

## A B S T R A C T

The catalytic conversion of ethanol to acetaldehyde in the vapour phase over silver catalyst has been studied in the temperature range  $474^{\circ}$ - $566^{\circ}$ C in a 25 mm i.d. pyrex glass differential bed flow reactor at a total pressure of one atm.

The catalyst used in this study has the following specifications :

Grade	-	Crystalline silver.
Make	-	M/s Engelhard Industries, U.K.
Bulk density	-	4.69 g/cc.
Surface area	-	0.171 m <sup>2</sup> /g as per B.E.T. method.
Average particle size	-	$4.6 \times 10^{-2}$ cm.

The investigation has been carried out in a range of conditions where resistances due to pore diffusion and gas film diffusion are negligible. The correction due to homogeneous oxidation reaction is not necessary. Dehydrogenation reaction over silver catalyst is found to be absent. The formation of acetaldehyde, therefore, takes place only due to catalytic oxidation over silver catalyst. The variables studied are as follows :

- (i) partial pressure of alcohol values ranging from 0.234 atm. to 0.455 atm.

(ii) partial pressure of oxygen values ranging from 0.175 atm. to 0.262 atm.

(iii) three bed temperatures ranging from  $474^{\circ}$ - $566^{\circ}\text{C}$ .

The activity of the catalyst has been tested time to time with very little fall in the value and hence no correction for the experimental rate is necessary.

Forty eight mechanisms based on Langmuir-Hinshelwood-Hougen-Watson models have been postulated and corresponding initial rate expressions are enlisted. The mechanisms have been tested with experimental data under conditions of constant oxygen partial pressure/constant alcohol partial pressure. Mechanisms yielding either less than satisfactory data-fitting or negative adsorption coefficients have been rejected. The best data-fitting is noted at all conditions of temperatures, partial pressures of alcohol and oxygen, with the mechanism where both the resistances - (i) adsorption of molecular oxygen on catalyst and (ii) surface reaction between alcohol in vapour phase and oxygen in adsorbed state — are simultaneously controlling the overall rate. The recommended initial rate equation for the above mechanism with irreversible adsorption and surface reaction is as follows :

$$r = \frac{2 k_s k_o p_A p_o}{k_s p_A + 2 k_o p_o}$$

where

$$k_s = 4.47 e^{-4740/RT} \frac{\text{g moles of acetaldehyde formed}}{(\text{min.})(\text{g cat.})(\text{atm.})}$$

$$\text{and } k_o = 4.14 e^{-4670/RT} \frac{\text{g moles of oxygen adsorbed}}{(\text{min.})(\text{g cat.})(\text{atm.})}$$

The rate constants  $k_s$  and  $k_o$  have been evaluated by the method of least squares. The experimental rate values have been compared with the calculated ones and are presented in tabular form.