

National Technical University of Ukraine “Kyiv Polytechnic Institute”

Department *Cybernetics of Chemical Technology Processes*





Scientific School

Mathematical and Computer Modeling of Chemical and Technological Processes and Systems

Head

Prof. Gennady Statyukha, D., Eng.

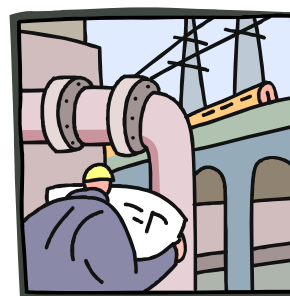
Mathematical and Computer Modeling of Chemical and Technological Processes and Systems

Formation on the system approach basis of the methodology of mathematical models development of technological systems of the different nature, different scale and for the different purposes are the main achievement of the scientific school.



Mathematical and Computer Modeling of Chemical and Technological Processes and Systems

Our common cause is development of mathematical models and their use in practice of chemical, food, building materials, pharmaceutical, petrochemical and other areas of the industry.



Conference

“Computer modeling in chemistry and technologies”



- Till 1990 our science school had the conference (in Cherkasy).
- Since 2008 we renew this tradition as the illustration of urgent necessity of demonstration of our achievements.



Conferences

We not only survived, we have mastered the new research directions that have been approvingly assessed the scientific community at international conferences in the Czech Republic, Spain, Hungary, Belgium, Germany, Poland, Russia, Slovakia, Turkey.

Also we regularly present our achievements at conferences MMTT (Russia), CHISA (Czech Republic), ECCE (Europe),ACHEMA (Germany), and in many journals.



Research Directions

The theoretical basis of the scientific school "Mathematical and computer modeling of chemical and technological processes and systems" has allowed to form at least five areas of application of mathematical modeling:

- *Environmental Systems*
- *Recipe-Product Systems*
- *Combinatorial Chemistry,*
- *Automated Control Systems*
- *Sustainable Development Assessment*

Here decision of optimization problems provides an significant effect and excites outstanding scientific interest.

Sustainable Development

Sustainable Development is
a new research direction
of the scientific school.

Research group supervisor –
Gennadiy Statyukha
D.Eng.

Research group manager –
Iryna Dzhygyrey Ph.D.



Environmental and Man-Caused Safety



Previous direction joins issues of technogenic safety, which are solved in research group of assistant professor Tetyana Bojko.

Product Engineering

Achievements in the area of experimental and statistical modeling have become very useful in the development of “*Product Engineering*” research direction

**Denys Skladanny Ph.D.,
Natalia Telitsyna**

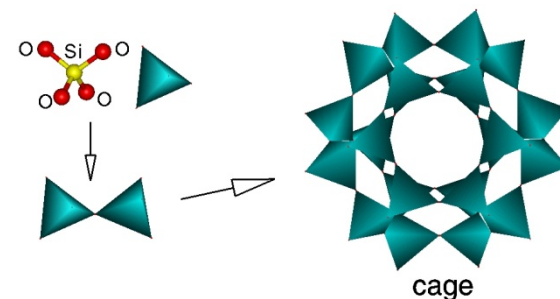
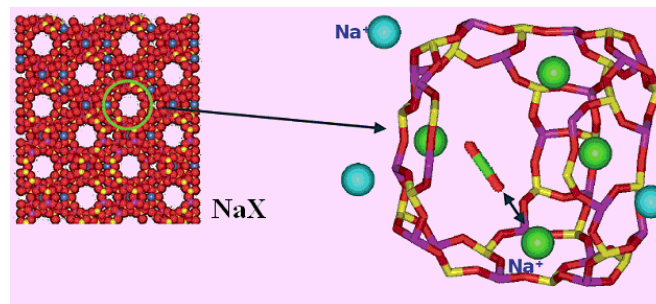




Mathematical Modelling of Technological Processes

Mathematical Modelling of Technological Processes

Research group supervisor –
ass. prof. **Yury Beznosyk**



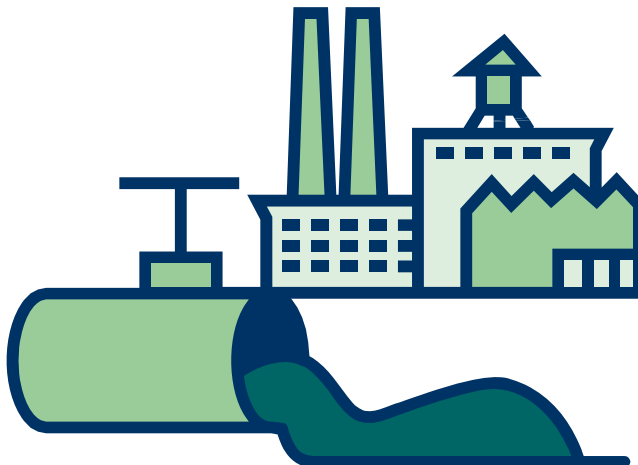
Industrial Water Networks Optimization and Resource-Saving Technologies

Research group –

ass. prof. **Olexander Kvitka**

Arcady Shakhnovsky Ph.D.

Iryna Dzhygyrey Ph.D.



Artificial Intelligence Methods Application



Research supervisor –
ass. prof.

Lyudmyla Bugaeva



UNIDO Project

Cleaner Production

Emphasis on the environmental dimension and the sustainable development makes it possible to use a lot of experience gained in the area of
Automated Control Systems of Technological Processes

Research group supervisor –
prof. **Romuald Medvedev**



Founders of the Scientific School



prof. **Bondar Alla** (1921 – 1981), D., Eng.,
Head of Cybernetics CTP Department
(1974-1981)

prof. **Gennady Statyukha**, D.Eng.,
Head of Cybernetics CTP Department



Staff of the Department



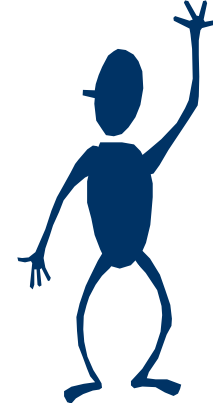
2	Professors
10	Associate Professors
2	Assistant Professors
1	Doctor of Engineering
16	Candidate of Science
8	Ph.D. Students



Main Research Areas of the Department

- Sustainable Development and Optimization of Chemical Products Life Cycle
- Mathematical and Computer Models development
- Control Systems development
- Computer Integrated Technologies development
- Environmental Problems handling and Resource-Saving Technologies design
- Information Technologies application in chemistry and chemical technology





Main Developments of the Department

- Automated design system of gas emissions purification “SAPR EKOLOGIIA” (1975-1990)
- Control system of ammonia production from coke-oven gas at nitro-fertilizer production of Novolypetsky metallurgical works “AMIAK-KG” (1985-1992)
- Control system of ammonia production from natural gas at Cherkasy production corporation “AZOT” (1985-1992)
- Control system of multicomponent substance production in fluidized-bed units by applying of fuzzy multipliers theory principles at Shostka branch of Scientific-Research Institute of Chemical Industry (1990-1995)
- Expert modeling system of sorption processes for chemical and others productions intensification (1992-1993)



Main Developments of the Department

- Expert system SSP EXPERT for analysis, modeling and retrofitting of gas emissions purification processes and other processes of chemical productions used in resource-saving technologies (1994-1995)
- Intelligent decision-making support system for modeling, optimization, design and control of processes and systems used in resource-saving and energy-saving technologies (1996-1997)
- Computer-aided tool for design of flue gas purification (1997-1998)
- Intelligent modeling system of chemical-technological processes of gas purification networks (1999-2001)



Main Developments of the Department

- Design and implementation of new technological units and networks of gas emissions purification (2002-2003)
- New methodology on the basis of exergy and pinch-analysis integration for design of energy- and resource-saving technologies (2000-2003)
- Design and implementation of the technique of industrial water consumption networks synthesis and optimization (2001-2003)
- Environment friendly chemical processes with computer aided modelling, design and control (COMODEC) (2002 – 2004).
- Process systems integration towards environmental improvement and sustainable development (2002 – 2004).



Main Developments of the Department

- Automated control system of boric regulation process in nuclear reactors (type BBEP-1000) at South-Ukrainian nuclear power station (1998-2003)
- Program system STAT-SENS for management of scientific researches and optimization of technological operations and substance properties by experimental-statistical modeling methods.
- Modeling system STAR for mathematical modeling, identification and synthesis of control systems (1995-2001)
- Assessment system of man-caused safety of unsafe types of industrial plants' activities (2000-2004)



Main Developments of the Department

- Energy-saving and environmental-friendly hybrid technological processes gas emissions purification (2006-2008)
- Environmental Sustainability Index: analysis of environmental component of region sustainable development in Ukraine (2007-2010)
- Modeling and calculations of aerosols PM_{2.5} as health indicator for sustainable development management in Kyiv (2007-2009)
- Technology of adsorption purification on zeolites of flue gases from nitrogen oxides (2007-2009) / Institut für Technische Chemie jointly (Dresden, Germany)
- Industrial water management networks design (2008)



Publications

(just in English)

- Beznosik Y., Bugaeva L., Kenig E., Gorak A., Kraslawski A., Astrelin I. An intelligent system for designing waste gas purification processes from nitrogen oxides // Proceedings of PRESS'99 (2nd Conference on Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction), May 31-June 2, 1999, Budapest, Hungary, published by Hungarian Chemical Society, pp.169-174.
- Statyukha G., Zemljak E., Potapov V. Evaluation and Management of Hazardous Activity at the Industrial Enterprises: development of methodology for the Ukrainian enterprises // Proceedings of 2nd European Congress of Chem. Eng., France, 1999.
- Statyukha G.A., Beznosik Yu.A., Rastami Pour D., Petrovsky V.E. An integrated information system on combined methods of SO_2 and NO_x purification // 14th Intern. Congress of Chemical and Process Engineering 27-31 Aug 2000, Praha, Sum.4, p.153.
- Statyukha G.A. Waste usage of cleaned plants for the manufacturing of thermal-insulated ceramic products // 14th Intern. Congress of Chemical and Process Engineering 27-31 August 2000, Praha, Sum.4, p.32.
- Statyukha G.A., Lefleur P., Skliar M., Petran A. The set of engineering tasks solved on the base of experimental statistical modeling approach applied to research of polymeric blend system // 14th Intern. Congress of Chemical and Process Engineering 27-31 August 2000, Praha, Sum.4, p.22.



Publications

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- Astrelin I., Beznosik Y., Bugaeva L., Vorozhbian M., Loboiko A. Modelling of nitrogen oxide absorption by tributylphosphate in a film-type absorber // 2nd International Symposium on Multifunctional Reactor - ISMR-2, Nuremberg, 2001.
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- Jezowski J., Statiukha G., Jezowska A., Beznosik J. Synteza zlozonych systemow technologicznych – stan wiedzy i mozliwosci aplikacji // Inzynieria i Aparatura Chemiczna, 2001, № 6, pp. 3-8.



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- Korniyenko Ya., Statyukha G., Skladanny D. Computing of experimental research of the process dehydration and granulation in an air-fluidized bed // Summaries of 15th Intern. Congress of Chemical and Process Engineering “CHISA 2002”. – 2002. - Vol. 4.
- Statyukha G., Bojko T., Bendyug V. For the question of technogenous hazard estimation of industrial objects from the position of sustainability // Summaries of 15th Intern. Congress of Chemical and Process Engineering “CHISA 2002”. – 2002. - Vol. 4.
- Statyukha G., Korniyenko Ya., Skladanny D. Analysis the process of dehydration and granulation at the air-fluidised bed using the lost function for sizes of dispersed particles quality // Summaries of International Conference of Chemical Engineering “ESSE - 4”, Granada, Spain. – 2003.
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Publications

- Statyukha G. Application of experimental statistical modeling approach in polymer processing systems // Environmentally friendly polymer technologies ECOPOLYMER – 2004. COMODEC, Center of Excellence, Lesco (Poland), May 18-23 2004, p. 80-86.
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- Shakhnovsky A., Kvitka A., Statyukha G., Jeżowski J., Jeżowska A. On the statistical analysis of data for the water usage network design. // Chemical and process engineering. – 2007. – v. 28. – p. 493-503.
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The Scientific School and Higher Education in Ukraine

It is hard to overestimate the influence of the scientific school on the level of chemical and technological education in Ukraine.

First of all, the Scientific School supports the education program in "Computer-integrated technological processes and productions" speciality.

Direction of Education
Time of education
Degree

• **0925 Automation and Computer Integrated Technologies**
 • **3 years 10 month Common amount of credits (ECTS 238)**
 • **Bachelor of Automation and Computer Integrated Technologies**

Constituent of the program of preparation	Name of courses	Common amount of credits ECTS
Normative part		154
Basic refreshment courses	Foreign language, psychology, jurisprudence; history of Ukraine; philosophy; sociology; Ukrainian language; economic theory; political science	29
Natural science courses	Higher mathematics; general physics; general and inorganic chemistry; programming; computer technique and organization of calculable works; ecology, numerical methods and mathematical design on computer; theory of chances and casual processes.	72,5
Professional and practical courses	Engineering graphic arts; theoretical and applied mechanics; electrical engineer and basis of electronics; technological measuring and devices; hardware of automation and microprocessor technique; theory of automatic control; safety of vital functions and guard of work; methods of optimization of chemical technological processes; thermodynamics; typical productions processes and equipment of processes of automation; computer-integrated government bases and computers networks; production practice; preparation of diploma project.	52,5
Variant part		84
Courses after the choice of higher educational establishment	Organic chemistry; physical chemistry; organization of scientific researches; principles of permanent development; computer graphics are the informative systems and complexes; systems analysis of difficult chemical technological complexes; bases of planning of the systems of automation and control systems by the experiment	64
Courses of free choice of students	Application computers systems in chemical technology; methods of artificial intelligence and their application in chemical technology; quality management of products; automation of business-processes; bases of work with the modern integrated complexes	20

Direction of Education
Speciality
Time of education
Degree

• **0925 Automation and Computer Integrated Technologies**
 • **8.092502 "Computer Integrated Technological Processes and Productions"**
 • **1 years 10 month Common amount of credits (ECTS 105.5)**
 • **Master of Computer Integrated Technological Complexes of Chemical Productions**

Constituent of the program of preparation	Name of courses	Common amount of credits ECTS
	Normative part	98
Basic refreshment courses	Labor protection in a region; foreign language; philosophical problems of scientific cognition; pedagogic high school, bases of enterprise	12.5
Natural science courses	Mathematical design of the systems and processes; mathematical methods of optimization; bases of steady development of society; bases of scientific researches.	10
Professional and practical courses	Mathematical models of chemical reactors and basic chemical technological processes; optimization of the chemical technological systems, design of the ecological systems; control of chemical technological processes and computers technologies of planning of the control systems; planning of optimum experiment; intellectual property is automation of design; intellectual systems of decision-making; scientific researches; preparation of master's degree work.	50
	Preparation of master's degree thesis	25,5
	Variant part	7.5
Courses of free choice of students	Bases of work with modern programmatic complexes	7.5

The Scientific School and Higher Education in Ukraine

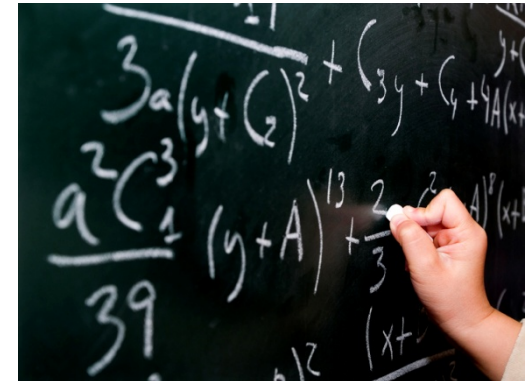
For many years teachers of the department conducting general training of students at Chemical-Technological Faculty and Engineering-Chemical Faculty.

This is such subjects as «Computing Mathematics and Programming» (1st and 2nd courses), «Mathematical modeling and application of computers in chemical technology» (4th year).

Almost every two years, these courses and laboratory workshops are updated by introducing new information technology advances and new software packages.

The Scientific School and Higher Education in Ukraine

Recently the department was committed with reading courses of «Mathematical modeling of systems and processes», «Mathematical methods of optimization», «Basics of scientific research» for the Masters of three faculties – Chemical-Technological Faculty, Engineering-Chemical Faculty and Faculty of Biotechnology.



These courses saturated with examples of research conducted by our scientific school and foreign scientific schools of mathematical modeling and introduce future industrial engineers with modern methods of analysis and design of chemical and technological systems.

The Scientific School and Higher Education in Ukraine



Last development of the scientific school jointly with the Institute of Applied System Analysis (IASA) – lectures

«The basis of sustainable development in society»

for masters of the entire University.





Cooperation

Close cooperation with scientific schools of

- Russia (RCTU, Moscow),
- UK (UMIST, Manchester),
- Germany (Universities of Dortmund and Dresden),
- Poland (Polytechnica, Rzeszów),
- USA (University of Utah, Salt Lake City; University of Minnesota, Duluth; Washington University in St. Louis)

and other countries, as well as Institutes of National Academy of Sciences (Institute of Physical Chemistry, Institute of Sorption and Endoecology Problems, Institute of Bioorganic Chemistry and Petrochemistry, Institute of Surface Chemistry, Institute of Gas, Institute of High-Molecular Substances, Institute of Cybernetics, Institute for Applied Systems Analysis, and others)

allows regularly introduce advanced achievements of scientific thought to students of "Computer-integrated technological processes and productions" speciality.



Ukrainian Engineering-Chemical Association

Ukrainian Engineering-Chemical Association which is part of the European Federation of Chemical Engineering actively works at the department.

President of the Association for many years is professor Statyuha G.O.

The main purpose UECA – the organization of cooperation between scientific and educational institutions of Ukraine and European community.

Thus, the cooperation with *Rzeszow University of Technology* (Poland) in the framework of the EU–COMODEC Program, Center of Excellence, gives an opportunity to intensify research work on the synthesis of complex technological and chemical systems. Three Ph.D. thesis are prepared to defend (two in our department, and other – in Rzeszow University of Technology) and three are in process.





Central Eastern European Institute of Sustainable Development

In 2008 the «Central Eastern European Institute of Sustainable Development» (CEEISD) was set up (prof. G. Statyukha – director) with the purpose of integrating efforts to favor the popularization and distribution of the data about the Earth, the methods of its protection and opposition to natural and industrial cataclysms and catastrophes in the framework of “sustainable development” as well as contribution into the elaboration of educational programs in the sphere of sustainable development and the protection of legal social, educational, cultural and other common interests of people.



Центрально-Східно-Європейський Інститут Сталого Розвитку
Центрально-Восточно-Европейский Институт Устойчивого Развития



Central – East – European Institute of Sustainable Development

**INTER-UNIVERSITY CONSORTIUM FOR
SUSTAINABLE DEVELOPMENT**

**Kiev – Slavutich/Chernobyl – Pultusk -
Minsk – Moscow - Kaliningrad**

**The Educational Scientific Complex
“Institute for Applied System Analysis”
of Ministry of Education and Science of Ukraine
and National Academy of Sciences of Ukraine
(ESC ‘IASA’)**



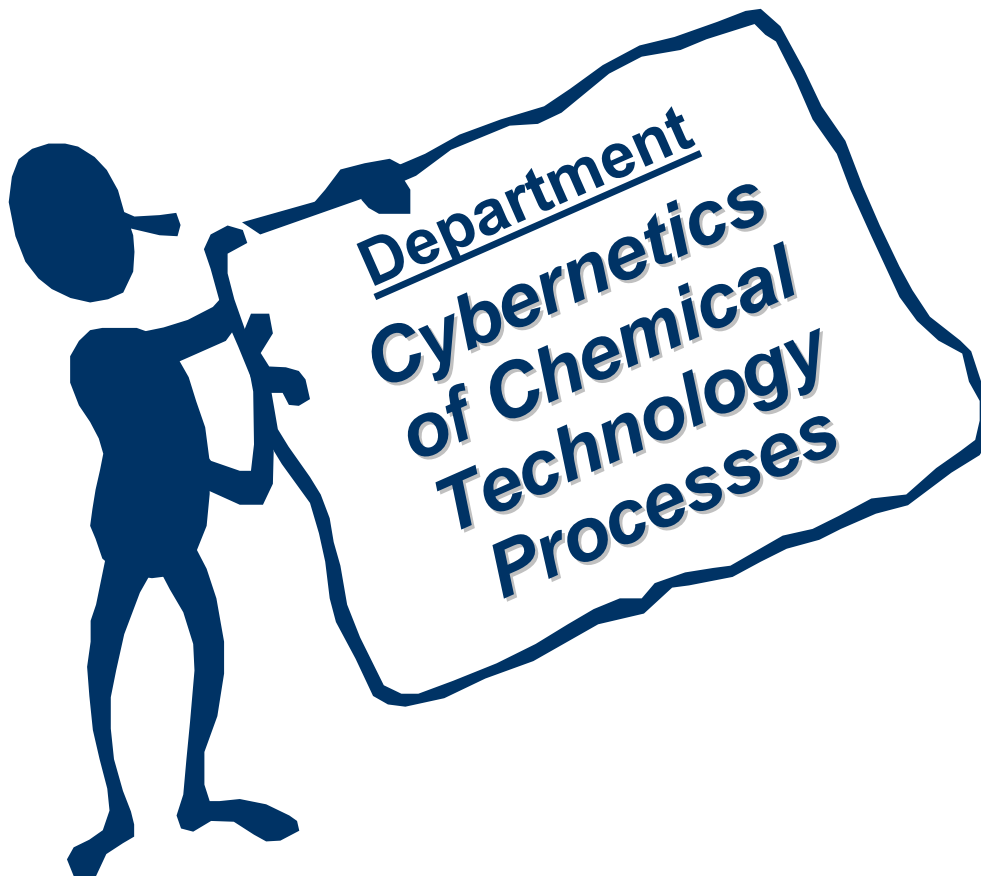
Fulbright Ukraine



The cycle of works in the area of environmental protection and sustainable development received a grant known American Fulbright (professor Statyuha Gennady) as confirmation of the high level of our achievements.



National Technical University of Ukraine “Kyiv Polytechnic Institute”



35 years
of Moving Forward