

THE DEPARTMENT OF PULP AND PAPER AT ITS 70th ANNIVERSARY

One of the main tendencies of the contemporary world is that of forgetting the past and people, disregarding the warning expressed by a reputed scholar:

“Man cannot mold the form of the future without being aware of his present conditions and of the limitations of his past.” [Ernst Cassirer (1874-1945), “An Essay on Man”] – or, in Leibniz’s (1646-1716) words: “To leap forward, one has first to step back”.

“There is in fact no such thing as the future, singular; only futures, plural. There are multiple interpretations of history, to be sure, none definitive – but there is only one past. And although the past is over, for two reasons it is indispensable to our understanding of what we experience today and what lies ahead of us tomorrow and thereafter.” [Nial Ferguson (1964), “Civilization: the West and the Rest”].

Not accidentally, the American Chemical Society proposed the creation of a foundation named “Chemical Heritage”, for capitalizing on cultural heritage in the field of chemical science.

In Romania, the first attempt to set up a department in the field of pulp and paper was done in 1948, in Bucharest, but it failed. That is why, Academician Cristofor Simionescu, associate professor at that time, received the mission to create, in Iasi, the Department of Technology of Pulp and Paper. Together with one of his colleagues, Professor Vasile Diaconescu, he succeeded in doing this under the most difficult conditions, inherent to any beginning, and not only. Later on, in 1955, the department is renamed Technology of Pulp, Paper and Rayon Fibers. Nowadays, as a result of the industrial development in Romania, the department is named Paper Engineering, as it is meant to provide the necessary highly qualified specialists for the Romanian industry.

Along with the organization and development of the educational system, there arose a concern about training specialists for teaching staff and, equally, for research activities. Thus, under the supervision of Professor Simionescu, the first PhD theses were elaborated and defended, such as: *Researches in the field of cellulose fractionation* (Elena Calistru – 1958); *Researches in the field of reed prehydrolysis* (Dorel Feldman); *Researches of applied chemistry in paper technology* (Emanuel Poppel – 1958); *Studies of carboxymethylcellulose and its applications in paper industry* (Nicolae Asandei – 1959); *Researches in the field of cellulose destruction* (Gheorghe Rozmarin – 1963), while over time, their authors became in turn reputed professors of the department.

The Humboldtian synergy between educational and research activities has become a characteristic of the school created by Professor Simionescu, actively manifested since its beginnings. Extensive investigations have been devoted to the chemistry of wood and annual plants, performed by mixed teams from the “Petru Poni” Institute of Macromolecular Chemistry and the teaching staff of the department. The studies carried out have enabled the publication of an impressive body of data, included in the following monographs:

- **Cristofor Simionescu**, Margareta Grigoraș, Agata Cernătescu-Asandei, “Chimia lemnului din România” [Chemistry of Wood in Romania], Romanian Academy Publishing House, Bucharest, 1964, which received the “Nicolae Teclu” Award of the Romanian Academy;
- **Cristofor Simionescu**, Margareta Grigoraș, Agata Cernătescu-Asandei, Gheorghe Rozmarin, “Chimia lemnului din România: Plopul și salcia” [Chemistry of Wood in Romania: Poplar and Willow], Romanian Academy Publishing House, Bucharest, 1973;
- **Cristofor Simionescu**, Gheorghe Rozmarin, “Chimia stufului” [Chemistry of Reed], (Technical Publishing House, Bucharest, 1966);
- **Cristofor Simionescu**, Viorica Rusan, Valentin Popa, “Chimia algelor marine” [Chemistry of Seaweed], Romanian Academy Publishing House, Bucharest, 1974 – which received the “Gheorghe Spacu” Award of the Romanian Academy.

The importance of these contributions should be outlined from several perspectives, such as: (1) originality of the approached subjects in relation to what was happening at a global level; (2) establishment of a data bank permitting to know the potential and biomass reserves, with implications in capitalization; (3) recording of the evolution of forest vegetation in relation to the environment, once known that trees reflect the influence of environmental factors over time through their morpho-anatomic structure; (4) study of annual plants and reed has provided data for industrial applications that have been subsequently developed

in Romania; (5) micro- and macro-marine algae are currently viewed as renewable raw material resources for biofuels and bioproducts.

Another interesting field of research, courageously approached at that time was that of plant tumors, many papers being published between 1956 and 1968 (analyzing their induction, characterization, inhibition, antioxidants). In this respect, the presence of vegetal tumors was identified in some woody species (such as plum), and they were chemically characterized. The chemical changes observed in the lignin content ascertained the idea that the tumoral process is propagated through radical reactions, as in the biosynthesis of aromatic polymers.

Another discovery was that tumors can be induced by the *Agrobacter tumefaciens* bacterium, which was subsequently found to infect plants, such as tomato and sugar beet. The studies to follow were devoted to the possible inhibition of vegetal tumor growth by using the following antioxidants: hydroquinone, gallic acid and its derivatives (propyl-, ethyl-, octyl- and dodecyl gallate), butylhydroxyanisole, norhydroguaiaretic acid, for the *Solanum lycopersicum* plant infected with the crown-gall tumor.

Regarding the originality of these researches, it is worth mentioning that, in the same period, Denham Harman (1916-2014) put forward “the theory of free radicals to be applied in the process of human aging”, published in 1956 in *Journal of Gerontology*, **11** (3), p. 290-300. He considered that antioxidants could be a means of prolonging life and that such products can be beneficial in cancer chemotherapy and nutrition. These studies have been further developed in our department – 15 PhD theses have been devoted to such topics.

An extensive body of research has been dedicated over the years to lignin chemistry, and materialized, in a first stage, in the establishment of a structural formula for reed lignin (Ioana Anton – PhD thesis elaborated under the scientific supervision of Academician Simionescu). Studies in this field continued with investigating the reactions of this polymer, while the recognition of Romanian researchers’ contributions was realized through their participation in national and international programs (EuroLignin and Ecobinders).

The chemical modification reactions of natural polymers have also been an area dealt with in depth, materialized in numerous fundamental and applicative contributions. At present, the grafting reactions of natural hydrophilic polymers have gained great scientific significance, as they confer hydrophobicity, enabling their processing in blends with synthetic polymers, with the aim of producing composite materials.

In a research program funded during the global oil crisis (1973), the chemical and energetic potential of vegetal biomass was studied as a possible renewable source of raw materials. Based on the studies carried out in that period, a complex model for biomass valorization was developed (Cr. I. Simionescu, V. Rusan and V. I. Popa, Options concerning phytomass valorification, *Cellulose Chem. Technol.*, **21** (1), 3 (1987)), which was used to design and build up a micropilot station at the “Petru Poni” Institute of Macromolecular Chemistry of Iasi. Over time, in research carried out both in Romania and abroad, the concept of complex valorization was defined as *biorefining*, aiming at obtaining energy and bioproducts through the fractionation of vegetal biomass. The term appeared in 1990, in analogy to what happens in an oil refinery, being defined by the International Energy Agency as sustainable biomass processing with the possibility of obtaining a wide spectrum of bioproducts (food, chemicals, materials) and bioenergy (biofuels, electric and/or thermal energy).

Another large-scale program tackled the issue of synthetic paper. In this case, rich scientific information has been also accumulated in publications, patents and applicative tests, up to an industrial level, for some paper grades. Finally, based on the results of the research, a micropilot plant was designed and built up.

The international recognition of the school of Iasi was confirmed on the occasion of the 13 *International Symposiums on Cellulose Chemistry and Technology*, organized under the chairmanship of Academician Cristofor Simionescu, starting with the year 1961. At the symposium held in 1965, a group of the scientists of the field entrusted Academician Simionescu with the task of setting up the journal *Cellulose Chemistry and Technology* (www.cellulosechemtechnol.ro), published by the Romanian Academy Publishing House. The journal has been uninterruptedly issued for over 50 years, even under the most difficult conditions, enjoying the support of the members of the editorial team, well-known scientists, not only in the field of chemistry and structure of chemical components of wood, but also in synthetic polymers.

As known, the scientific contributions of Academician Cristofor Simionescu have been appreciated both at national and international level. In the field of pulp and paper, it is worth mentioning the awarding of the Jubilee Medal of American Chemical Society (the Division for Cellulose), in 1976, on the occasion of the USA bicentenary. The medal was awarded to 20 world-renowned personalities of the field, who were invited

to contribute with review papers, published in a special volume, on this most special occasion. The medal was handed to Academician Simionescu at the Romania-USA Polymer Seminar, held in Iasi in 1976, a manifestation that can be also considered as recognition of the Romanian school in the field of polymers.

In the teaching activity at the department, there was special concern to improve the learning process, practical applications and to introduce new information. Thus, in academic year 1962/1963, a new course Theory of Hydrolytic Processes (further named Technology of Hydrolytic Processes and Fermentation by Gheorghe Rozmarin) was introduced in the curriculum. Later, students could choose among optional disciplines, such as Technology of Hydrolytic Processes and Fermentation and Special Papers (Vasile Diaconescu). Starting from academic year 1967/1968, another discipline, Physics and Physico-Chemistry of Cellulosic Materials, which later became Rheology and Electrokinetic Processes in Paper Manufacture, was offered to students. Since 1970/1971, Printing (later named Technology of Printing Processes, Paul Obrocea) could be attended by students. The progress in scientific research and the evolution in the field of industry have determined the introduction of another two disciplines in 1978/1979: Synthetic Papers (Emanuel Poppel) and Technologies of Lignin Valorization (Valentin Popa). Starting from 1974, new facilities for teaching and research have been built for the department, and, in 1980, a pilot paper machine, with a production capacity of 500 t/year, was designed for research and practical applications.

In 1989, a restructuring of the curricula followed, to make it correspond to the new requirements of the industry and in agreement with the Bologna process (bachelor's, master's and doctoral studies). The name of the department was changed to Paper Engineering, being the only department in Romania preparing graduates in this field.

Teaching and research activities have been continued by the staff of the department completed with professors such as Elena Bobu, Dan Gavrilescu, Teodor Malutan, Florin Ciolacu, Paul Obrocea Jr. and Adrian Puitel, who publish and patent their scientific results, edit books and monographs in Romania and abroad. At the same time, they lead research projects financed by Romanian or European funds (Orizont 2000, CEE: FILTRAL, LIGNOMAT, POMALAB, BICOP, PNII: BIOSUN, ELHART, PAPREST SAFEACK, ECOCOMPOZ, PAPERCON, PNII-PAPERCON, FP7- SORT IT, FP6 – Ecobinders, EPPIC – European Pulp and Paper Industry more Competitive, EUROLIGNIN, Europolysaccharides (EPNOE) and numerous COST actions).

We should also mention that the department is involved in programs of continuing education (Raw Materials and Recycling, News in Pulp and Paper Industry, Waters in Pulp and Paper Industry, Applications of Biotechnological Processes in Paper Manufacture, Management in Paper Industry *etc.*) addressed to specialists from the industry.

The activity of the Romanian School of Pulp and Paper can be appreciated by its large numbers of university and PhD graduates, as well as by the numerous papers and monographs published in Romania and abroad, the research projects and the important contributions to the development of the pulp and paper industry in Romania.

On the occasion of this anniversary, we believe that this department will have a major contribution to training specialists for the paper industry in Romania, as this is one of the areas that can contribute to sustainable development.

REFERENCES

- ¹ P. Obrocea, V. I. Popa, E. Bobu and D. Gavrilescu, “Școala Românească de Celuloză și Hârtie. 1949-1999” [Romanian School of Pulp and Paper. 1949-1999], Plumb Publishing House, Bacău, p. 291
- ² V. I. Popa, Școala Românească de Celuloză și Hârtie [Romanian School of Pulp and Paper], *Revista de Politică Științei și Scientometrie*, **5**, 14 (2016)
- ³ V. I. Popa, Academicianul Cristofor Simionescu, fondatorul Școlii de Polimeri Naturali și Sintetici [Academician Cristofor I. Simionescu, founder of the Romanian School of Natural and Synthetic Polymers], *Memoirs of the Scientific Sections of the Romanian Academy*, Series IV, Tome **XL**, 13 (2017)
- ⁴ V. I. Popa, in “Istoria chimiei românești” [History of Romanian Chemistry], edited by Petre T. Frangopol, Romanian Academy Publishing House, Bucharest, 2018, p. 199-218

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