# Toxic gas separation through novel membrane mechanisms.

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**Abstract:**

Toxic gases, such as carbon monoxide and hydrogen cyanide, are important feedstocks in many chemical industries, such as ammonia generation and plastics formation. Conventional separation processes for toxic gases are based on solvent absorption, but gas separation membranes are a potential alternative approach. This investigation examines the potential for membrane gas separation to achieve successful hydrogen cyanide (HCN) separation, along with other toxic gases such as carbon monoxide. The HCN permeability through a range of common polymeric membranes were measured and resulting HCN selectivity reported. Rubbery polymeric membranes' permeability strongly correlated with condensability of the gases, and therefore in HCN processing the order of permeability is $H_2O > H_2 \approx HCN > N_2$. In contrast, glassy polymeric membranes' permeability correlated with kinetic diameter of the gases, and permeability order is $H_2O > H_2 > HCN \approx N_2$. To improve the separation performance, a facilitated transport mechanism was developed based on metal chlorides within both glassy and rubbery polymeric membranes. The complexation between the hydrogen cyanide and the metal ion increased the concentration of HCN within the polymeric membrane and facilitated the permeation of HCN. This improvement was enhanced by the presence of water vapour, which enabled stronger complexation with the metal ion. As a result, the selectivity increased by an order of magnitude. This facilitated transport mechanism has implications for other toxic gases, such as carbon monoxide and demonstrated the potential for membrane gas separation to compete in toxic gas processing.

**Keywords**: Toxic gas; facilitated transport