



## Book Review

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### **Electrochemical Processing for the Pulp & Paper Industry.**

*The Electrochemical Consultancy, Underhill,*

*Fairview Drive, Romsey, Hants SO517LQ, (1996)*

*232 + xxiv pages, ISBN 0-9517307 2 X Hardback (£45),*

*ISBN 0-9517307 7 0 Paperback (£30)*

This A5 size monograph follows textbooks on electrochemical kinetics (Pletcher) and electrochemical engineering (Walsh), published by Professor Pletcher, who has co-authored the fourth in the series, on ion exchange membranes.

The author intends his book to promote the use of electrochemistry in the pulp and paper industry, making the processes involved more environmentally benign. The book's publication is timely, particularly in view of chlorine receiving such an increasingly bad press in recent years, resulting in a symposium concerned with its "image". The environmental pressure to replace chlorine, until recently the most commonly used bleaching agent in pulp processing, is evident even from the units used for the maximum permitted concentrations of the chlorinated derivatives formed, in the case of dioxins being parts per quadrillion!

The book is ambitious in its scope, each of the four chapters being extensively referenced to recent journal, book and patent literature, and covering:

1. *Pulp and paper technology* (51 pages) – pulping, brightening and bleaching, papermaking, recycle of fibres, material recovery and pollution control.
2. *Principles of electrochemical technology* (59 pages) – cells, reactors, processes.
3. *Electrochemical technology for the pulp and paper industry* (88 pages) – chemical pulp, mechanical pulp, waste treatment, electrochemical processing of lignin.
4. *Process synthesis* (32 pages) – conceptual design of processes, flowsheets and stream tables, material and energy balances, cost estimation, process modelling and optimisation.

For those, like the reviewer, who had little knowledge of the pulp and paper industry, the first chapter provides both a fascinating overview of the principal processes involved and a framework for understanding how electrochemical technology has contributed, and may yet contribute, to alleviating the industry's environmen-

tal pressures of water and energy use, and pollution prevention by clean(er) technology. As aqueous sulfide is used for 'defibrating' the wood, the chemistry of the various processes are described using a combination of overall chemical reactions, block diagram process flowsheets, and black-and-white photographs of plants and equipment where appropriate.

Chapter 2 covers the principles of electrochemistry and electrochemical engineering, presumably aimed principally at those in the pulp and paper industry, particularly those responsible for introduction of new technology. As might be expected, the book is particularly authoritative in chapter 3, which summarises recent electrochemical developments in, or impacting on, the pulp and paper industry, and especially those with which the authors has been involved personally, as with hydrogen peroxide production. Recent technological developments are summarised in the production of chlorine-containing ( $\text{Cl}_2$ ,  $\text{HClO}$ ,  $\text{ClO}_3^-/\text{HClO}_3$ ,  $\text{ClO}_2$ ,  $\text{ClO}_2^-$ ) and oxygen-containing oxidants ( $\text{H}_2\text{O}_2/\text{HO}_2^-$ ,  $\text{O}_3$ ), together with sulfur-containing ( $\text{S}_2\text{O}_8^{2-}$ ,  $\text{HSO}_5^-$ ) and other peroxy compounds, for chemical bleaching of pulp and a range of other mainly inorganic oxidants (e.g.  $\text{Ce(IV)}$ ) and reductants (e.g.  $\text{S}_2\text{O}_4^{2-}$ ,  $\text{V(II)}$ ,  $\text{Cr(II)}$ ). In addition, salt spitting with ion-exchange membranes and on aqueous and gaseous waste treatment processes. It would be unfortunate if the title of the book deters those who could benefit from its discussion e.g. of the generation of oxidants and reductants, which have present and prospective applications well beyond the industry it addresses. For example, recent technological developments in the production of dithionite ( $\text{S}_2\text{O}_4^{2-}$ ) have been made by Olin Corporation, Tennessee, that presumably sells its product well beyond the paper industry. The final chapter provides a balancing view that while electrochemistry offers an elegant means of injecting chemical energy into many systems of relevance to the pulp and paper industry, economics provide the ultimate figures of merit.

The author is to be congratulated on having written so readable a book which should be of value to all those with interests in electrochemical technology, regardless of their industrial affiliation. The book's relatively low price, appropriately good quality paper, clear text and well drawn diagrams and flowsheets, should encourage personal, institutional and industrial purchasers.

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