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Conference on "Green Chemistry"

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In April 2001 in Swansea on the territory of University of Wales took place a conference "Green Chemistry. Sustainable Products and Processes" initiated by the Royal Society of Chemistry. The Organizing Committee invited to attend the Conference the representatives of the academic schools, industrial chemists, engineers, the members of governmental circles and environmental societies. The Conference was opened by the Assistant of the President of USA on the problems of science and technology Mr. P. T. Anastas. Surly existed a danger that the participants would not find common topics for discussion since the interests of the audience were quite different. Luckily the apprehensions were futile. The reports on the abstract philosophical environmental topics were rare. The general trend of the conference consisted in definite problems that underlay the new ideology: The chemical processes should be safe, environmentally friendly, economical from the point of view of raw material and energy consumption, the product should be turned out stable and with minimum amount of wastes; the chemists should learn to tackle these problems already at the laboratory scale, on the molecular level. It have been frequently stated that the industrial companies are inclined to consider only the economical side; however the requirements of the "green chemistry" do not contradict the feasibility. Examples were cited where the many-sided treatment of a process made it environmentally friendly without raising the price of production. It has been demonstrated that the numerous advances in the environment protection and preventing of pollution that were developed in fundamental science and industry in the XXth century give hope that the companies holding only the economical viewpoint would be moving countercurrent.

Especially great advances occurred in solving of the problem of applying harmful materials to production. Millions of kilograms of harmful substances are already eliminated from industry that have been applied to production of useful products, and not always this transformation was economically unfeasible.

Let us mention some problems interesting for all chemists. It is the use of nontoxic, cheap solvents, carrying out of reactions in environmentally friendly solvents as water, supercritical CO_2, reactions without solvents, in particular, in the solid phase, application instead of the common acids and bases of solid acids and bases, finally, the replacement of toxic reagents by nontoxic. For instance, in the cellulose and paper production the pulp is bleached with chlorine. On the Conference was reported the process where the bleaching was proposed to perform with hydrogen peroxide in the presence of metal-complex catalyst.

It should be noted that in general the catalytic processes permitting performance of reactions chemoselectively (and when isomers may arise also regio- and stereoselectively) go to the forefront. Here the most significant problem is recycling of the catalyst. The solutions are various: catalyst put on the carrier, grafting of the catalyst on the solid phase, use of two-phase systems where the product and catalyst exist in different phases. Finally, an important stage in the solution of this problem also treated in the Conference was development of membrane technology for catalyst separation. It was shown that certain membrane types permit separation of common transition metal complexes with organic ligands and thus is avoided the necessity to synthesize complex dendrimeric molecules.

The reports of institute directors responsible for innovation policy and those of the chairmen of committees and commissions responsible for long-range planning called for attention of researchers to the global problems as alternative energy sources, alternative raw material instead of oil, renewable sources of raw materials, the use of biomass and the products prepared thereof, the recovery of wastes and use thereof for production of useful things. All these problems and the problems connected therewith concerning the use of energy and water supply are vitally important since the presumed population will be two times greater than in the nineteen nineties to the middle of the present century. This planning and this analysis can answer to the question what and in what amount the humans can consume allowing the ecosystem to restore.

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Many interesting suggestions were contained in reports on educational topics: The education should be based on all the maim concepts that should ensure the stable development of chemistry. It is presumed that such educational system will operate if the problems are correctly formulated, the exchange of information furnished, and the appropriate research stimulated. Therefore in the future should be extended the practice of organizing symposia, publishing textbooks, and establishing international collaboration.

As regards the definite chemical reports, they contained information on new catalysts, new catalytic reactions, on application of *sc* $C0_2$ in such reactions as oxidation; new biocatalyic reactions were announced, processes based on nanotechnology, production of new composite materials. Among these reports should be mentioned the very interesting communication of P. Willams (UK) on refined preparation methods for polymers and plastics with better characteristics; the report of M.Poliakoff (UK) on supercritical fluids, the communication of H.van Bekkum (the Netherlands) on the renewable sources of raw materials, first of all carbohydrates, the report of B. Trost (USA) on ruthenium-catalyzed reactions of alkenes with alkynes, a bright example of the principle he advanced: atom economy.

Very impressive was the report of C.-H.Wong (USA) "Chemo-Enzymatic Approach to Carbohydrate-Based Drug Discovery": it described the computer software developed for the synthesis of polysaccharides from building blocks where in all positions were introduced the protective groups of different reactivity that provided a possibility to carry out successive synthesis by catalytic reaction. As a result a synthesis requiring a work of two men for a year is performed within an hour. Among the compounds synthesized in this way are some with antibiotic properties.

Note also the report of K.Jansen (USA) from MAT on development of microreactors for "green chemistry". It is shown that the use of these reactors is revolutionary for industrial production since it drastically reduces the risk at the necessary application of toxic compounds. The conceptually new technology was actually demonstrated that is also efficient in various stages.

Among the forms of supporting the research contributing to the "green chemistry" should be mentioned awarding the prizes to studies with significant results.

On the conference were reported on three studies whose authors received various prizes from the British industry or organizations. These studies concern very different reactions and processes, as follows:

(1) New catalysts fit for recyclization to be used in aromatic nitration (Imperial College, UK). The possibility was demonstrated to use instead of sulfuric acid Lewis acid of the type $Zr(OTf)_4$ and nitric acid in equimolar amounts.

(2) Superefficient dyes for cotton (DyeStar, UK) that allow to decrease the consumption of dyes, water, salts, and the other materials, and also energy and labor.

(3) Oxazolidine diluents (Industrial Copolymers Ltd, UK) that permit to produce coating without solvents.

It should be said in conclusion that the success of the Conference was ensured not only by the interesting reports but also by an excellent organization. Among the organizers I like to mention first of all Professor K. Smith (University of Wales).