

Chemistry in Slovenia

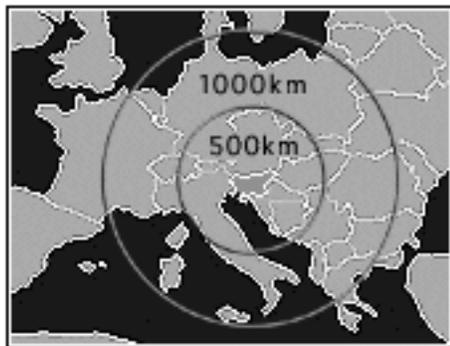
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Introduction

Slovenia's geographic and demographic area has witnessed an extraordinarily rich development of chemical knowledge, education, industry, and use of chemicals and chemical products, mainly because the region that is now Slovenia has been, throughout history, an active crossroads of different economic paths, interests, areas, specific features, and problems.

This article surveys the beginning, development, and present status of chemistry in Slovenia, encompassing the general evolution of both the chemical industry and chemical education as they have developed and grown.

Slovenia is a young Central European country; it declared its independence on 25 June 1991 after the breakup of Yugoslavia. Slovenia occupies an area of 20 256 km² and has 2 million inhabitants. The country is situated at the crossroads of four distinct geographical regions: the Alps to the north, the Pannonian plain to the northeast, the Dinaric mountain chain to the southeast, and the Adriatic coast to the south. European Union countries recognized Slovenia as an independent, sovereign state on 15 January 1992. Slovenia has been a permanent member of the United Nations since 22 May 1992, and on 6 March 1995, the European Community's



Geographical position of Slovenia in Europe.



An old-fashioned iron smelting furnace from the north-western, ore-rich region of Slovenia, where metallurgy had been in use from the 14th century to the beginning of the 20th century.

Council of Ministers granted a mandate for the beginning of negotiations on the association agreement between the European Union and Slovenia.

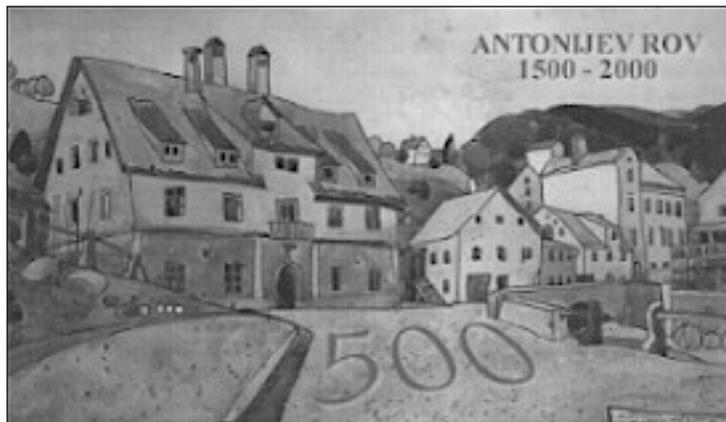
Chemistry in Pre-20th Century Slovenia

The earliest known Slovenian document, entitled *The Freising Fragments* and written in Latin script, appeared about 1000 A.D., but it was not until the 17th century that the first written text having chemistry as its subject appeared.

In the 14th and 15th centuries, as the humanist movement spread across Europe, a number of thinkers, professors, doctors, and educators of Slovenian origin were active in European universities, courts, or in diplomatic services. They were also acting as contributors in spreading information about the historical, cultural, and demographic heritage of the Slovenian nation well outside of its geographic borders.

In 1490, mercury was discovered in the town of Idrija, and the place soon became the second biggest mercury mine in the world (after Almaden in Spain). The discovery of mercury sparked considerable development of science and technology; Paracelsus, having visited the site of the mine in the early 16th century, started to exploit mercury systematically as a medicine. Scientists, mainly geologists and physicians, frequently worked in the area from the second half of the 18th century on, and they communicated their findings about

its geological and technological features throughout Europe. As a consequence of these intensive investigations, a School of Metallurgy and Chemistry was established in Idrija in 1769. (The school contributed significantly to the advancement and use of modern geological approaches to mining for the next 200 years. After World War II, geologist Ivan Mlakar made a highly original study of the complicated geological deposits of Idrija and established the internationally renowned Idrijan Geological School.)



Antonij's shaft, a visitors' entrance to the underground of the world's second largest mercury mine in Idrija.

Chemical education in Slovenia was at that time at its very beginning. The first teacher of chemistry was Baltazar Hacquet, who worked from 1782 to 1787 at the Medico-Surgery Lycée in Ljubljana. At the beginning of the 19th century, chemistry became one of the subjects taught at the Central School (renamed the Academy in 1811) in Ljubljana. Through the end of the 19th century, chemical education prospered further. Textbooks were issued; systematic chemical education was established; and papers on chemical elements, their symbols, and properties appeared. In 1898, the Agricultural-Chemical Experiment Station was built.

During the 19th century, other notable discoveries and advances were connected with the Slovenian region. Jozef Stefan, director of the Physics Institute in Vienna, Austria, discovered the law of radiation, and Austrian geographer Adolf Schmidl established speleology as a new scientific discipline on the basis of his research on phenomena in Slovenian karst caves. The most important karst topography phenomena include formation of sinkholes and caves in the barren, rocky limestone-based ground; presence of underground rivers; appearance and/or disappearance of surface streams; and absence of permanent surface rivers, streams, and lakes.

During the 19th century, chemical industry witnessed its first stage of industrialization without much signifi-

cant growth or expansion. It produced mostly basic chemical products, among them soaps, candles, sulfuric acid, and potassium nitrate; there were also some refineries for mineral oils. There were specific factories producing synthetic resins; lacquers and paints (Color, Medvode); zinc from zinc ore (Cinkarna, Celje); black powder (the chemical industry of Kamnik); coatings (Jub, Dol near Ljubljana); and washing powder, cleaning agents, and cosmetics (Zlatorog, Maribor; now Henkel Slovenija).

Early 20th Century Slovenian Chemistry

Chemical Industry

Before the beginning of World War I, several chemical industry factories had been built for production of aluminum oxide (Kemická továrna Moste), cosmetics, cleaning agents and candles (Ilirija-Vedrog, Ljubljana), and for food processing and production (Kolinska, Ljubljana).

In the era between the two world wars, the Slovenian chemical industry experienced a rapid period of growth. During this expansion, factories were established for the production of carbides, ferroalloys, and synthetic fertilizers (Tovarna dusika Ruse);

rubber, leather, and chemical products (Sava, Kranj); chemical, graphics, and paper industry (Aero, Celje); and insulating materials (Izolirka, Ljubljana).

The beginning of World War II put an end to the expansion and growth of the chemical industry in Slovenia. The majority of factories were taken over by the German army, and their industrial processes were channeled into the manufacture of military-specific products.

Chemical Education

In 1910, the first chemistry textbook in the Slovenian language, *Chemistry and Mineralogy* by Baltasar Baebler, was printed.

In 1919, the University in Ljubljana was established. The first professors of chemistry at the university were Maks Samec and Marius Rebek. They started lecturing in 1919–1920 at the newly established Institute of Chemistry. Maks Samec was a well-known chemistry teacher and the author of three German-language books and one English-language monograph on colloid chemistry of starch and cellulose.

Postwar Chemistry in Slovenia

After the end of World War II, most of the industrial infrastructure of Slovenia needed considerable repair and/or modernization. In addition, new factories were



The main building of the University of Ljubljana, erected in 1902.

built, mostly in the areas of fertilizers, pesticides, specialty chemicals, melamine- and urea-based resins, hydrogen peroxide and sodium perborate, surface protection coatings, and special additives for the textile and leather industries. The two largest pharmaceutical companies, Lek (Ljubljana) and Krka (Novo mesto), were also built during this period, in 1946 and 1954, respectively. The economy, and especially the chemical industry, developed rapidly, assuming in the mid-1950s an entirely new appearance and reaching for new markets. The chemical industry as a whole became a leading branch of the economy.

From the 1950s on, more new factories were built, including those for production of organic acids, synthetic fibers, plastics, adhesives, and cement.

According to 1997 data from the Chamber of Commerce and Industry of Slovenia, the chemical and rub-



The pharmaceutical company Krka, located amid the green scenery of the Dolenjska region, near the beautiful Krka River.

ber industry represented 14.9% of the total Slovenian industrial turnover, 9.8% of the total industrial labor force was employed in the chemical and rubber industry, and their contribution to the added value of Slovenian industry amounted to 18.2%.

University Study

Chemical education, particularly at the university level, also felt the aftermath of World War II. There were only ten professors, four assistant professors, and eight assistants for chemistry teaching after the war ended. The governmental initiative in 1953–1954 reorganized all faculties back into one unit under the management of the University of Ljubljana. The situation then remained unchanged until the beginning of the 1960s with the same curriculum—ten semesters of study and an average of 240 students per year.

At the beginning of the 1960s, two new initiatives were launched that significantly changed the organization and scope of chemical education. First, the government passed a law establishing a three-level higher education system consisting of two-year education, full undergraduate education (four-year study), and postgraduate education (additional two-year study). Second, the university itself proposed a plan for combining science and technology as closely as possible. The result of the latter initiative was the establishment of the Faculty of Natural Sciences and Technology, within which the chemistry department consisted of four divisions: chemistry, chemical technology, textile technology, and pharmacy.

School reform at the beginning of the 1970s considerably changed the dynamics and curriculum of university studies. Organized study of chemical sciences (chemistry and chemical technology) lasted for four years, and students could benefit from another full “student-status” year. In the third year of study, students could decide on signing up for courses in either chemical technology or chemical and process engineering. The four-year curriculum also incorporated specialized study of chemical education, intended primarily for future high school teachers.

At the beginning of the 1990s, as a direct consequence of the implementation of the *matura* (secondary school graduation) exams, the Ministry of Education and Sport divided university studies into two significantly different parts. Options now included a four-year period of study leading to a university degree (B.S.), as well as a three-year curriculum leading to a specialized vocational degree.

In 1991, the Faculty of Natural Sciences and Technology split into several independent faculties, among them a newly established Faculty of Chemistry and Chemical Technology.

With the recent intention of Slovenia to join the

European Union, the European Credit and Transfer System (ECTS) was adopted. The ECTS enables the free flow of post-second-year students in any of the European universities that have signed mutual bilateral agreements.

The Faculty of Chemistry and Chemical Technology in Maribor was established in 1995 under the Act that reorganized the University of Maribor, although the study of chemistry had its roots already back in 1959 with the Technical High School. Through the years, chemical education expanded and reorganized several times, and today the study of chemical technology forms the main course taught at the Faculty. There is also the Institute for Chemical Research, which comprises eight laboratories.

The Faculty of Environmental Sciences was established in Nova Gorica in 1995 by its cofounders, the Jozef Stefan Institute of Ljubljana and the city and community of Nova Gorica. The institution was reorganized and renamed Polytechnic of Nova Gorica in 1998. Post-graduate studies of interdisciplinary environmental sciences and economy engineering, along with the school of applied natural sciences, form the backbone of comprehensive studies supported by research laboratories, libraries, and the Technology Park of the Primorska region.

Research Work—Its Development, Importance, and Achievements

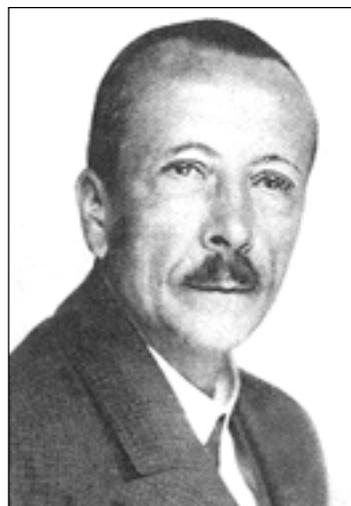
After the University was founded in Ljubljana in 1919, its first well-known chemistry professors were Maks Samec and his colleague Marius Rebek.

During his long academic career in the chemical sciences, Maks Samec, the founder of modern chemical



Maks Samec, well-known teacher and scientist, founder of modern chemical science in Slovenia, and driving force for establishment of the Slovenian Chemical Society.

science and the university study of chemistry in Slovenia, initiated the establishment of the Chemical Laboratory under the auspices of the Slovenian Academy of Arts and Sciences in 1946. Later on, the Chemical Laboratory was transformed into the Institute of Chemistry, which quickly became the central institution for chemical research in Slovenia. Samec also assisted in the establishment of the Slovenian Chemical Society, for which he was a leading force. He was recognized worldwide in the chemical profession for his achievements in the colloid chemistry of starch and cellulose.



Frederik Pregl, the only Slovenian scientist ever to have received a Nobel prize in chemistry.

The only Slovenian scientist ever to have received a Nobel prize in chemistry was Frederik Pregl (1869–1930). A physician by profession, he became head of the Medical-Chemical Institute in Graz, Austria in 1913. A year later, he received Liebig's prize in recognition of his development of methods in organic microanalysis. He further developed and popularized these methods, which brought him the Nobel prize in 1923.

Two nonprofit institutions, the Jozef Stefan Institute and the National Institute of Chemistry (both located in Ljubljana, the capital of Slovenia) also perform leading research in chemistry. Besides basic and applied research, both institutes also perform target-oriented specialized research and development studies, mostly as projects stemming from collaboration with Slovenian industry. An important function of the institutes is their approach to the education of graduate and postgraduate students. Both institutes are internationally recognized and maintain extensive contact and collaboration with universities and other institutes worldwide.

Establishment, Role, and Status of the Slovenian Chemical Society

The Slovenian Chemical Society was established in Ljubljana in 1951. It unites specialists in all fields of chemistry, chemical technology, and chemical engineering, and its goals are as follows:

- to enhance progress in all fields of chemistry, exchange experience, and popularize achievements;
- to enhance professional knowledge of its members;
- to connect its members via organized activities; and
- to establish contacts with other organizations that are active in the field of chemistry.

Today the Slovenian Chemical Society has 1300 members. It is managed by a Board that is elected for a four-year term at the annual meeting. The executive body of the Board is the Executive Committee, which consists of the president, two vice presidents, two secretaries, and the treasurer.

The Society encompasses a Division of Chemistry and a Division of Chemical Engineering and Technology. Two branch offices of the Society are active in the Dolenjska region and in Maribor. These units are managed by committees whose presidents are also members of the Society's Board.

Supervision of the work of the Society's bodies is performed by the Supervisory Committee. The Code of Ethics Committee is called in to act in cases of violation of the Professional Code of Ethics.

The Slovenian Chemical Society publishes its own quarterly periodical, *Acta Chimica Slovenica*, which contains original scientific papers; survey papers on the activities of research groups; reports on investments and industrial achievements; Society news; book reviews; reports on B.S. degrees, M.S. theses, and Ph.D. dissertations from both Slovenian universities; and agendas of scientific and specialized events at home and abroad. *Acta Chimica Slovenica* is edited by an International Editorial Board, and all published papers have been internationally refereed. The publication has been indexed in *Chemical Abstracts*, *Current Contents*, and *Science Citation Index*.

The Society cooperates with national and foreign

institutions, aside from being a member of the Federation of European Chemical Societies (FECS), IUPAC, the European Federation of Chemical Engineering (EFCE), and others.

Activities of the Society are carried out via ten sections, two committees, and two regional branches.

Membership in the Society is open to any person with a professional qualification in the chemical sciences at all levels of education, to practitioners in the chemical sciences, and to students. Conditions of membership include membership dues and agreement to abide by the Statutes of the Society and to adhere to the Professional Code of Ethics.

The Slovenian Chemical Society can nominate Honorary or Distinguished Service members in recognition of their outstanding contributions made to the promotion of the Society.

Primary tasks of the Committee for Chemical Terminology and Nomenclature are to monitor the development of Slovenian chemical terminology and nomenclature, and to cooperate with the Technical Committee of the Section for Terminology Dictionaries at the Institute for Slovenian Language (Fran Ramovs) of the Slovenian Academy of Sciences and Arts in preparing the third edition of the General Technical Dictionary. The aim of the Committee is to establish a terminology bulletin board where researchers from different fields of science would participate with suggestions for new Slovenian terms from their disciplines. This bulletin board would also enable researchers from other disciplines to contribute their own suggestions and comments with a view toward introducing and disseminating Slovenian chemical terminology.

Slovenian Chemical Days

Slovenian Chemical Days is the annual convention of chemists and chemical engineers that has taken place in Maribor every September since 1995. This convention is the meeting place for practitioners, users, and allied professionals from all areas of the chemical and process industries. Scientists from other countries also participate in this traditional event.