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COMMUNICATION

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CONVERSION OF CH_2CL_2, $CHCL_3$ AND CCL_4 TO HCL AND CO_2 IN THE PRESENCE OF PT/(CUO/AL_2O_3)

CH_2Cl_2, $CHCl_3$ and CCl_4 have been passed over a catalyst in the presence of air and a hydrocarbon fuel such as butane. The reaction products from the gas mixture and chlorinated hydrocarbons were CO_2 and HCl. Catalyst containing 0.6% Pt/(CuO/Al_2O_3) gives 65–73% conversion with all reactants at about 430°C. Effect of temperature, vapour pressure of chlorinated hydrocarbons and depth of catalyst bed were examined.

1. INTRODUCTION

This study intends to convert CH_2Cl_2, $CHCl_3$ and CCl_4 to HCl and CO_2 which are subsequently scrubbed out and reused, thereby removing the danger of a biologically harmful substance reaching the public drainage system.

Because of the chemical inertness of chlorinated hydrocarbons, the only currently available method of destroying them is by high temperature incineration, a procedure which in turn produces harmful effluents which should be removed by wet scrubbing. The purpose of this work is to devise a simple, safer and hopefully a cheaper procedure by which waste chlorinated compounds could be rendered harmless [1]. Catalyzed destruction of chlorinated hydrocarbons in the presence of Pt/Al_2O_3 has been reported [2]. Conversion of $C_2H_2Cl_2$, C_2HCl_3 and C_2Cl_4 to HCl and CO_2 in the presence of Pt/(CuO/Al_2O_3) has been investigated by SADEGHI [3].

2. EXPERIMENTAL METHODS

2.1. APPARATUS AND PROCEDURE

The reactor system used for this work and the procedure for conversion of CH_2Cl_2, $CHCl_3$ and CCl_4 is the same as for the systems reported for the conversion of $C_2H_2Cl_2$, C_2HCl_3 and C_2Cl_4 by BOND [2] and SADEGHI [3].

2.2. CATALYSTS

10% CuO/Al_2O_3 was prepared by impregnating — alumina with aqueous copper nitrate solution, and calcining the product in air for six hours at 400°C. This was then treated with a volume of aqueous chloroplatinic acid containing the desired quantity of platinum. About 6 g of each catalyst was used.

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3. RESULTS

After establishing qualitatively that high conversion of chlorinated hydrocarbons to HCl and CO_2 was occurring with a maximum reactor temperature of 430 °C, the effect of variation of vapour pressure on conversion and on reactor temperature systematically investigated. Vapour pressure 1 to 100 mm Hg for CH_2Cl_2, $CHCl_3$ and CCl_4 were used. Dependence of conversion on vapour pressure, and on temperature for three reactants are presented in Table 1. The results are shown in Figures 1 and 2. Except in

Table 1

Dependence of conversion on vapour pressure

Vapour pressure (mm Hg)	CH_2Cl_2		CHCl		CCl_4	
	Temp. (°C)	Conversion (%)	Temp. (°C)	Conversion (%)	Temp. (°C)	Conversion (%)
1	425	72.5	425	71.8	415	66.5
10	420	71.4	420	70.6	410	67.8
20	430	70.8	420	69.8	405	67.3
40	425	70.1	420	69.2	390	66.5
60	425	69.5	410	68.7	380	66.4
80	420	69.6	415	68.2	375	56.5
100	410	69.3	400	68.2	365	65.5

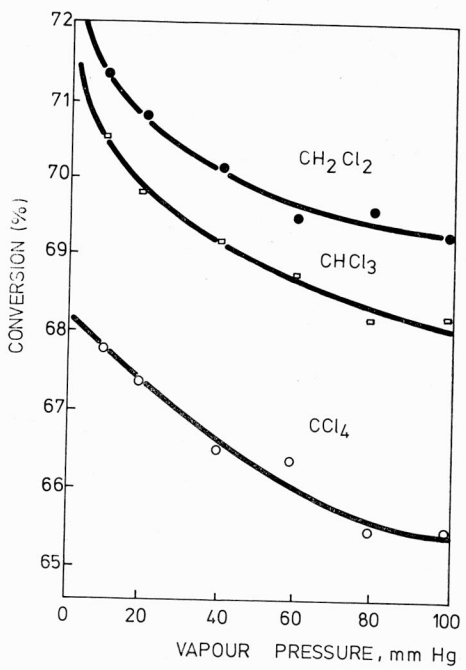

Fig. 1. Dependence of conversion on vapour pressure for CH_2Cl_2, $CHCl_3$ and CCl_4

● – CH_2Cl_2, □ – $CHCl_3$, o – CCl_4

Rys. 1. Zależność konwersji od ciśnienia pary dla CH_2Cl_2 $CHCl_3$ i CCl_4

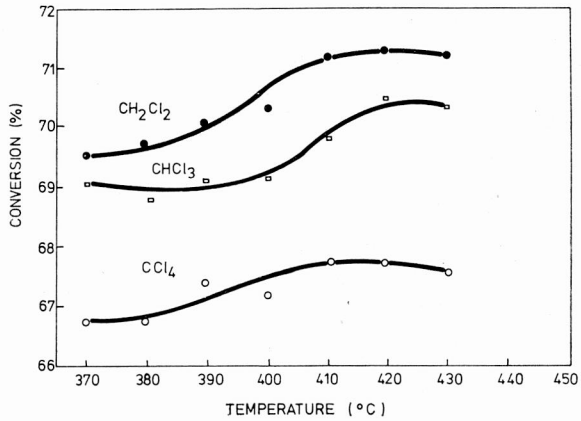

Fig. 2. Dependence of conversion on temperature for CH_2Cl_2, $CHCl_3$ and CCl_4 (at vapour pressure 10 mm Hg)

● — CH_2Cl_2, □ — $CHCl_3$, o — CCl_4

Rys. 2. Zależność konwersji od temperatury, dla CH_2Cl_2 $CHCl_3$ i CCl_4 (przy ciśnieniu pary 10 mm Hg)

he cases of CCl_4, the maximum reactor temperature remained constant in all experiments. In all cases here was only a slight decrease in conversion with increasing vapou r pressure. Dependence of conversion or all reactants on the Pt content of catalyst, at vapour pressure o f 10 mm Hg, is presented in Figure 3. The variation of conversion with bed depth of the catalyst for the three reactants has also been studied; he results are presented in Fig. 4.

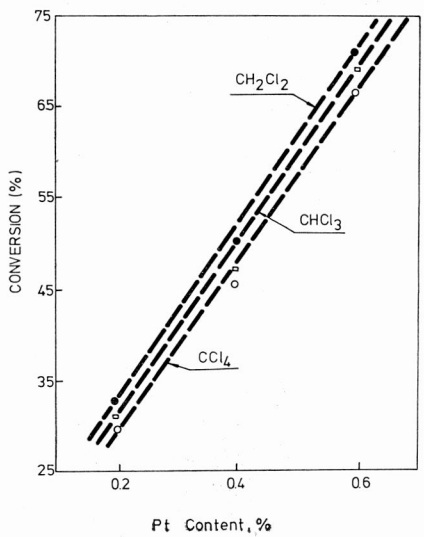

Fig. 3. Dependence of conversion on Pt content of catalyst for CH_2Cl_2, $CHCl_3$ and CCl_4 (at vapour pressure 10 mm Hg)

Rys. 3. Zależność konwersji od zawartości Pt w katalizatorze dla CH_2Cl_2, $CHCl_3$ i CCl_4 (przy ciśnieniu pary 10 mm Hg)

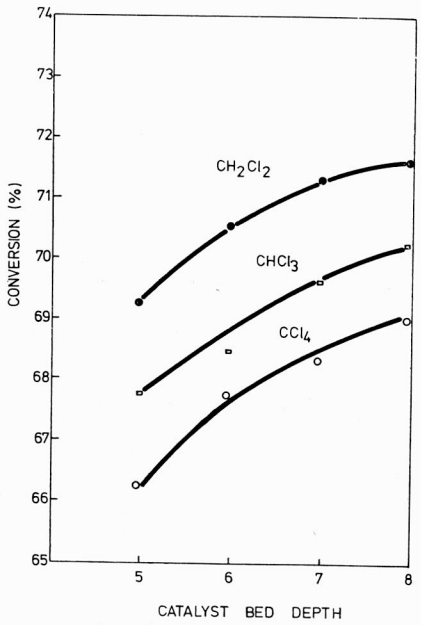

Fig. 4. Dependence of conversion on catalyst bed depth for CH_2Cl_2, $CHCl_3$ and CCl_4

● – CH_2Cl_2, □ – $CHCl_3$, o – CCl_4

Rys. 4. Zależność konwersji od głębokości złoża katalizatora dla CH_2Cl_2, $CHCl_3$ i CCl_4

4. DISCUSSION

The results described above show that conversion of all reactants is similar: under all conditions the conversion falls in the sequence CH_2Cl_2 $CHCl_3$ CCl_4, but the difference in conversion of CH_2Cl_2 and CCl_4 is significant. The variation of conversion with bed depth of catalyst was found very significant.

REFERENCES

[1] Searles R. A., Environmental Pollution Management **2**, 280, 1972.
[2] Bond G. C. and Sadeghi N., J. Appl. Chem. Biotechnol. **25**, 241–248, 1975.
[3] Sadeghi N., Environment Protection Engineering (EPE) Vol. II, No. 1, 1976.