"Adsorbents and Adsorption Processes"

by

D. E. Weiss

Being a collection of published works, with explanatory notes, submitted in support of his candidature for the Degree of Doctor of Science of the University of Adelaide, October 1958.
Table of Contents

I. Preface
II. Notes on individual publications submitted
III. Publications in order of reference in the Preface
IV. Appendix
V. Patents
A. INTRODUCTION

The contributions of the candidate to Science and Applied Science in the field of adsorption and ion-exchange are described in this thesis in a series of experimental papers, reviews and patents. The work was performed in the laboratories of the Division of Industrial Chemistry, Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia. As far as can be ascertained, none of this work reproduced or duplicated work carried out in any other laboratory. It was original with the candidate except to the extent indicated by the acknowledgments given in the text or mentioned in the notes on individual papers given below.

This thesis is the result of an interest acquired while employed as a shift chemist in a paper mill where it was observed that the various dyestuffs added in very small amounts to the paper pulp segregated in layers on the foam which occasionally accumulated on top of the water draining from the pulp on the Fourdriner screen. It was realised that this was a counter-current adsorption process operating under total reflux. Thus the dyes which were preferentially adsorbed at the air-water interface were carried by the rising air bubbles to the top of the foam column where the foam broke and deposited them in the solution which drained back as a descending reflux stream. The dyes thus segregated as layers in the column according to their ability to be adsorbed at the interface.

This observation led to a compelling interest in counter-current adsorption processes and to the idea that the capacity of the process might be increased to a practicable value by putting an adsorbent at the air-water interface. After a brief period in the antibiotic industry, which was using adsorption processes at the time, the candidate was fortunate in being given the opportunity to actively pursue the development of novel adsorption processes in the Division of Industrial Chemistry.

This Preface will show how this original interest in foam fractionation has led logically and successively to studies in such diverse fields as those of antibiotics, hydrometallurgy, water demineralisation, rubber reinforcement and processes of energy transformation akin to those of biological systems. Because the interrelation of these various fields may not always be apparent from the publications submitted, it is desirable to show how these interests have developed so that the thesis may be considered as a logical whole.

B. INDUSTRIAL ADSORPTION PROCESSES

The characteristics of an industrial adsorption process are determined essentially by the rate of adsorption. If large organic molecules such as antibiotics are being adsorbed from solution, very finely divided adsorbents will be required for the operation of the process at a practicable rate; if the molecules are small, as in the exchange of inorganic ions by ion-exchange resins, or in the adsorption of gases, granular beds of coarse adsorbent particles may be used since the rates of adsorption are high.