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INNOVATIVE CHEMMOTOLOGICAL THOUGHT AS AN INTEGRATED SYSTEM OF KNOWLEDGE

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Abstract. This article offers insight into history, development and modern state of Chemmotology science. The main problems and tasks of the Science are discussed. The bases of Chemmotological scientific and pedagogical school of the National Aviation University, its main positions, goals and activity are described.

Keywords: chemmotology, fuels, lubricants, technical fluids.

1. Introduction

The origins of Chemmotology date back to 1964. Separation of Chemmotology into independent applied science united scientists and practitioners of engineering, oil and chemical industries along with the companies which operate the technologies for Chemmotological problems solving.

Over the last several years Chemmotology being an applied science, has found its broad scientific and social acceptance. The results of the research have been presented at the World Petroleum Congresses (Mexico City, 1967; Moscow, 1971, Tokyo, 1975, Bucharest, 1979), at the Mendeleev's Conventions for General and Applied Chemistry, at Chemmotological seminars and conferences in Moscow, Sankt-Petersburg, Berdiansk, Dnepropetrovsk, Drogobych, Kyiv, Chelyabinsk, Tashkent, and Tbilisi.

In order for the new science to develop, the government of U.S.S.R. passed a resolution under which the State Chemmotology research institute was set up in 1968. This decision was followed by the one to establish Chemmotological centers in different sectors of economy in 1970 and the main Chemmotological organization – the State Chemmotology research institute – in 1984 (based on the 25th State research institute of the Ministry of Defense of Russian Federation).

As any other field of scientific activity, Chemmotology is based on specific fundamental knowledge, whose important constituents are basic terms and concepts. Without them further development of any science is not possible. High level of language culture and technological (Chemmotological) one in particular, characterizes in its way the level of scientific and technological advance. The analysis of literature sources shows that the variant reading of the term “Chemmotology” exists. Therefore, there is an objective need for more accurate definition and standardization of this term.

The definition and the main problems of Chemmotology are stated in various reference books and encyclopedias. The Etymology of the definition of Chemmotology shows that in 1964 K.K. Papok in his article proposed to use this term for the first time and defined the science as “*a new science that studies chemical, physical-motor properties of fuels, lubricants and special fluids as well as their service performance, and develops the way for their rational use in technical equipment.*” At a later date, the science definition was specified as “*a science about properties, quality and rational use of fuels, lubricating materials and specific fluids in technological equipment.*” Further, the definition of science was developed in a new version as “*theory and practice of rational use of fuels and lubricants.*” In the monograph of 1985 by colleagues and followers of K.K. Papok Chemmotology was defined as “*an applied science about service performance, quality and rational use of fuels, oil, greases and specific fluids in technological equipment.*”

The newer and more specific definition of Chemmotology, its subject, methods and goals was proposed in 2005 in accordance with previous publications. It is “*a technical applied science about properties, quality and rational use of fuels, lubricants and specific fluids in technological equipment.*”

In the author's point of view, the more accurate formulation of Chemmotology is the following. It is "a science about technological processes, properties, quality and methodology of rational use of fuels, oils, greases and specific fluids." The Big Soviet Encyclopedia defines science as a sphere of human activity that has a development and theoretical systematization of objective knowledge about reality as a function. According to the source, the immediate goals of science are description, explanation and prognostication of the processes and the phenomena of reality, i.e. theoretical reflection of reality. All these signs are possessed by Chemmotology, too.

2. Modern State of the Chemmotology Science

For the modern science it is the transition from subjective to problematic orientation that becomes more typical. The new areas of knowledge arise because of advancement of some major theoretical or practical problem. This is the reason for the edge sciences to appear, and, Chemmotology, as a problem science being at the edge of Chemistry, Physics, Engineering, Economics and others, in particular. It is even possible to use such word combination as "technical Philosophy," since it describes the essence of this science.

The role of Chemmotology as an applied science is supported by the importance of the problems it solves: securing energy safety of economy of a country, rational use of traditional and alternative fuels, lubricants and specific fluids during the operation of modern and prospective technologies.

The analysis of publications for the last seven years gives a possibility to distinguish three main directions of development of theoretical bases of Chemmotology:

- Study of the mechanisms of influence of various components and functionality additives on the quality of fuels and lubricants;
- Search for more general patterns in Chemmotology based on the use of fundamental laws of Physics, Chemistry and other sciences;
- Study of Chemmotological processes for prognostication of fuels and lubricants performance in technological equipment at various conditions.

The main goals of Chemmotology are the following:

- Optimization of requirements for quality and composition of fuels, lubricants and technical fluids, their service performance taking into account the primary energy sources reserves, achievements of scientific and technological advance in the development of technology,

peculiarities of technological equipment and the conditions of its performance, ecological and economic requirements;

- Development of recommendations as for unification, interchangeability and determination of conditions of rational and economic use of fuels, lubricants and special fluids;
- Improving of oil product supply systems and quality management during production, storage, transportation, and application of fuels, lubricants and special fluids;
- Modernization of compliance assessment system (certification, testing, permission to production and application), modernization of methods of qualifying tests for fuels, lubricants and special fluids;
- Unification of local standards for testing methods of fuels, lubricants and special fluids with international ones;
- Development of new highly efficient kinds of fuels, lubricants and special fluids that ensure the improvement in technical and ecological performance of technological equipment;
- Disposal and recycling of the off-grade and worked-off fuels, lubricants and special fluids;
- Building grounds for conducting logistic measures for preserving the quality and decreasing the losses of fuels, lubricants and special fluids during their storage, pumping and transportation;
- Developing methods for service performance and quality control assessment of fuels and lubricants, along with disposal of worked-off, unmarketable and off-grade fuels and lubricating materials;
- Improvement of the existing and development of the new technologies for fuels, lubricants and special fluids production.

The processes of interdependency and interaction of chains of Chemmotological system (Fig. 1) are the main research subject and the essence of Chemmotology.

The subject of Chemmotology is service performance of fuels, lubricants and special fluids.

The main scientific and practical goal is rational use of fuels, lubricants and special fluids during equipment operation.

From economic standpoint Chemmotology is aimed at achievement of maximal economy of raw materials, of fuels, lubricants and special fluids through optimization of balance and quality of products, their rational and efficient use.

Theoretical bases of Chemmotology consist in development of general theory and establishing laws that bond the quality of fuels, lubricants and special fluids together with reliability, durability, ecological compatibility, economy and efficiency of technical equipment;

substantiation of optimal requirements for the quality; selection (development) of the new grades; unification of types and grades; ensuring the quality preservation; study of physical, chemical, and ecological properties during the storage, transportation and distribution; decreasing specific consumption and normed loss; decreasing the overall volume of quality control; development of quality regeneration methods; solving the problems of interchangeability of fuels, lubricants and special fluids grades produced in different countries; developing methods, equipment and service performance testing systems and quality parameters tests; protection of the environment from the influence of Chemmotological system (Fig. 2).

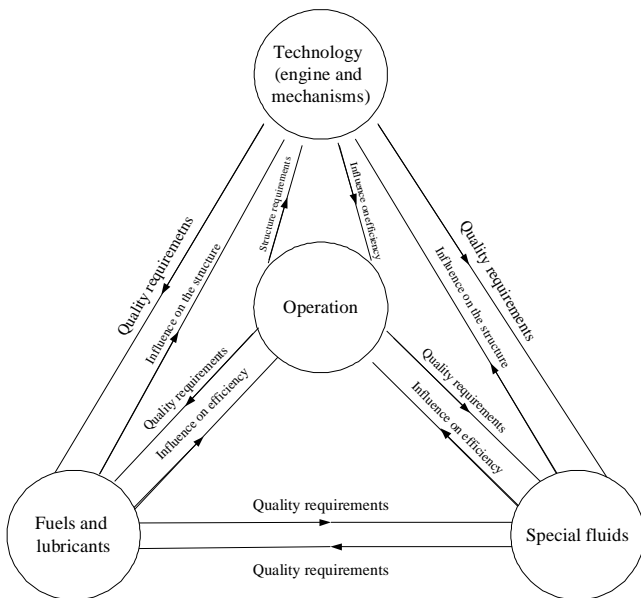


Fig. 1. Universal four-link Chemmotological system

Chemmotology creates the necessary “basement” for ensuring optimal conditions of oil products rational use and modern requirements of their quality. The structure and content of the science of Chemmotology can be described by Fig. 3.

The generalized function of utility of oil products as products useful for society can not be described with the single set of corresponding design papers and engineering drawings as opposed to the generalized function of utility of vehicles. It is this principal distinction of oil products from the products of engineering industry that has created an objective ground for the origins of Chemmotology.

The use of fuels and lubricants with overstated quality parameters (quality level) leads to exceeding in costs of their production, and, in the case of their underestimation – to increasing costs in engineering and equipment operation.

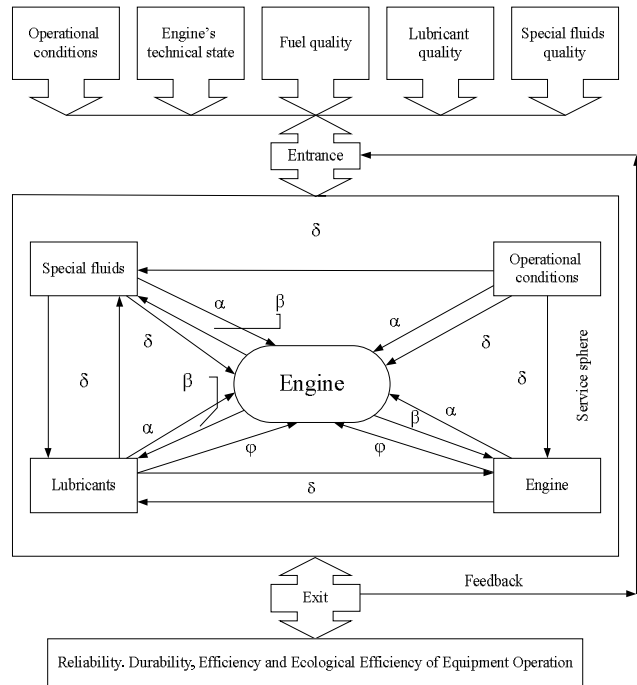


Fig. 2. Chemmotological model of “engine-fuel-lubricant-special fluid” system functioning during equipment operation: α – influence of fuels, lubricants and special fluids on working characteristics of engine; β – requirements for fuels, lubricants and special fluids quality from the engine side; δ – influence of operation conditions on characteristics of engine, quality of fuels, lubricants and special fluids; φ – influence of fuels, lubricants and special fluids on the engine operation efficiency

The general diagram of connections between the steps of development, production, quality assessment, multi-level testing and use of fuels, lubricants and special fluids is shown in Fig. 4 whereas Fig. 5 shows the generalized universal model of the chemmotological system with interconnections and inter-impacts between engines, machines, their exploitation and fuels, lubricants and technical liquids.

3. Chemmotological Scientific School at the National Aviation University

The bases of Chemmotological scientific and pedagogical school at the National Aviation University, started to form at the end of the 1950s when laboratories of tribology under the supervision of Prof. B.I. Kostetzkiy and Prof. N.L. Holego were organized. In these laboratories, the processes of physical and chemical mechanics of materials under friction were studied with the help of unique equipment; and the recommendations as for the increase in longevity, reliability of machines and mechanisms along with improvement of fuels and lubricants quality were based on these research. Many

staff members and students who took active part in this research later became significant scientists and founders of the science (Prof. A.Y. Alyabyev, Prof. V.V. Zaporozhietz, Prof. P.V. Nazarenko, and others).

The studies in the field of theoretical and practical research of hydraulic drives and their elements were started under supervision of Prof. T.M. Bashta at the same time, too.

The department of details of machines and mechanisms (Prof. M.V. Rayko), department of aeronautic engineering (Prof. Z.S. Chernenko), department of Physics (Prof. A.N. Solovyev), department of electrical engineering (Prof. A.L. Groholskiy), and other subdivision also participated in solving of Chemmotological problems.

Clear orientation of Chemmotological research toward solving problems connected with ensuring working reliability of aircraft fuel, oil and hydraulic systems appeared in the 1960s. It was at that time that the special scientific group for solving the problems of fuels, lubricants and special fluids use was created on the initiative of Prof. Alexander Aksenov at the department of technical operation of aircrafts and aircraft engines (Head of the Department – Associate Professor Vasilii Sukharikov). Different scientists including V.P. Belyanskiy, V.I. Teryohin, A.A. Litvinov, A.I. Kozachenko, Y.G. Nekipelov, A.E. Borodin, and A.Y. Shepel participated in the research conducted by this school.

Chemmotological scientific field was formalized at the National Aviation University of Ukraine under scientific advisory of Rector Alexander Aksenov in order to coordinate all research works and analysis of their results.

The activity of scientific school is inseparable from teaching. An independent department of Chemistry and Technology of fuels and lubricants was created in 1968. It was followed by the creation of the faculty of fuels and lubricant a year after (the head of the department and the first dean was associate professor Alexey Litvinov).

The first group of specialist in the field of testing and use of fuels and lubricants graduated in 1975. All the graduates (around 50 specialists) were in high demand and were hired by different operation companies, research institutes and educational institutes for civil aviation.

The majoring department of testing and usage of fuels and lubricants created by Professor Litvinov trained specialists in the field aviation Chemmotology. As a result, there was a significant increase in a professional level of quality control system of fuels and lubricants.

The department of Chemmotology, created in 2007, is seen as an official successor of that department today.

Phenomenon of scientific and pedagogical school is realized via information supply of the study process in the conditions of integration of science and higher school with the goal of research institute creation. The meaning of classic research institute, as first defined by W. Humboldt in the 19th century, is in integration of study process with fundamental scientific research. The motto of the University of Berlin, founded by William von Humboldt in 1809, was “Devotion to science”. Information supply being a constituent of integrated scientific supply of study process is aimed for the creation of organizational and substantial basis of informational and educational environment which meets the level of society’s informing.

In general scientific and pedagogical schools are the centers of accumulation, concentration, and production of scientific and educational information and its application. These centers increase stability, determinancy, predictability and manageability of educational systems and processes. Being open self-managing systems these scientific schools are flexible and active in their interaction with external informational environment; they also constantly support and renew the scientific potential of their representatives and followers including students familiarized with science.

V. Vernadskiy, Ukrainian natural philosopher and naturalist, when describing the appearance of scientific schools, noted that “tzar Peter I established the scientific research in Russia understanding its benefits for the state. And this scientific work has quickly found its place in public minds and didn’t stop in the long decades of government not supporting the scientific activities. It was formed by the intellectuals of the state, their personal efforts, personal initiative or through the organizations created by them.”

Leading positions in Chemmotological movement today belong to the department of Chemmotology and the Ukrainian research and training center of Chemmotology and certification of fuels, lubricants and special fluids of the National Aviation University.

The Ukrainian research and training center of Chemmotology and certification of fuels, lubricants and special fluids created at the National Aviation University is the successor of Ukrainian center of aviation Chemmotology and certification of products (created by Professor Belyanskiy in 1994).

In the modern conditions when requirements for all types of products and services including consulting and educational ones have significantly increased and the conditions of collaboration and relationships between participants of the oil supply system have changed, the

role of Chemmotological scientific and pedagogical school is gaining an extremely important meaning in the system of information supply.

Extension courses for the specialists of gas-transporting companies of Ukraine and petroleum and chemical laboratories of Ukrainian oil supply companies including aviation fuel supply have been organized on the basis of the centre in cooperation with the department of Chemmotology and the Institute of post-graduate training.

The centre's testing equipment allows conducting the research of most of the oil products at the level of requirements of standards including the international ones. The laboratories of the centre received the accreditation of international standards of 17025 and 9001 series. Educational activities aimed for training and professional development of personnel involved in production, usage and quality control of fuels, lubricants and special fluids is also being realized in the centre, along with development of educational, methodological and normative literature and documentation.

The centre and the department of Chemmotology together actively participate in scientific and educational activities of the university. This includes the organization of domestic and international scientific conferences, seminars, symposiums; carrying out a number of researches and engineering works for both domestic and international customers.

The main scientific and applied problems that are being solved by the representatives of the school include the following:

- Development of competitive resource- and energy-efficient technologies for storage, transportation of fuels and fuelling;
- Development of alternative fuels for vehicles;
- Study of physical, chemical and service properties of fuels, lubricants, and special fluids during conduction of different technological operations;
- Development of express methods and methodologies of quality assessment of fuels, lubricants, and special fluids;
- Development of organization, technical and norming activities for preserving the level of quality of fuels, lubricants and special fluids;
- Development of new competitive additives for fuels and lubricants;
- Creation of a complex of methods qualifying tests of fuels, lubricants and special fluids.

The concept of development of Chemmotological scientific school at the National Aviation University is oriented toward the innovative model, the one that allows to collect and multiply the achievement of our staff in the

conditions of today's crisis situation in the fuels and lubricants market; the one that lets to increase the level of developments and discoveries to the competitive level and to implement them practically in a short term; and also to create a basis for improvement of working conditions of scientific and pedagogical staff of Chemmotological school, realization of their scientific and educational programmes, finding and developing talented creative persons among the students youth, and preparation of top qualification specialists.

The goal of Chemmotological scientific school is stimulation of scientific researches and experimental-design works along with training (extension courses) of specialists in accordance with international laws and standards for solving of actual and prospective problems of Chemmotology, specialists in testing systems, production and usage of fuels, lubricants and special fluids, for aviation industry in particular, and introduction of energy-efficient technologies.

The strategic goal of Chemmotological scientific school is achievement of modern level of research and training of scientific and pedagogical personnel of the highest qualification.

The main mission is carrying out of fundamental and applied research, scientific and experimental-design research in accordance with scientific specializations of the university, notably: Chemmotology, Tribochemistry, Tribology, Environmental protection and life safety, certification and quality management, testing, diagnostics, permission for production of fuels, lubricants and special fluids with the goal to solve priority problems of science and practice.

Social and economical impact of Chemmotological scientific school comes in the shaping of highly-educated specialist which could meet modern level of highly-technological production and service in the first place. The role of this kind of specialists is constantly increasing in many countries since as of today deep knowledge and superior technologies become the new strategic resources.

Chemmotological scientific school of the National Aviation University through stimulation of spreading of knowledge and skills ipso facto ingenuously promotes:

- Integration and coordination of researches of creative groups in the field of Chemmotology of fuels, lubricants and special fluids;
- Carrying out scientific and experimental-design research;
- Training (professional advancement) of personnel for solving Chemmotological problems, certification, and quality management in compliance with international standards;
- Development of new materials and products;

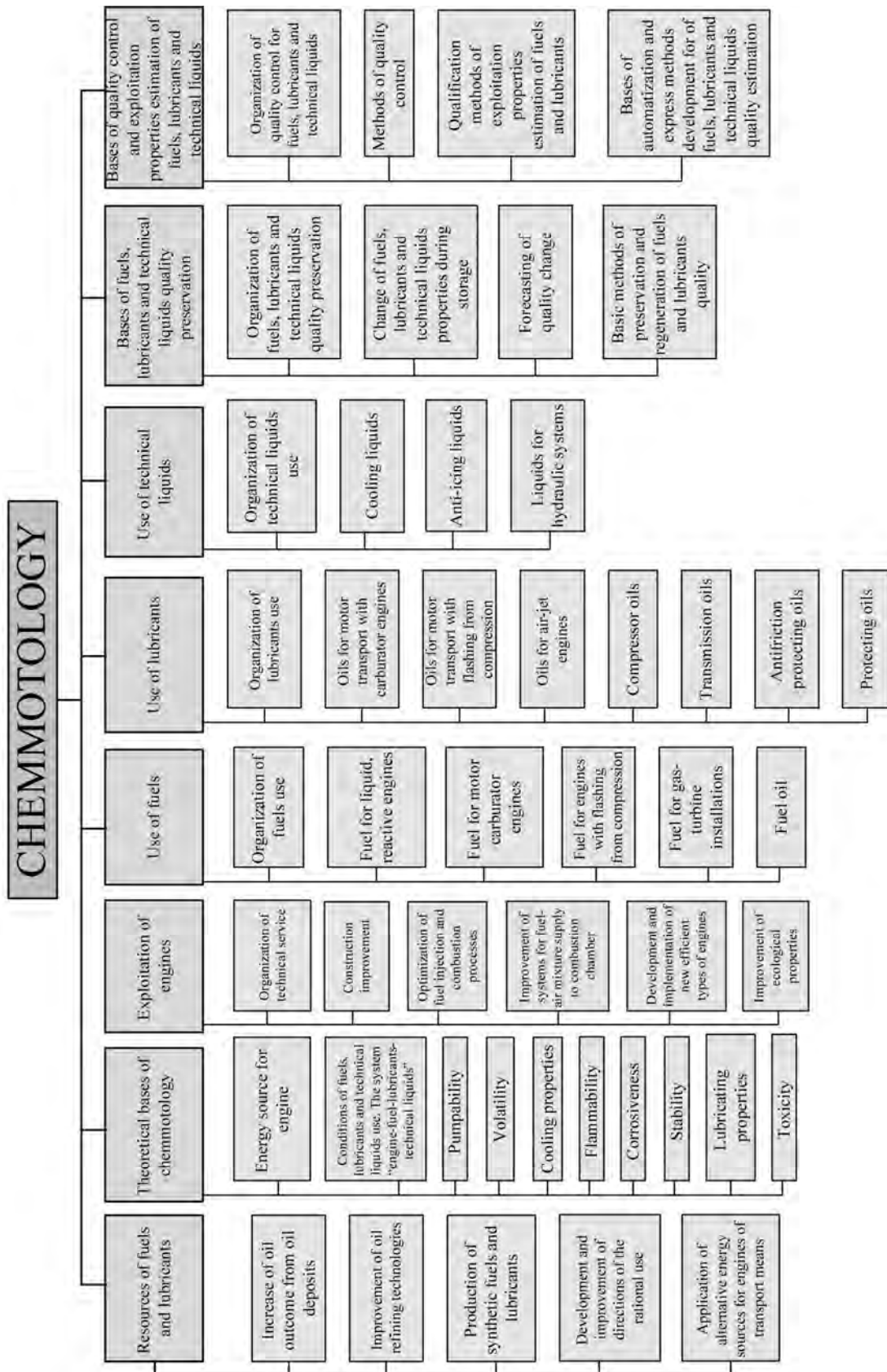


Fig. 3. The structure and the contents of Chemmology

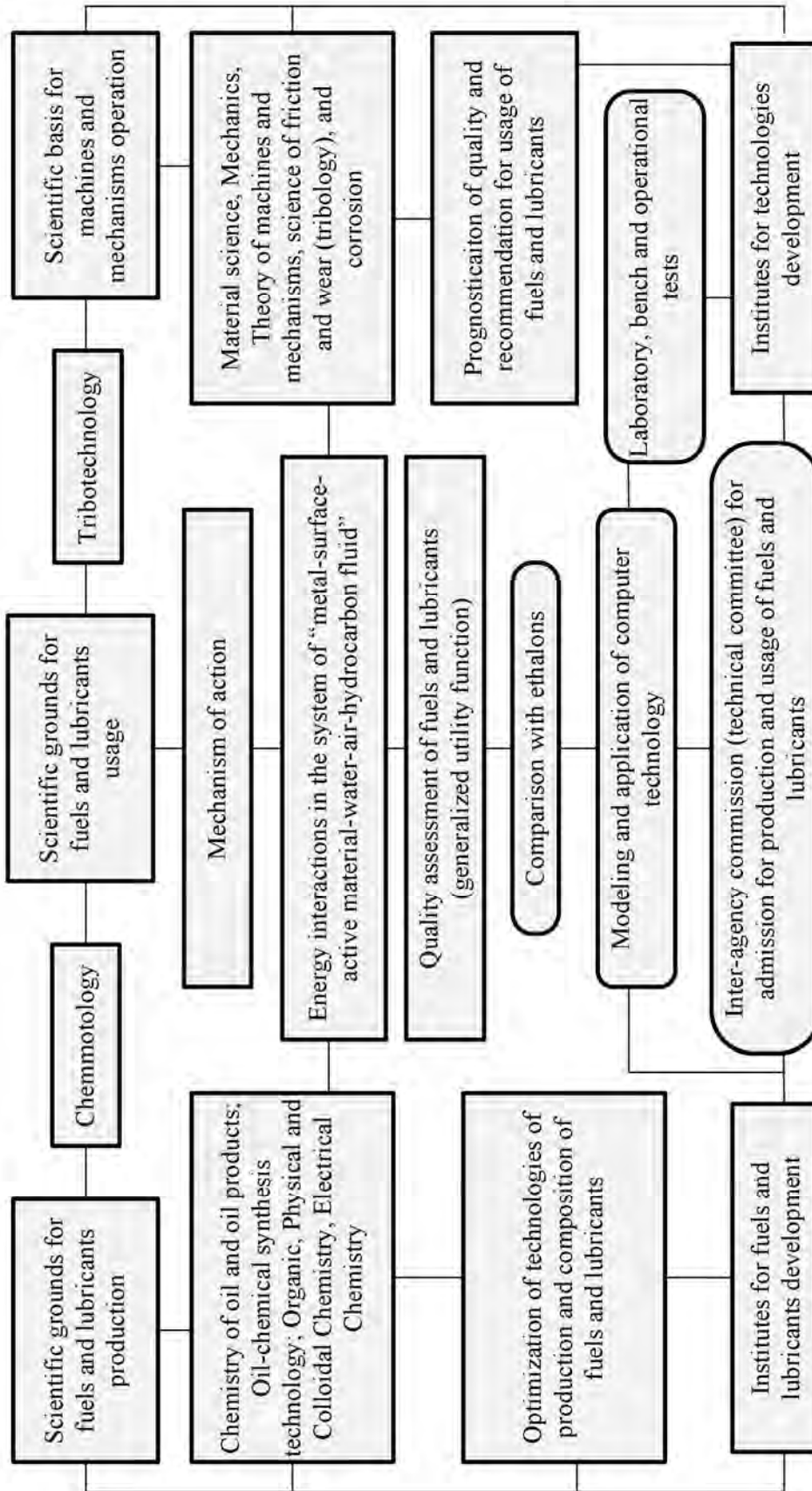


Fig. 4. The diagram of development, quality assessment and usage of fuels and lubricants

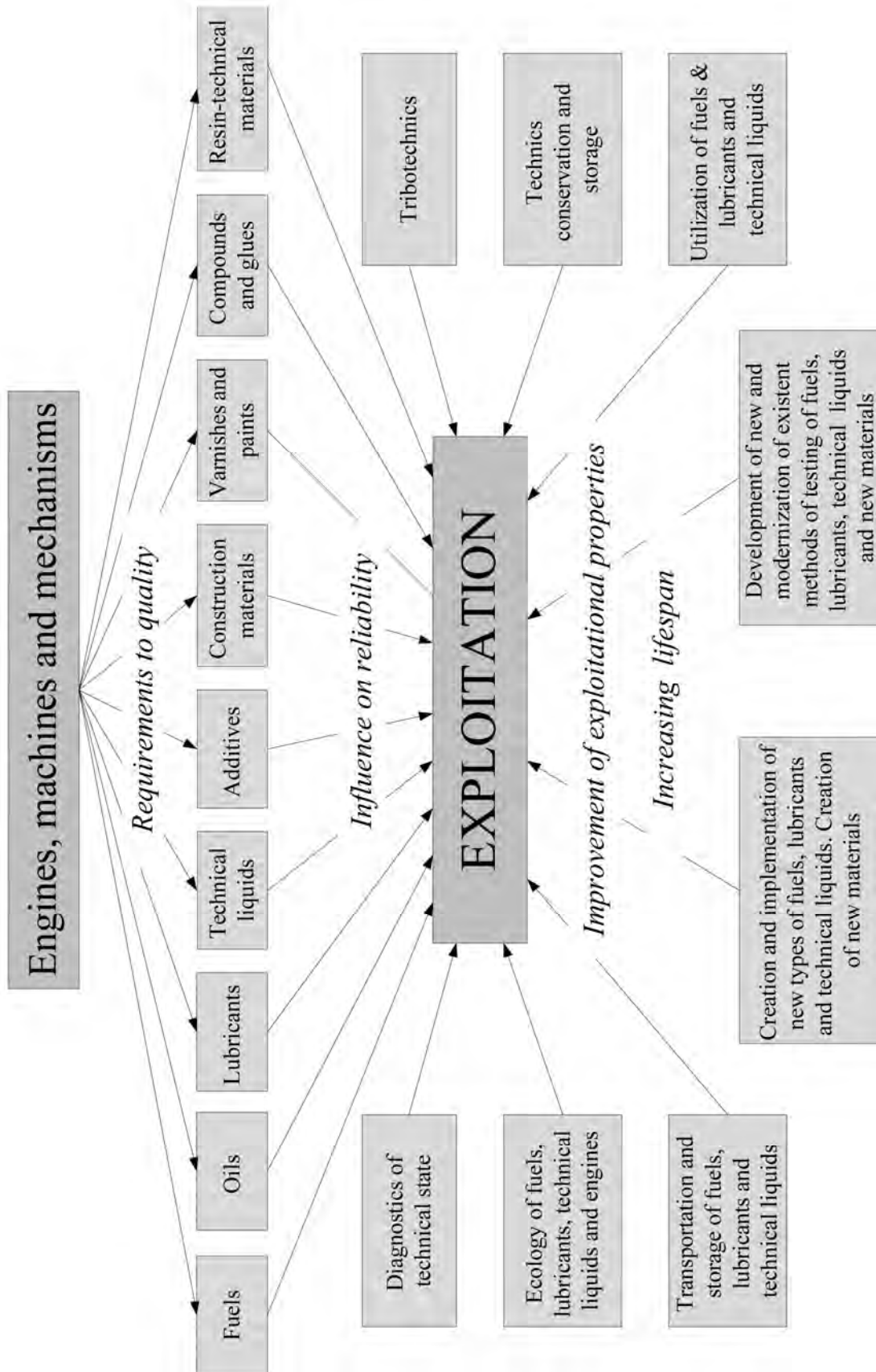


Fig. 5. Generalized universal model of the chemmological system

- Increasing competitiveness of products and services at the world level;
- Changing the culture (technical in particular), world outlook and modern way of life, *etc.*

4. Conclusions

Thus, the Chemmotological scientific and pedagogical school of the National Aviation University influences different sides and spheres of social life of the university, especially the ones connected with basic training of specialists in the education field, and also with research activities (oriented towards rational use of fuels, oils, greases and special fluids, for aviation equipment in particular). The school being an important constituent of information supply of educational process furthers the inclusion of information medium of the university into the global information system. The activity of the school in the structure of the university serves as a joining link between the university and world scientific environment, global Chemmotology scientists community. It also ensures the needed level of training of specialists in the field of oil products supply according to the social needs.

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ІННОВАЦІЙНЕ ХІММОТОЛОГІЧНЕ МИСЛЕННЯ ЯК ІНТЕГРОВАНА СИСТЕМА ЗНАНЬ

***Анотація.** Представлено історію, розвиток і сучасний стан хіммотології. Розглянуті основні проблеми і завдання. Приведено основи хіммотологічної наукової і педагогічної школи Національного авіаційного університету, її основні принципи, цілі та напрямки діяльності.*

***Ключові слова:** хіммотологія, палива, мастильні речовини, технічні рідини.*