ESTABLISHMENT AND EVOLUTION OF THE DEPARTMENT OF CHEMICAL ENGINEERING AT SARATOV STATE TECHNICAL UNIVERSITY

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The Department of Chemical Engineering in Engel's was established in 1968 at the Saratov Polytechnical Institute. This took place because of social demand — qualified chemical engineers were required in the region for the largest, swiftly developing chemical fibre enterprises in the country: Balakovo for production of viscose and polypropylene fibres, Engel's with powerful Capron, triacetate, and diacetate fibre capacities, and Saratov, where the polycrylonitrile fibre Nitron was produced for the first time in the USSR. The specialists at these enterprises were subsequently directed to Nitron plants — in Navoi (Uzbekistan) and Novopolotsk (Belorussia). In the total volume of chemical fibres produced in the USSR, the share of these three enterprises in the Saratov region was approximately 20%.

I was responsible for organizing the Department and have been its director from 1970 to the present. The most pressing problem of the Department was to move education as close as possible to production and to steer the educational and scientific process toward solving the problems of the region’s enterprises.

Since 1970, more than 2000 chemical engineers have been educated in the Department and form the basic corps of engineers for plants in the chemical industry in the Saratov region and other regions of the country as well.

The day, evening, and correspondence courses offered in the Department have attracted workers and technical personnel with industrial experience to teaching, positively manifested by solving the important problems of the enterprises and degree projects and research. At the Balakovo and Engel's enterprises, out of 820 engineering and technical workers, 320 are graduates of the Department. They include: the technical director of the Balvolokno plant V. T. Razumovskii; the chief technician and heads of the plants and shops at Engel's Khimvolokno Co. In production of Nitron at the Saratov Nitron Co., almost 90% of the engineering and technical staff graduated from our department. Many graduates of the Department have received candidate and doctoral degrees in science and teach in different educational institutions in the region. A tendency toward formation of dynasties of engineers and polymer scientists (parents — children — grandchildren) has been observed and is to a great degree responsible for the stable potential of the branch.

The scientific direction of the Department was formulated under the effect of the most pressing problems of the enterprises. The developing and rapidly expanding production capacities produced a significant amount of wastes — unconditioned fibres, filaments, films, which were not used and were dumped. The necessity of finding a use for them led to the development of a set of scientific and technical programs and as a result, to the formation of the scientific direction “Creation of new polymer composite materials based on chemical fibres” [1]. The results of the research in this direction led to recycling of raw materials in the technological process, the creation of subdivisions for processing fibres into nonwovens, fabrication of spare parts for equipment from composites, replacement of cotton by viscose fibres in production of industrial rubber articles, and many others.

The educational process was transformed into a scientific-educational process based on close contact and collaboration between education, science, and industry. The directors of enterprises in the region L. B. Butovskii, D. F. Mel’nikov, V. K. Gusev, L. E. Vashenkov, V. I. Reshetov, and V. I. Timofeev understood the importance and significance of the Department and its scientific direction. Thanks to the financial and material assistance of the enterprises and free transfer of tools and equipment, it was possible to rapidly create and equip the Department’s laboratories at the required level and gradually develop the infrastructure to meet the requirements of the time. Today the Department consists of 12 special laboratories, a polymer materials certification laboratory, and Kompozit AOZT. There are 14-16 post-graduate students, primarily our graduates, doing post-graduate work in this direction, and 3-4 candidate dissertations are defended each year.

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Teachers for the Department were also primarily trained from graduates who initially conducted research in the most prestigious and authoritative scientific schools — the Moscow Textile Institute directed by Professor Z. A. Rogovin, Institute of Chemistry of Macromolecular Compounds of the UkSSR directed by Academician Yu. S. Lipatov, the Institute of Synthetic Polymer Materials, Russian Academy of Sciences, in collaboration with Professors A. A. Berlin and N. A. Khalturinskii; they defended their candidate dissertations there. Since the use of the most advanced methods of investigation for studying the structure and properties of composite materials became a tradition, the post-graduate students in the Department have worked in the Leningrad Institute of General Chemistry with Professor M. S. Vilesova, in A. Kokherman’s Laboratory of Chromatography at the Institute of Chemistry, Estonian Academy of Sciences in Tallin, at the B. Paton Institute in L. Bezruk’s Laboratory of Electron Microscopy, in L. S. Gal’braikh’s department at the Moscow State Textile Academy (MSTA), and others.

I will discuss these aspects in enough detail to show how our scientific collective in the Department was created, grew, and gained strength and trained modern specialists despite its distance from the scientific centers of Russia. The important traditions established by Professor Z. A. Rogovin should especially be noted — annual conferences of department heads attended by both the directors and 2-3 instructors from each department, and the leading scientists and specialists in the area. Holding these conferences alternately in the cities to which the departments were “dislocated” allowed becoming familiar with local specialized enterprises, meeting with students from other institutions of higher education, specialists from scientific-research institutes, becoming immersed in the history of the region, the way of life and beauty of the area, and the culture of the city. The atmosphere of high demands on the results of the Department’s work and sometimes impersonal criticism of reports educated everyone, regardless of rank. The routes to the circle of colleagues were unforgettable: Tashkent — Bukhara, — Navoi or Tashkent—Samarkand, organized by Professor B. E. Geller; to Krasnoyarsk at sea on a motor boat on the Yenisey, attending the Krasnoyarsk State Electric Power Plant organized by the trade union, and many others. All of these impressions broadened our education, stimulated patriotism and expanded our world view — and the teacher then transmitted these impressions and knowledge to their students.

Today, two professors with doctorates in technical sciences, seven assistant professors, four with candidate degrees in chemical and three with candidate degrees in technical sciences, two senior instructors, and one senior scientist are fruitfully working in the Department.

In the overall scientific direction of the Department which has evolved, there are many developments, experiments, technical characteristics, and economic indexes associated with the qualifier “for the first time” and protected by patents and certificates of invention.

Alternative polymer materials technology by the method of polycondensation filling [1-4] was developed for the first time and reduces the stages of the process, decreases the ecological pressure of production, increases product quality, expands the spectrum of specific properties, and decreases materials costs. The essence of the method consists of impregnating the filler (fibre, disperse powder) not with oligomers (phenol—formaldehyde, epoxy, etc.), but with the starting monomers with appropriate catalysts and modifying additives, and subsequent synthesis of a polymer binder from them both in the structure of the filler and on its surface.

The inhomogeneity and defectiveness of the structure of fibres, their high sorption power, and the presence of reactive groups ensure almost total impregnation of the fibre with the reaction medium over the entire cross section with subsequent transformation into polystructures during synthesis. Microthin layers of polymer binder are synthesized on the surface of the fibres (particles, filaments) and ensure the uniform distribution, high homogeneity, and density of the particles and as a result, significant adhesive strength between them, and an increase in the physicomechanical and physicochemical properties of the material.

In addition to fibre composites [2], technology has been developed for magnetoplastics with the polycondensation method, replacing the traditional mixed method, which significantly increases (by 1.5-2 times) the strength, their basic magnetic characteristics and conductivity, and their competitiveness with the best foreign analogs [3]. Small-scale production of magnetoplastics with elevated magnetic characteristics for therapeutic laser instruments, separators, and other purposes has been organized with this technology in the Department (Table 1).

Ion-exchange fibre materials (IFM) for purification of wastewaters, including removal of synthetic surfactants (SS) and caprolactam, were synthesized for the first time by the polycondensation method of filling [4]. An ion-exchange polymer binder with formation of anion-active (AFM) and cation-active (CFM) fibre material is synthesized from monomers in the structure and on the surface of the chemical fibres (Table 2).

Technology for modification of viscose and polyacrylonitrile fibres with fireproofing compounds [5] for textile applications to obtain difficult to burn composite materials was developed for the first time (Tables 3 and 4). The mechanism of action of phosphorus—halogen—nitrogen-containing fireproofing compounds (including in microencapsulated form), mixtures of