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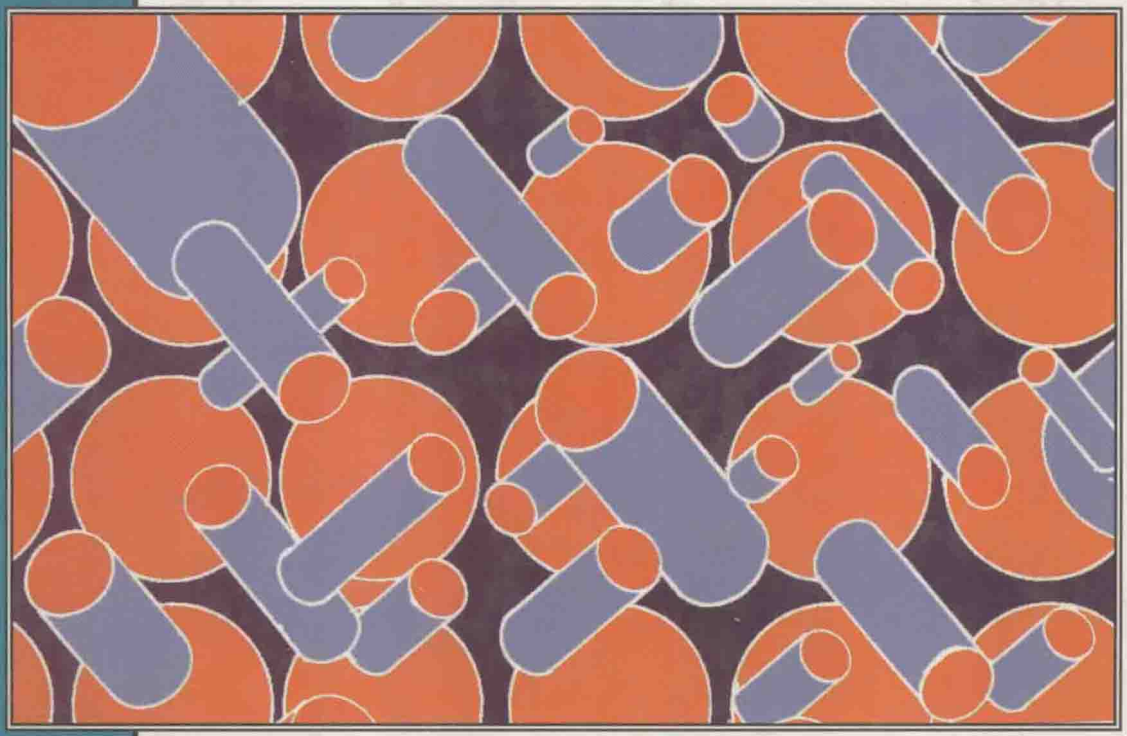
CELLULOSICS: PULP, FIBRE AND ENVIRONMENTAL ASPECTS

editors
J.F. Kennedy, G.O. Phillips
and P.A. Williams



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This meeting owed its success to the invaluable assistance of the Organising Committee.

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International Educational Scientific Meetings
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CELLUCON CONFERENCES AND THE CELLUCON TRUST

Cellucon Conferences as an organisation was initiated in 1982, Cellucon '84 was the original Conference, which set out to establish the strength of British expertise in the field of cellulose and its derivatives. This laid the foundation for subsequent conferences in Wales (1986), Japan (1988), Wales (1989), Czecho-Slovakia (1990) and USA (1991). They have had truly international audiences drawn from the major industries involved in the production and use of cellulose pulp and derivatives of cellulose, plus representatives of academic institutions and government research centres. This diverse audience has allowed the cross fertilization of many ideas which has done much to give the cellulose field the higher profile that it rightfully deserves.

Cellucon Conferences are organised by The Cellucon Trust, an official UK charitable trust with worldwide objectives in education in wood and cellulosics. The Cellucon Trust is continuing to extend the knowledge of all aspects of cellulose worldwide. At least one book has been published from each Cellucon Conference as the proceedings thereof. This volume is one of two volumes arising from the 1991 conference held in New Orleans, USA, and the conferences in Wales 1992, Sweden 1993 etc., will generate further useful books in the area.

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Preface

Cellulose '91, by any standards, was a monumental International meeting. Three major organisations, with a proven track record in organising cellulose conferences joined forces to celebrate the 50th Anniversary of the Southern Regional Research Center of the United States Department of Agriculture. These were:

- ACS Cellulose, Paper & Textile Division
- Cellucon Conferences
- Syracuse Cellulose Conferences

What could be more appropriate? Celebrating the fifty years of research achievement by the famed Southern Regional in the historic home of cotton - New Orleans. The venue alone ensured a massive turn-out of 500 scientists and camp followers. The meetings were held in the old-style Monteleone Hotel in the French Quarter; dinner was served on the Cajun Queen on the Mississippi River; the daily creole cuisine all provided the stage for a memorable Conference.

The science more than matched the occasion, as this volume testifies. Europe, Japan and the USA combined to provide a high-level cross-section of the world's best cellulose research. The output, set out in this book, confirms the resurgence in cellulose research, development and application. Lignocellulosic sources now offer the most versatile new functional, structural and varied industrial products which are environmentally friendly.

The areas covered in this book support this generalisation:

- Cellulose blends and composites
- Cellulosic enzymes
- New cellulose fibers
- Cellulose fiber-reinforced plastics

- New pulping processes
- High performance derivatives
- New fabrics and finishes
- Biogenesis of cellulose and related polymers
- Cellulosic liquid crystals
- Innovations in cellulose fiber technology
- High performance polymers from lignocellulosics
- Biological degradation

Some years ago I observed the headline in the famous New Orleans daily, the Times Picayune: *KING COTTON RIDES AGAIN.* This would be an appropriate title to this volume, if were not for the fact that a wide variety of cellulosic and lignocellulosic sources are encompassed in the papers. The series of volumes, on cellulosic research, of which this book forms the latest addition, have provided a great stimulus for cellulosic research on the five continents. We all came together in New Orleans in a spirit of friendship and cooperation in the interests of cellulose research. May we thank all who made this memorable meeting possible.

NOELIE R. BERTONIERE, CO-CHAIR CELLULOSE '91

GLYN O.PHILLIPS, CO-CHAIR, CELLULOSE '91

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PART 1

1

Research on the delignification process in pulpings

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ABSTRACT

It has been revealed that methods used to state the chemistry of delignification are not sufficient so that out of a great number of reactions of lignin defined while investigating its model compounds to expose those reactions that occur in fact within real pulping and control its stages. To eliminate this defect it has been proposed traditional methods of investigation of the chemistry of delignification supplement with the results of studies of the change of the functional composition of lignin during the real pulping. To obtain representative preparations of lignin it is necessary to use correct methods of extracting it out of liquors and residual wood. Significant differences have been proved in changes of content of the same functional groups in the process of delignification in lignins of liquor and wood residual and also in the lignin extracted in different ways out of liquors in the case of oxygen-alkaline pulping.

INTRODUCTION

Up to now investigations of the chemistry including mechanism of reactions leading to delignification have mainly been based on identification of conversion

products of substances modelling lignin main structures "in situ". However the important and necessary information collected only allows one to represent a number of reaction routes illustrating conversion ways of lignin "in situ" that are possible but not obviously realized in real pulping. The information is insufficient to define what of these reactions are determining the separate stages of a real pulping process. Study of products formed during the treatment of protolignin modelling lignin preparations or wood itself also did not confirm the truth of lignin conversion chemistry during pulping because in many cases it was not possible to define lignin structures responsible for either product formation. Besides, the behaviour of lignin preparations during treatment which models pulping, substantially differed from lignin "in situ" behaviour in the pulping. When studying the products of pulping of wood directly, additional problems arise because a wide range of identical aliphatic products form during pulping out of lignin and polysaccharides as well, some products also destruct or form in the pulping liquor, etc.

For the last 10 years the above-mentioned chemical research has included kinetic studies, investigation of reacting particles character, etc. However at present a question on advantages and drawbacks of some (approximately four) usual kinetic models is only at the discussion stage [1]. The use of kinetic research results to determine the chemistry of delignification is complicated by the fact that delignification is preceded by substantial conversion of lignin in the wood. Kinetic methods can only state the presence of this latent process without any detailed characteristics.

Determination of reacting particle type is very important for defining a mechanism of reaction but gives little information to define delignification chemistry. It relates to the fact that according to the pulping conditions the same reactions of lignin conversion and fragmentation sometimes can be realized both by homolytical and heterolytical mechanisms with the help of different particles.

When a great complexity of the object (lignin), the system where it is located (wood) and the examined process (delignification) overlap, the chemistry of real pulping is more difficult to deterimne than one can imagine even using modern research methods, simulation and computers.