6 capture and recovery: A review

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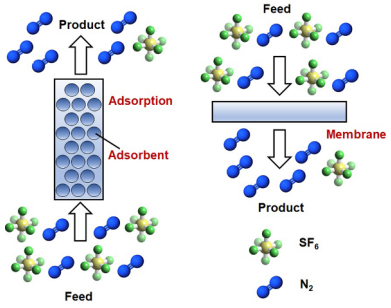
HIGHLIGHTS

- Recent progress on developments of porous adsorbents for SF_6 separation and recovery is discussed.
- Recent efforts in membrane-based SF_6 separation are introduced.
- Advantages and drawbacks on both adsorptive and membrane-based SF_6 separations were discussed.
- Current challenges and future direction in SF_6 separation are provided.

GRAPHICAL ABSTRACT



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ABSTRACT

Sulfur hexafluoride (SF_6) is an industrial gas used in various applications such as high-voltage electrical transmission and distribution systems, film protection, semiconductors, and plasma-etching processes. Compared with CO_2, the most common greenhouse gas that has received a tremendous amount of attention, SF_6 possesses a considerably higher potential for global warming and longer atmospheric lifetime. Conventional SF_6 capture and recovery methods such as distillation and liquefaction are known to be costly due to the energy required for phase changes. The use of adsorbents and membranes in SF_6 separation has therefore been extensively studied for its attractive advantages such as lower energy penalty. In this review, we present a brief overview of the current status of SF_6 separation based on adsorbents and membranes together with the technical challenges involved in such separation processes for potential industrial applications.

1. Introduction

Sulfur hexafluoride (SF_6) is a non-flammable, non-toxic, tasteless, odorless, and colorless gas [1,2]. These properties together with its high dielectric property have led to the use of SF_6 in several specialized applications such as high-voltage electrical appliances, electrical transmission, and distribution systems including circuit breakers, gas-insulated switchgear (GIS), and transformers [3–5]. The production of SF_6 began in 1953 when SF_6 was involved in the installation of the first circuit breaker in the United States. The introduction of GIS using SF_6 in 1972 further accelerated the rate of SF_6 production [5]. In 2018, the global market for SF_6 was reported to be 205.9 million USD with a 6% expected annual growth rate until 2025 [6]. SF_6 is used in film protection to prevent molten metal (e.g. magnesium) from oxidizing when exposed to ambient air [7]. SF_6 also plays a pivotal role in plasma-etching, a crucial process in the fabrication of photovoltaic devices,

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