MODERN CHLOR-ALKALI TECHNOLOGY

MODERN CHLOR-ALKALI TECHNOLOGY

Editor:
M. O. COULTER
formerly Development Manager, BP Chemicals
Sandbach Works, Cheshire

Published for the
SOCIETY OF CHEMICAL INDUSTRY
London
by

ELLIS HORWOOD LIMITED
Publishers · Chichester

First published in 1980 by

ELLIS HORWOOD LIMITED
Market Cross House, Cooper Street, Chichester, West Sussex, PO19 1EB, England

The publisher's colophon is reproduced from James Gillison's drawing of the ancient Market Cross, Chichester.

Distributors:

Australia, New Zealand, South-east Asia:
Jacaranda-Wiley Ltd., Jacaranda Press,
JOHN WILEY & SONS INC.,
G.P.O. Box 859, Brisbane, Queensland 40001, Australia.

Canada:
JOHN WILEY & SONS CANADA LIMITED
22 Worcester Road, Rexdale, Ontario, Canada.

Europe, Africa:
JOHN WILEY & SONS LIMITED
Baffins Lane, Chichester, West Sussex, England.

North and South America and the rest of the world:
Halsted Press: a division of
JOHN WILEY & SONS
605 Third Avenue, New York, N.Y. 10016, U.S.A.

British Library Cataloguing in Publication Data
Modern Chlor-alkali technology.
1. Chlorine industry
I. Coulter, M. O. II. Society of Chemical Industry
665'.83 TP245.C5 80–412–36

ISBN 0-85312-184-2 (Ellis Horwood Ltd., Publishers)
ISBN 0-470-27005-5 (Halsted Press)

Typeset in Press Roman by Ellis Horwood Ltd.
Printed in Great Britain by W. & J. Mackay Ltd., Chatham

Table of Contents

Introduction

M. O. COULTER

When this symposium was held, only 3 years had elapsed since the 1976 meeting on 'Diaphragm Cells for Chlorine Production' [1], which was also sponsored by the Electrochemical Technology Group of The Society of Chemical Industry. Such has been the pace of development, however, that ample new information was available for presentation and discussion, and the programme of 23 papers submitted for publication attracted an international gathering of some 280 delegates from 20 countries.

In recent years the most rapid advances have been made in the development of perm-selective membranes capable of withstanding the highly aggressive conditions in chlorine cells, and in the design of membrane cells. But continual improvement has also been taking place in the traditional mercury and diaphragm processes, both to minimise overall costs in the context of rapidly escalating fuel prices and to reduce the potential hazards to health and the environment.

The first 7 papers deal in the main with development of the traditional processes. They include information on improved diaphragms (not all based on asbestos), on the the commercial performance of a bipolar diaphragm electrolyser and on a new method of brine purification employing liquid/liquid extraction of polyvalent ions with oil-soluble ion exchange agent, which avoids the production of solid waste contaminated with mercury. There are also comparisons of the competing cell technologies, information on a method of controlling the chlorate concentration in the circulating brine for membrane cells and a fascinating account of mercury cell development in one organisation from the Castner-Kellner rocking cell to their latest 400 kA design.

The next 5 papers are concerned with electrode coatings. Considerable research has been in progress on improved methods for coating titanium anodes and on alternative coating compositions to those based on ruthenium dioxide, the objectives being to reduce first cost or to improve durability and short-circuit resistance in mercury cells. The development of platinum/iridium coated titanium anodes, which have proved successful in chlorate manufacture and sea-water electrolysis, is described. Attention has also been paid to reducing the cathode overvoltage in diaphragm and membrane cells by applying porous nickel coatings, a subject which is also referred to in one of the more general papers in the first section.

In their early days, membrane chlorine cells found acceptance principally for very small plants where the chlorine and caustic products could be used on site. However the papers in this section show that they are already becoming competitive for plants of medium size, especially at locations where particularly stringent pollution regulations are in force. The subjects covered in this section range from the fundamentals of membrane behaviour to data on plants in commercial operation of capacity up to 80 000 tonnes per annum of caustic soda. A novel development, approaching the stage of industrial scale testing, is a membrane electrolyser with vertical electrodes and a rising amalgam cathode; it is hoped that this will combine the advantages of membrane cells and horizontal mercury cells.

The maintenance of high current air-break switches in cell-rooms has long been a problem. The development of sealed vacuum-break and argon-filled liquid metal switches, which are described in the next two papers, is therefore particularly welcome. A multi-break scheme suitable for the higher switching potential of bipolar electrolysers is included.

The two final papers deal with safety and environmental protection. Although the chlorine industry world-wide has not been entirely free from incidents, its safety record in relation to the tonnage produced, transported and handled is very creditable. These papers illustrate the contributions made in the UK to this record by guides to safe practice, developed by the industry in close collaboration with statutory bodies, and by the intelligent application of quantitative hazard analysis.

The Society's thanks are due not only to the contributors to this volume, but also to the opening lecturer [2], the Organising Committee [3] and the session Chairmen [4], whose efforts ensured the success of the symposium, and to BP Chemicals Limited for generous hospitality.

[1] Diaphragm Cells for Chlorine Production. (Proceedings of a symposium held at The City University, London, England, 16–17 June 1976). London: Society of Chemical Industry 1977.

[2] J. Wood. Olin Corporation, P.O. Box 248, Charleston, Tennessee, 37310, U.S.A. An Overview of the Coming Programme with an Update on Chlorine Gas Handling, (not for publication).

[3] Dr. A. Pennell, BP Chemicals Limited (Chairman); Mr. W. E. Cowley, Associated Octel Limited (Chairman, Electrochemical Technology Group, Society of Chemical Industry); Mr. D. Bell, BP Chemicals Limited (Organising Secretary); Mr. B. Lott, Associated Octel Co. Limited; Dr. S. F. Mellish, ICI Limited; Mr. M. A. Warne, IMI Marston Limited.

[4] Dr. A. Pennell; Mr. R. Schoberle, Solvay et Cie, Rus de Prince Albert 33, 1050 Bruxelles, Belgium; Mr. R. Mitchell, The Chlorine Institute Inc., 342 Madison Avenue, New York 10017, U.S.A.; Dr. S. F. Mellish; Mr. W. E. Cowley.

Section A

Design and performance of chlorine cells and brine electrolysis systems