WILEY/SITA Series In Surface Coatings Technology

RESINS FOR SURFACE COATINGS

Volume 1 (Second Edition)

Acrylics & Epoxies

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VOLUME I
Acrylics & Epoxies

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N.Truck
Edited by P.K.T.Oldring

JOHN WILEY AND SONS
CHICHESTER · NEW YORK · WEINHEIM · TORONTO · SINGAPORE

Published in association with
SITA TECHNOLOGY LIMITED
EDINBURGH · LONDON UK

Published in 2001 by
John Wiley & Sons Ltd
in association with SITA Technology Ltd.

Wiley Editorial Offices
John Wiley & Sons Ltd, Baffins Lane,
Chichester, West Sussex PO19 1UD, England

John Wiley & Sons, Inc, 605 Third Avenue,
New York, NY 101580012, USA

VCH Verlagsgesellschaft mbH
Pappelalee 3,
D-69469, Weinheim, Germany

Jacaranda Wiley Ltd, GPO Box 859, Brisbane
Queensland 4001, Australia

John Wiley & Sons (SEA) Pte Ltd, 37 Jalan Pemimpin 05-04,
Black B, Union Industrial Building, Singapore 2057

John Wiley & Sons (Canada) Ltd, 22 Worcester Road,
Rexdale, Ontario M9W 1L1, Canada

Copublished with J. Wiley & Sons Ltd, Chichester

Library of Congress Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

ISBN 0471 978 949

Printed and bound in Great Britain by Short Run Press Ltd, Exeter.

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Volume I
(Second Edition)

Acrylics & Epoxies

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CHAPTER 1

INTRODUCTION

INTRODUCTION

Since the 1950's there have been many significant changes in surface coatings which have necessitated major changes in the resins used, even though many may still be referred to by generic names. Thus it is appropriate that a series of books written for graduates new to the resins and surface coatings industries giving an overview of the technology of resins for surface coatings should be issued in time for the new millennium to reflect the recent advances within these industries.

It is reported[1] that there was a time when the surface coatings industry dealt with a relatively small number of materials and processes for making paints and varnishes. Indeed it is claimed[1] that between 1736 and 1900, Watin's book on varnish formulations was reprinted 14 times with only minor modifications. This was claimed[1] to be the industry standard. Compare that with today's situation. A book which lasted for 200 years to the turn of the century was followed by a series of books[1-5] published in the 1940's which lasted 40 years which were superseded by a set which lasted 20 years before needing to undergo major revisions. It is not the writing which is inadequate, but it is a true reflection of the increasing rate of change of the surface coating industry.

Reference to some of the earlier text books written for the surface coatings industry reveal how far this industry has progressed over the last 50 or so years. Examination of a 5 volume set of books published by Wiley[1-5] and Sita will be used to illustrate the changes and progress which have occurred and the approximate dates for introduction of what were considered new technologies over the last hundred or so years. Dates for new technology developments may be the subject of debate, because it was often different between North America and Europe and even within some parts of Europe. Dates are given to try and put this industry and its developments into historical perspective.

In the early 1900's resins used for surface coatings were based upon naturally occurring materials, albeit with some degree of modification or processing in some cases. Some of the early resins for surface coatings resembled alchemy, where secret ingredients and/or processing techniques were handed down from father to son (at the turn of the century, there were few, if any, female resin chemists).

In the opening paragraph of Volume III, Chapter 4 of Mattelio's book[3] written in the early 1940's which is reproduced here, the reader will note a lot of similarities to the above paragraph and some would question whether the situation had changed. Rest assured it has changed beyond all recognition from the 1940's let alone prior to 1900!

"The art and skill of the old-time varnish maker have yielded slowly to more scientific control and to the development of the chemists and engineers who have

entered the coating-materials industries. The complexity of the organic molecules which they have had to deal with, however, has necessitated the continued use of methods which, although more exact and more scientifically grounded than those of their predecessors, nevertheless are still empirical".

".....it is well to remember that the molecular complexity of the drying oils and resins which are now (1943) in commercial use has provided a formidable variety of problems, which have long proved perplexing.....Under such circumstances, one hardly need wonder that empiricism has so long prevailed or why there have been so many recorded differences of opinion and conflicting experimental observations".

To quote a recognised industry standard publication[1] 55 years ago, "manufacture was in the hands of untrained men. Chemists or engineers, if there were any in this industry one hundred years ago (ca 1850), were a curiosity. The breadth of science had not yet touched it, and most manufacturers at that time saw no reason why it should."

When resins were processed, early controls consisted of mainly empirical factors, such as string length – how long a piece of resin could be stretched before breaking. The objective was to process a resin as close to its 'gel point' as possible, without actually gelling the resin. Being oil based and relatively small scale manufacture, gelation of a resin although undesirable was not the catastrophe which it would be if a 'modern' synthetic resin were to gel, particularly on the 20+ tonne reactor scale. The addition of vegetable oils to 'oil out' the gel was commonplace. The gels tended to be much less structured and less tough than a gel from a urethane reaction, for example. Much thermal processing was on gas fired open iron vessels, which resembled a pan on a gas cooking ring. Foam over and associated fires were common place. Indeed, folklore has it that some resin processing was controlled by processing until it "foamed over" or ignited.

Early surface coatings were limited mainly to air drying systems which film formed by either evaporation of solvent, to leave a dried film of the natural resin or oxidative crosslinking of any unsaturation present in vegetable oil based binders. French polish, based upon shellac is an example of the first type of coating, whilst alkyds or oleoresinous based systems are examples of the latter.

Alkyds and oleoresinous based coatings were originally used for many surface coating applications, where there was a performance demand, such as increased durability or resistance to water or alkali, compared to alternative systems. The unsaturation in the vegetable oil portion of the resin enabled crosslinking reactions, induced by oxygen in the air, to form resistant and durable films. Some decorative paints, based on linseed oil, for example, could easily yellow. Other systems (varnishes, rather than coatings), were often based upon so lutions of hard, naturally occurring resins.