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# Separation of Acidic Gases from Humid Flue Gas Using Advanced Membrane

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Combustion technologies constitute a major source of industrial emissions. In addition to solid by-products, combustion processes generate a wide range of compounds that are released in the gaseous phase. Various flue gas treatment methods are currently implemented to ensure compliance with emission limits prior to atmospheric discharge. However, these technologies are increasingly approaching their intrinsic limits in terms of separation efficiency.

The objective of this study is to investigate the performance of novel membrane materials using a custom-designed experimental apparatus for the separation of gaseous mixtures under humid conditions representative of real operating environments. The automated testing system is equipped with a membrane module featuring a variable effective membrane area, water vapor saturators, and humidity sensors installed on all process streams, enabling rapid and precise adjustment of experimental conditions. Furthermore, the system incorporates a gas analyzer capable of quantifying acidic components, such as $CO_2$ and $SO_2$, within complex gas mixtures.

Within this work, the purification of feed gas to levels compliant with European Commission legislative requirements is demonstrated using a thin-film composite membrane with a polyamide and polyethyleneimine selective layer under humid conditions. In addition, other polymeric membrane materials, including those based on ionic liquids and polymers of intrinsic microporosity, were evaluated using single gases and their mixtures across a range of feed pressures. Their separation performance, expressed in terms of permeability, selectivity, and stage-cut, is systematically analyzed.