Chemistry of Modern Papermaking

by Cornel Hagiopol and James W. Johnston

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Wood cellulose is one of the oldest natural polymer materials. The processes of refining (pulping) and modifying cellulose fibers to make paper, have also been in use for a long time. Today, given the dramatic increase in the production of synthetic or artificial polymers, rejuvenating old papermaking processes is a daunting challenge. The publication of the "Chemistry of Modern Papermaking" is part of that effort.

This compendium of 9 chapters, is a literature review based on an impressive number of references (over 3400). The authors' work on the effect paper chemicals have on the three-dimensional network of cellulose fibers is aimed at evaluating the main ideas put forward by the scientific community in the last decades.

After a brief review of the papermaking history, an introduction in the organic chemistry of pulping processes and reactions performed on poly-carbohydrates is presented in Chapter 2. Chapter 2 - in which 525 references are reviewed - also refers to polymerization, polycondensation and polymer-analogues reactions used to obtain synthetic polymers as potential paper chemicals.

Chapter 3 discusses the effect of chemical additions on the papermaking process (the fate of paper chemical at the wet end). The authors' investigation goes beyond the technologic effect of paper chemicals (poly-electrolytes, latexes, inorganic particles, non-ionic water-soluble compounds): paper chemical diffusion, ionic interactions, adsorption, migration, re-conformation are presented along with their impact on paper quality.

Chapters 4, 5 and 6 are focused on the temporary wet-strength, wet –strength and dry-strength resins. Their water solubility, molecular weight, cationic charges, multiple reactive functional groups, ability to generate strong or weak chemical bonds with cellulosic fibers are reviewed in minute detail. Special attention has been given to the re-pulpability potential of paper obtained in the presence of different types of paper chemicals.

Chapter 7 incorporates a highly complex study on internal sizing agents. Sizing agents have the ability to impart a hydrophobic character to cellulose fibers and to ensure a reduction in paper wettability. After the presentation of alum chemistry and of standard sizing agents (rosin and its derivatives), new chemical products are carefully studied: alkyl ketene dimmers, alkenylsuccinic anhydrides, poly-cationic compounds, fluorinated compounds, etc. The more important products are described as dispersions in water. The potential sizing mechanism (reactive and nonreactive dispersions) takes into account their reactivity toward cellulose fibers.

Creping adhesives and softeners are described in Chapter 8, together with the main technological parameters and a comprehensive list of chemical products such as: paper nonreactive creping adhesives, reactive self-crosslinkable creping adhesives, creping adhesives with a cross-linker, etc.

The last chapter (Chapter 9) deals with the chemical treatment of the paper surface. Mention is being made of the fact that chemical polymer products, especially those with high molecular mass that can or cannot contain ionic charges, are particularly useful. Special attention was given to polymer latexes, starches, emulsions of nonreactive small molecules, polymerizable surfactants, fluorochemicals, etc.

The wealth of information included in the book under review validates the authors' efforts to reflect upon and improve the papermaking processes developed during the last century. The authors should be commended for the accurate fashion in which they presented, explained and organized the information contained in their book. The technologically relevant data is analyzed with a focus on the physical and chemical interactions between the cellulose fibers and various other additions. The structures of chemical compounds are studied from the perspective of their potential to improve the final properties of paper.

"Chemistry of Modern Papermaking" will be particularly helpful to researchers and engineers working in the field, and will become required reading for young researchers specializing in the remarkably broad field of papermaking chemistry.

Dan Donescu