Removal of Odorous Aromatic Amine Environmental Pollutants by Chloramine-T*

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INTRODUCTION

Aromatic amines are well-known odorous compounds derived from numerous industrial sources and thus, represent significant environmental pollutants (SUMMER, 1963). Because these amines are highly malodorous, it would be advantageous to use a suitable scrubbing or reaction liquid or absorbent for odor removal. Hypochlorite (SAWYER, 1957) has been used as a scrubbing agent because of its strong oxidative and chlorinating ability. However, it has the disadvantage of instability, decomposing rapidly in the presence of light (ALLMAND et al., 1925; SIDGWICK, 1962).

The present study concerns the reaction of some aromatic amines, which may be emitted as industrial air and water pollutants, with chloramine-T (CAT). The original hypothesis of this study was that an organic chlorinating agent such as CAT (p H_3C-C_6H_4-SO_2NClNa. $3H_2O$) might function as efficiently as hypochlorite in terms of odor removal and yet have an enhanced stability. This communication consists of preliminary results done in the laboratory, without the use of a scrubber or flow system, suggesting that CAT would be an effective scrubbing liquid for aromatic amine environmental pollutants.

MATERIALS AND METHODS

Materials: p-Chloro-, p-bromo- and p-nitroanilines were of analytical reagent grade (Eastman Kodak/Aldrich). Chloramine-T (Eastman Kodak) was freed from possible dichloro- contaminants by washing with carbon tetrachloride and dried.

Methods: The reaction mixture, containing slight excess of CAT compared to the amine, was kept in buffered (pH 7.4) aqueous medium at 50°C; in each case the reaction was allowed to proceed to completion. The precipitated N-chloroaniline was filtered and recrystallized in ethanol.

Various isolated N-chloroaniline derivatives as well as respective reaction mixtures were compared with the respective

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original reactant in terms of odor threshold. In each case the approximate range of odor was determined crudely by dissolving the compound in ethylene glycol. Once the odorous range was bracketed, approximately six binary dilutions were made of the compound ranging from slightly odorous to non-odorous. Each dilution (5 ml) was placed in a small closed container and for each dilution there were also four containers containing only 5 ml of ethylene glycol having no odor (blanks). Each member of the odor panel, consisting of untrained individuals (9), was presented with each set of 5 bottles, at each dilution, and asked to determine which one of the 5 bottles contained odorant. The odor threshold was that dilution at which 1/2 of the panel members were unable to detect the odor.

RESULTS AND DISCUSSION

The results of the odor analysis of some selected reactants and their respective products appear in Table I.

TABLE I

Odor Analysis of Reactants and Products

Compounds		Odor Threshold Dilution Level	
Reactant	Product	Reactant	Product
p-nitroaniline	N-chloro-p-nitroaniline	1 mg/ml (1.0 binary dilution)	No odor
p-chloroaniline	N-chloro-p-chloroaniline	0.75 mg/ml (1.5 binary dilutions)	No odor
p-bromoaniline	N-chloro-p-bromoaniline	0.8 mg/ml (1.4 binary dilutions)	No odor

It is clear from Table I that in each case the odor threshold dilution of the reactant is greater than for the corresponding product. Thus, with p-bromoaniline , for example, 1.4 binary dilutions are necessary to make the substance undetectable to one half the panel, while no odor could be detected from the undiluted product by the panel.

It was also observed that CAT reacts more slowly than hypochlorous acid, (HOCl). For the concentrations studied at 30°C in the case of p-nitroaniline, which is the least reactive (determined from the kinetics of the reaction which will be presented elsewhere in more detail), the reaction is complete in less than one hour. Nevertheless CAT has certain advantages over HOCl in that it is substantially more stable and can be stored both prior to

scrubbing and after the scrubbing operations and would not decompose to any substantial degree. Hence, it would have a much greater capacity as a scrubbing liquid than HOCl. Consequently, CAT has a good potential for being utilized as a scrubbing liquid.

CONCLUSION

A study of the reaction of some aromatic amines (e.g., some substituted anilines, emitted from industrial stacks or as sewage effluent ultimately becoming environmental contaminants) with chloramine-T has been made. Odor studies have been performed on the products as well as reactants using an odor test panel to determine the odor threshold levels. From the preliminary studies it is concluded that this chlorinating technique may have application in air and water pollution control.

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REFERENCES

ALLMAND, A.J., P.W. CUNLIFFE and R.E.W. MADDISON.: J. Chem. Soc. 127, 822 (1925).

SAWYER, C.N.: Sewage and Industrial Waste 29, 978 (1957).

SIDGWICK, N.V.: The Chemical Elements and their Compounds. Vol. 2, pp. 1212-1217, London: Oxford University Press 1962.

SUMMER, R.: Methods of Air Deodorization. New York: Elsevier Publishing Co. 1963.