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Most adsorptive separation processes depend on differences in adsorption equilibrium. Kinetic separation processes are more difficult to design and require more precise control of the operating conditions, especially the cycle time. They are therefore generally employed only when no equilibrium selective adsorbent with sufficient selectivity and capacity is available. Nevertheless, several practically important separations are carried out using kinetically selective adsorbents and kinetic separation processes for the separation of C_3H_6 / C_3H_8 and N_2 / CH_4 appear to be on the verge of commercialization. A brief summary of these processes and the fundamental kinetic data on which they are based is given here.

Olefin/Paraffin Separation

Recent studies of sorption kinetics in 8-ring zeolites (notably of the CHA family) have shown that subtle changes in the framework atoms (such as the substitution of Si for Al) have a small but significant effect on the dimensions of the 8-ring windows, leading to a dramatic effect on the diffusional activation energy and hence the sorption rate for critically sized molecules – see Table 1. It is clear that the diffusivity ratio ($D_{propene}/D_{propane}$) for SiCHA and DDR3 is large enough to allow rapid uptake of the faster diffusing propene with very little adsorption of propane, thus providing the basis for a highly selective separation with high propene recovery.

Table 1

		SiCHA				**DDR3**		
	K	K_{ratio}	$D(cm^2s^{-1})$	D_{ratio}	K	K_{ratio}	$D(cm^2s^{-1})$	D_{ratio}
C_3H_6	700		$8x10^{-11}$		1000		$5.5x10^{-12}$	
	}	0.8	}	11,500	}	~1.0	}	9,500
C_3H_8	900		$7x10^{-15}$		~1000		$6x10^{-16}$	

N_2 / CH_4 Separation

Efficient removal of N_2 from low grade natural gas requires a highly N_2 selective adsorbent. Most adsorbents adsorb N_2 and CH_4 at similar rates and with similar affinities but it has been shown that the titanosilicate ETS-4, when Sr exchanged and dehydrated at 540K provides the required kinetic selectivity. A pressure swing process based on this material has been demonstrated at pilot plant scale and appears economically attractive.

Douglas Ruthven, Professor of Chemical Engineering, University of Maine, U.S.A.
PhD, 1966; ScD, 1988; University of Cambridge, U.K.
Fellow of the Royal Society of Canada – Elected 1989
Max Planck Research Prize with Prof J. Kaerger , 1993
Century of Achievement Award; Canadian Soc. for Chemical Engineering, Oct 1999.
Humboldt Senior Fellowship, 2003.