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Kinetics and Self-Poisoning of the Oxidation of Carbon Monoxide on Pyrex Glass

Since the discovery of microcatalytic technique by Kokes *et al.* (*1*) for the evaluation of catalyst performance, it is the most frequently used method for the measurement of kinetic parameters. The catalyst is usually held in place in the microreactor by glass wool plugs. Sometimes powdered glass is also used as a catalyst diluent in the pulse reactor. Recently, it has been found by some investigators (*2*,*3*), that under microcatalytic conditions Corning glass wool and powdered Pyrex glass show catalytic oxidation property for the reaction of carbon monoxide to carbon dioxide. The present report concerns with the kinetics and self-poisoning studies of this reaction on powdered Pyrex glass.

The Pyrex glass microreactor used in the present study has been shown in Fig. 1. The reactor is composed of two parts, which can be coupled together by means of flange and screws and made gastight using a neoprene rubber gasket. The rubber septa S_1 and S_2 permit blank estimation and injection into the catalyst bed separately. About 3 g Pyrex glass of 60–80 mesh (BSS) size was charged in the reactor. Pulses of 0.25 ml gas mixture of the composition 64.4% CO and 35.6% O_2 were injected into the catalyst bed. The reaction product and the unreacted components directly passed through a gas chromatographic column (Griffin, U.K.) along with the carrier gas. The flow rate of argon carrier gas was 91 ml/min under a gauge pressure of 10 psi.

The results of this investigation have been shown in Fig. 2A and B. The rate constants were evaluated from the first

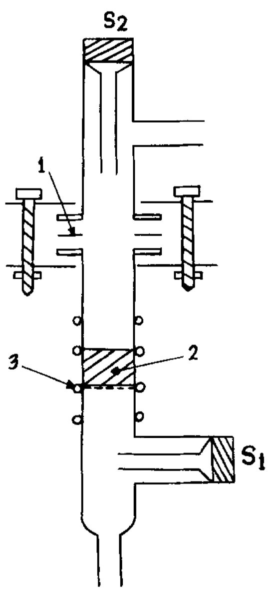

FIGURE 1

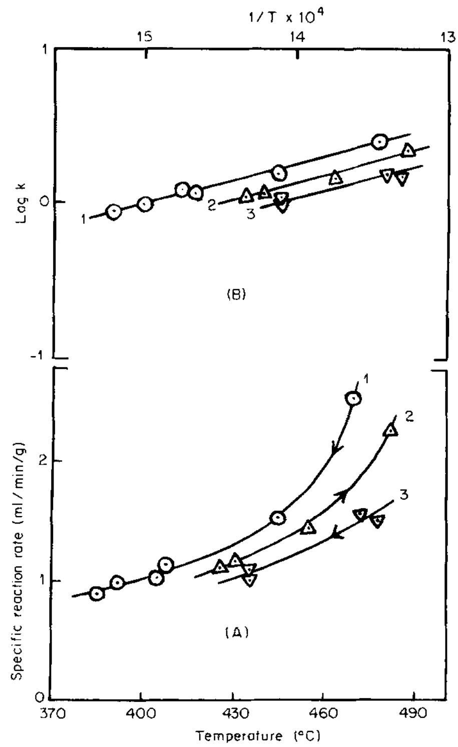

FIGURE 2

order flow reactor equation (*4*)

$$k = 2.303 \frac{F^\circ}{W} \cdot \frac{T_c}{273} \log \frac{1}{1-x}, \quad (1)$$

where, F° = flow rate of the carrier gas in ml/min, W = weight of the catalyst, x = degree of CO_2 conversion and T_c = catalyst temperature.

Macdonald and Hayes (*2*) found that this reaction is of the first order with respect to carbon monoxide but gradually falls to zero due to the reversible poisoning by the product CO_2. The specific rate constants in Fig. 2A show the extent of poisoning as observed in three runs performed on the same charge in the sequence of the arrowheads. Although the rates of reaction decreased considerably with repeated runs, neither the reaction order nor the apparent activation energy of 11.9 kcal/mole were found to change. The apparent activation energy for the Corning glass wool has been reported (*2*) to be 12 kcal/mole.

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