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Education and Science for Sustainable Development

D. I. MUSTAFIN¹, M. D. SANATKO²¹*D. Mendeleev University of Chemical Technology of Russia,
Moscow, Russia**E-mail: dim.moscow@gmail.com*²*Medical and Diagnostic Center of the Ministry of Defense of the Russian Federation,
Moscow, Russia*

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Abstract

XII All-Russian Scientific and Practical Conference “Education and Science for Sustainable Development” dedicated to the Decade of actions to achieve the goals of sustainable development was held on April 21–23, 2020, at the D. Mendeleev University of Chemical Technology of Russia. Due to the difficult conditions caused by the present pandemic of coronavirus, the conference was held in on-line format for the first time during the recent 12 years. More than 150 persons representing 15 organizations from many regions of the Russian Federation participated in the conference. The representatives of all levels from Bachelor, Master and Post-Graduate students to worldwide known scientists were among the participants. The scope of reports provides evidence of an increase in the positive effect of various areas of chemistry on sustainable development and proves the priorities of green chemistry.

Keywords: Education and science for sustainable development, sustainable development goals, UN

On April 21–23, 2020, the XII All-Russian Scientific and Practical Conference “Education and Science for Sustainable Development” was held at the Institute of Chemistry and the Problems of Sustainable Development of the D. Mendeleev University of Chemical Technology of Russia. The conference was dedicated to the Decade of actions to achieve the goals of sustainable development*. Due to the coronavirus pandemic, the Conference was held in on-like format for the

first time during the recent 12 years. The members of the Organizing Committee, Conference participants and the members of the Award Panel were coping with this format right in the course. Nevertheless, the Conference is to be recognized as a successful event. Energy and activity of the Organizing Committee allowed them to involve a large number of researchers within a short term, to solve unfamiliar organization tasks connected with the specificity of remote participation rapidly and efficiently.

The conference included two plenary and three section meetings participated by more than 150 persons representing 15 institutions from

*United Nations. Goals in the area of sustainable development. URL: <https://www.un.org/sustainabledevelopment/ru/sustainable-development-goals/> (accessed 15.05.2020).

many regions of the Russian Federation. The subjects of reports provided evidence of an increase in the positive effect of various directions of chemistry on sustainable development, as well as on the priorities of green chemistry, which allows narrowing chemical experiments within theoretical science, so that the necessary results may be obtained even without the use of chemical reagents. It is very important that the speakers at the Conference were the representatives of all levels, from Bachelor students, Masters and Post-graduates to scientists who are well known in the international community.

The opening speech was held by Andrey Andreevich Gureev, General Director of the Public Corporation FosAgro, which was recognized by the United Nations (UN) as one of 36 companies in the world making the greatest contributions to sustainable development. In particular, A. A. Guryev stressed: "Today we see more clearly than ever before how fragile our world is, how important it is to make the problems of sustainable development to be the foundation of the construction of new line of thinking and behavior of humans. Science and business should unite efforts to achieve the goals of sustainable development No. 3: Provision of a healthy way of life and assistance in well-being for everybody at any age – "Good health and well-being", so that global challenges that are to come after coronavirus pandemic could not catch the mankind off the guard anymore. This relates to the development of vaccines, reliable means of prophylactics and treatment of diseases, development of the relevant medical infrastructure, and, most important, personnel training. We recognize that competitiveness and high rates of the growth of a company cannot be provided without innovations: science is undistinguished in the industry but its absence has an instantaneous effect!" It is a non-trivial task to hold a scientific and practical conference under the conditions of the pandemic. Because of this, Mr. Guryev specially marked the work carried out by Natalya Pavlovna Tarasova, Director of the Institute of Chemistry and the Problems of Sustainable Development of the D. Mendeleev University of Chemical Technology of Russia, and all organizers of the XII All-Russian Scientific and Practical Conference.

Greeting the participants, Chairperson of the Organizing Committee Corresponding Member of RAS Natalya Pavlovna Tarasova stressed that in 1995 the world's first Chair of the Problems of Sustainable Development was founded at the

Mendeleev University, and in 2000 Institute of Chemistry and Problems of Sustainable Development was established on the basis of this Chair. So, the year 2020 became the year of double anniversary. "During these 25 years, we succeeded to bring up a large group of specialists who work in different large companies paying special attention to the implementation of the goals of sustainable development. We must unite our efforts to go out of the closes of unsustainable existence and to follow the route of sustainable development", – N. P. Tarasova stressed. It is evident that the transition to sustainable development starts from the introduction of high-quality education, and the conferences of this kind promote this transition.

The Organizing Committee of the Conference received 43 claims from researchers who wanted to make reports. Due to natural time restrictions, the members of the Award Panel chose 18 works for oral online reports to be discussed at plenary and section meetings. However, the works that were not included in the list of selected reports are undoubtedly interesting and will be published in the Book of Conference Proceedings according to the decision of the Organizing Committee.

Summarizing the results of the Conference, Chairman of the section of Green Chemistry for Sustainable Development Professor V. G. Tsyrelson, Doctor of Science in Physics and Mathematics, Head of Quantum Chemistry Chair of the RCTU, winner of the International Prize named after A. Humboldt stressed that sustainable development is surviving a serious challenge today. The coronavirus pandemic accelerated the broadening of the existing frames of green chemistry, which is now becoming a natural ground for convergence of previously uncrossing routes for the improvement of chemical processes. Reports presented in the section embrace a broad range of problems from the development of new technologies for the point delivery of medicines in practical medicine to the molecular simulation of the mechanisms of complex formation in ionic liquids. All the 19 reports delivered in this section are connected with achieving different Goals of sustainable development, in particular, Goal No. 3: Provision of the healthy lifestyle and promotion of well-being for everybody at any age; Goal No. 4: Provision of all-encompassing and equitable high-quality education and encouragement of the possibility of learning during the whole life for everybody; Goal 9: Development of stable infrastructure, promotion of all-encompassing and

sustainable industrialization and innovations; Goal No. 12: Responsible consumption and production, and depict diverse aspects of the life of society.

The first place was awarded to the work "Quantum chemical simulation of the stability of the complex of dimethylphosphate anion – S₈" (Yu. I. Ivankova, A. N. Egorova) dealing with the investigation of the behaviour of a cyclic S₈ molecule in the interaction with dimethylphosphate anion (DMP-1), which is a component of ionic liquids. It was demonstrated that the formation of DMP-1–S₈ complex is accompanied by the opening of the sulphur ring with the transfer of negative charge to the terminal sulphur atom. This effect may promote the acceleration of polymerization in the systems involving ionic liquids in which the complex under study is present, in particular, acceleration of caoutchouc vulcanization.

The second place was awarded to the work "Forced localization of the reaction zone of the oxidative polymerization of pyrrole" (I. V. Plyuschiy, Ya. O. Mezhuiev, Yu. V. Korshak, A. L. Luss, V. A. Dyatlov, M. I. Shtilman) in which a method for the suppression of oxidative polymerization of pyrrole within the volume of the reaction system was elaborated. One of the problems of the application of polypyrrole is conjugated with its processing, which is almost impossible after the synthesis. It was demonstrated that the proposed method allows obtaining polypyrrole coatings with good electric conductance. These coatings may be used as chemical and biological sensors, as well as the materials for making electrodes of current sources.

The third place was awarded to the work "Simulation of the structure and noncovalent interactions in the soluble pharmaceutical forms of riluzole within the density functional theory" (O. A. Alatortsev, S. V. Artobolevskiy, D. E. Makhrov, M. V. Vener). The authors studied the systems which included the medicinal compound riluzole and a co-former (a substance promoting an increase in riluzole solubility for the development of liquid pharmaceutical forms). The application of Riluzole (Rilutek, 50 mg tablets) has a positive effect on people suffering from amyotrophic lateral sclerosis (ALS), an incurable progressive disease of the central nervous system. New data on the stability of heterodimer of riluzole with a conformer were obtained in the work for a number of organic compounds which promising co-formers, and noncovalent intermolecular interac-

tions were studied, in particular N...H...O bonds in these structures providing this stability.

Chairman of the section on Social-economical aspects of sustainable development, Doctor of Science in Economics Professor A. E. Kharaturov stressed that Humankind needs a transition to the principles and kinds of economic activities that would promote long-term enhancement of human well-being without posing substantial ecological risks on future generations. He noted that the problems connected with the social-economic aspects of sustainable development, and the studies dealing with sustainable production and consumption were discussed in the section. In particular, reports were dealing with green economics – economic activities leading to an increase in human well-being, providing social justice, and at the same time causing a substantial decrease in the risk for the environment and the risk of depletion of the nature. Economic and social changes within the implementation of the sustainable development concept were considered to ensure consistent methods of the management of natural resources, investment directions, scientific and technological developments, personality development and institutional changes. These processes will become a guaranty of economic efficiency of the organizations with minimal possible negative and maximal possible positive effects on the environment and social medium; they will strengthen the potential of civilization for meeting the needs and desires of the present and future generations.

Report by D. S. Boykevich and A. V. Malkov concerning the successful solution of numerous problems of machinery manufacturing plants connected with environmental pollution, provision of industrial safety, development of integrated control systems was presented in this section.

Different approaches to the development of modern strategy on meeting human needs minimizing environmental damage were considered in the work by K. V. Mashneva and A. E. Kharaturov. Their work was focused on the formation of green economics based on the concept of neo-industrialization and innovative development, which will allow one to introduce modern technological processes and new technologies, to adjust the production of high-quality high value-added products, to prevent the negative effect of industrial enterprises on the environment, to decrease the consumption of natural resources, to enhance the economic efficiency of enterprises and the quality of human life.

Yu. V. Khrustaleva and S. O. Gomanova investigated the professional self-actualization of women in natural sciences, technologies, engineering and mathematics. The concept of sustainable development includes not only the set of ecological problems to be solved but also structural changes of labour conditions and the access to welfare for all social groups. One of the key problems is gender inequality connected with the oppression of women in different areas of life. A separate point of the concept of sustainable development presented by the UN is the struggle against gender discrimination, which is depicted in Goal 5: Provision of gender equality and broadening of the rights and possibilities of all women and girls.

Professor A. E. Khachaturov summed up the meeting of the section on Social-economic aspects of sustainable development held on April 22, on the World Earth Day, by the words of Antoine de Saint-Exupery: "We all are passengers of one ship named the Earth".

Chairman of the section on Environment and sustainable development, Leading Researcher at the Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry RAS, Doctor of Science in Physics and Mathematics, Professor V. I. Malkovskiy attracted attention to the connection between fundamental science and sustainable development. He formulated his impression of the presented reports: "A specific feature of our section was the fact that each problem solved by the authors of reports was integrated in its nature. As a rule, it could not be reduced to a standard engineering task but it required an actually creative approach and fundamental research to be carried out. This was likely dictated by the very essence of environmental problems holding the first-place importance for the implementation of the concepts of sustainable development. Many reports in the section were presented by young researchers. This is important, first of all, because young scientists (masters, bachelors, post-graduates) carrying out the works in basic research institutions assimilated research methods corresponding to the world level, got the experience of working with the modern equipment. Second, making their reports, young researchers starting their route acquired a very important experience of scientific communications, sometimes necessarily rigid ones, without any discounts for young age, and understood how important it is not to get embarrassed and to fight their ideas before the scientific community".

The Award Panel of the conference after extended discussions and arguments distinguished the works of reporters who not only succeeded in presenting the results of their research efficiently but also provided a convincing demonstration of the relevance of problems under consideration because ecological restrictions are believed to be the factors holding back the development of the major part of the branches of industry and agriculture. The solution of ecological problems is the necessary condition for the world's sustainable development. Integrated nature and complexity of ecological tasks often do not allow reducing them to the search for standard engineering solutions but require fundamental research instead. The range of these studies connected with solving ecological problems was very broad this year: from isotope geochemistry to mathematical modeling.

The winner of the competitive selection was the work "Lithogeochemical studies of the territory of Mezhdurechensk (Kemerovo Region) for the evaluation of the effect of anthropogenic factors" (N. A. Osipova, M. G. Kudryabtseva, E. G. Yazikov), connected with Goal No. 11: Provision of openness, safety, vitality and ecological stability of cities and settlements – "Stable cities and settlements". This work deals with an integrated problem of technogenic pollution of the city, which is closely connected with coal mining industry but involves also other industrial objects as possible sources of pollution. The work is carried out at a very good professional level: from the choice of sampling sites and quantitative chemical analysis of the samples to the use of statistical methods of data processing and interpretation of results. The choice made by the Award Panel was due not only to the high level of the work performance but also to the impression made by the report itself because the lecturer showed a free and professional command over the entire material presented in the report.

Among other winners, the work by I. P. Bagnychev and V. A. Kuznetsov was distinguished. The work deals with the implementation of Goal No. 6: Provision of the maintenance and rational management of water resources and sanitary for everybody – "Pure water and sanitary". The authors presented the work entitled "Minimization of the effect on the environment during obtaining drinking-quality water at local stations of water preparation", in which they studied the technology of electrochemical water preparation for local household water pipe networks, by the example of the use of water from the Kuma River (the

northern boundary of the Republic of Dagestan). Integrated evaluation of the technology under development was presented, in particular technological and economic parameters, and the possibility of utilisation of the formed wastes.

Reports presented at the conference were connected with all main Goals of sustainable development.

At the-Conference closing, Anna Anatolyevna Shcherbina, Vice Rector for Research at the D. Mendeleev University of Chemical Technology of Russia, Doctor of Science in Chemistry, stressed the relevance of the subjects and the high level of the Conference, as well as the importance of the generalization of experience accumulated in holding the events of this kind in the on-line regime. She stressed that green chemistry enrolls an increasing number of supporters in the real sector of economics. Young specialists trained for practical work aimed at achieving the Goals of sustainable development are in high demand in the national industry.

The winners were awarded virtual diplomas. A deserved award for them was a collection of reminiscences-essays "Laverov's Universe" prepared by the Russian Academy of Sciences for the 90th anniversary of Nikolay Pavlovich

Laverov, Member of the Russian Academy of Sciences, outstanding Soviet and Russian scientist, educationist, organizer of science. Among the participants of the conference, there were many apprentices of Academician N. P. Laverov who had been Emeritus Professor of Mendeleev University, Scientific Leader of the Higher College of Rational Nature Management at the Institute of Chemistry and the Problems of Sustainable Development of the D. Mendeleev University of Chemical Technology of Russia. In spite of high engagement in state and academic structures, Academician Laverov communicated with students considering these communications to be his most important affair. Many conference participants recalled N. P. Laverov's words: "The ideas of sustainable development will be determinant in the society of the XXI century".

XII All-Russian Scientific and Practical Conference "Education and Science for Sustainable Development" dedicated to the Decade of actions aimed at achieving the Goals of sustainable development has finished, but we still keep on our desire to live in agreement with the laws of the biosphere, which is to pass into the new state – noosphere, the sphere of intellect as V. I. Vernadsky stated.