



**Laboratory workshop on the chemistry of oil and gas as an effective
Educational Technology in the learning process of students in a
Technical University**

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Technology in the learning process of students in a Technical University**

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ANNOTATION

In the article the goals and tasks of such educational technology as "laboratory practical" are considered, which is an effective tool for the formation of industrial-technological and experimental-research competencies for students of technical specialties. The laboratory workshop was conducted on the basis of a technical college, when studying the course "chemistry of oil and gas." The basis of the performed laboratory works is the normative documents GOST, OST, ASTM, which allows understanding how the physical and chemical analysis of oil and oil products is carried out in the laboratories of any oil and gas producing company.

Keywords: educational technology, laboratory practice, industrial and technological competence, experimental and research competence.



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1. INTRODUCTION

The purpose of the educational and learning process is the training of a highly qualified specialist in the higher school of the Russian Federation. The discipline "Oil and Gas Chemistry" is the discipline of the basic part of the basic educational program in the field of 23.03.01. "Oil and Gas Engineering". The study of this discipline in the university assumes the formation of a whole block of professional competencies: general professional, production-technological, experimental-research.

Formation of the industrial and technological competence involves the formation of the following knowledge and skills in the field of oil and gas chemistry:

- to carry out technological processes of oil and gas production, collection and preparation of well production;
- to carry out field control and regulation of hydrocarbon recovery;
- to carry out technological processes of storage and sale of oil and oil products and liquefied gases;
- to carry out technological processes of construction, repair, reconstruction and restoration of oil and gas wells;
- ability to work with regulatory documents (GOST, OST, ASTM, ISO, etc.), giving an idea of the regulatory environment in which the activities of specialists should take place;
- ability to make decisions related to professional activity, relying on the connection of theoretical knowledge and practical skills, as well as the active professional position of future specialists;
- ability to work with information, databases, to consolidate and expand theoretical knowledge by targeting students in the most diverse information that they need;
- ability to work with the computer programs (for example, Microsoft Excel), to gain experience in their use, in solving problems of physical and chemical oil analysis;
- communication skills - ability to use the experience and abilities of their colleagues to solve the tasks set.

2. RESEARCH METHODS

Methods of analysis, synthesis, comparison, observation, generalization.



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3. RESULTS

The purpose of this article is to describe such a form of studies as a laboratory workshop - the pedagogical technology of teaching bachelor students in the discipline "Oil and Gas Chemistry".

This pedagogical technology contributes to the formation of the main above described professional competencies, which are spelled out in the State Standard of Higher Education of the Russian Federation.

The core characteristics of the phenomenon studied are the concepts of "pedagogical technology", so let us turn to their consideration.

In Russian language, the explanatory dictionary by S.I. Ozhegov and N.Yu. Shvedova give such definitions of the concept as: "Technology - a set of techniques used in any case, skill, art" (Ozhegov, S.I. (1996)).

V.P. Bespalko claims that the pedagogical technology is a meaningful technique for implementing the educational process.

Selevko G.K. describes pedagogical technology as a system set and the order of functioning of all personal, instrumental and methodological tools used to achieve pedagogical goals in the book "Modern Educational Technologies". (Selevko G.K.(1998)).

V.A. Slastenin, I.F. Isaev, A.I. Mishchenko, E.N. Shiyanov define the "pedagogical technology as a coherent, interdependent system of the teacher's actions connected with the application of a particular set of methods of upbringing and education carried out in the pedagogical process with an aim of solving various pedagogical tasks".

We adhere to the latter point of view and highlight some characteristics, the presence of which determines the similarity and affinity of all definitions:

- integrative nature;
- any technology has constituent elements;
- communication with the environment;
- continuity.

This understanding and definition of pedagogical technology gives us as the teachers of higher school the right to choose pedagogical technology in accordance with the goals, opportunities and conditions of interaction between the teacher and the students.



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The implementation of any pedagogical technology is a combination of actions aimed at the consistent implementation of general pedagogical principles that regulate the whole pedagogical process.

The principle is a certain system of initial, basic requirements for teaching and upbringing, the fulfillment of which ensures the necessary effectiveness of solving problems of a comprehensive, harmonious development of an individual (Smirnov, S.D. (2003)).

Yu.K. Babansky, P.I. Pidkasisty, V.A. Slastenin distinguish the following general pedagogical principles:

- purposefulness;
- scientific character;
- connection with life;
- the principle of group and individual learning;
- consciousness and creative activity of trainees;
- systematicity;
- continuity and consistency in training;
- visibility;
- accessibility, etc.

In addition to general pedagogical principles, the implementation of pedagogical technology in teaching the discipline "Oil and Gas Chemistry" is based on the specific principles. We distinguish the following specific principles: interdisciplinary coordination; variability.

The principle of interdisciplinary coordination is considered as the coordination of scientific content of the academic disciplines, their consolidation (Ivanov, D. A. (2008)), as well as the implementation of the need for a solution in the unity of cognitive and professional problems (Shkurkina, V.I. (2005)). When teaching the discipline "Oil and Gas Chemistry" the implementation of this principle is important, since many disciplines of the mathematical, natural-scientific cycles have common ground - a common subject area (Ivanov, D. A. (2008)).

The principle of variability, which is highlighted by the scientist N.V. Ippolitova (2006), reflects the complexity of the structure and content of students' training in the discipline



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"Oil and Gas Chemistry". This principle presupposes the selection of optimal methods, means and forms of pedagogical interaction used in the pedagogical process.

The principle of variability is implemented at two levels in our case: personal and organizational.

At the personal level, the planning and implementation of the educational activities of students as an integrative, professionally significant personal quality is carried out depending on the conditions, namely the individual characteristics of students, the level of their educational and professional-educational competencies, educational and mental abilities, etc.

At the organizational level, the effectiveness of students' educational activities depends on the correct choice of technology, methods, means and forms of instruction, in accordance with the pedagogical task.

Thus, taking into account all the factors and the principles of pedagogical process, such pedagogical technology as laboratory practice allows us creating favorable conditions not only to form the professional and educational competencies, but also to improve these competencies at the personal level, to enhance the personal and professional development of future oil engineers.

The laboratory workshop is potentially the most significant and effective component of the natural-science, general professional and special training intended for acquiring skills of working on real equipment, with the analogues of which a future specialist may have to deal in his practical activities. In the technical universities, a laboratory workshop is conducted in the specialized training laboratories (GOST 31378-2009. Oil. (2013), GOST 33-2000. ISO 3104-94 Oil Products. (2001).).

It should be noted that all laboratory works in the study of the discipline "Oil and Gas Chemistry" are based on a number of regulatory documents (GOST, OST, ASTM), which allow us understanding how the physical and chemical analysis of oil and petroleum products is conducted in the laboratories of any oil and gas producing company.

Let us consider the course of the laboratory work "Oil viscosity determination".

The laboratory work includes several stages:



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Stage I - setting the study purpose. The students choose the objects of research, in this work - an oil sample: light, medium, heavy, bituminous (the terminology is given in accordance with GOST -31378-2009 (Timerbaev, R.M., Danilov, V.F., Akhsanov, M.M. Fuel (2013), Mukhutdinov R. H., Timerbayev R. M., Falyakhov I.I., (2016.)). It is determined in what units - SI or GHS - should the measurements be carried out. Each group works with its own sample.

Stage II - study of the experimental procedure in accordance with the regulatory document (GOST, OST, ASTM). When the determination of the parameters of object investigated is possible according to several regulatory documents, it should be carried out their comparative analysis with each other, should be noted the merits and demerits of each method, and should be selected one of the methods for conducting the experiment. At this stage:

- it is considered the order of working with devices and equipment;
- it is carried out the analysis according to the regulatory document methodology (Ibatova, A.Z., Ippolitova, N.V., Muchametgaliyeva, S.K., Rodionova, A.E., Yagafarova, K.N., Ikonnikova, L.N. (2016), Ibatova, A.Z., Mukhametgaliyev, I.G., Mukhametgaliyeva, S.Kh., Kuzmenko, V.I., Mirzagitova, A.L., Vdovichenko, L.V. (2017)).

Stage III - it is carried out the experimental and research part of the work, in which the experimental conditions are changed:

- it is determined the viscosity of the selected samples at other temperatures;
- it is determined the viscosity of the samples in which the oil of different types (mostly heavy or bituminous with extra light oil) is mixed;
- it is determined the viscosity of samples of heavy and bituminous oil with solvents: hexane and toluene.
- it is determined the influence of demulsifiers on the oil viscosity.
- it is carried out the calculations of dynamic viscosity, fluidity, etc..

Stage IV - analysis of the results:

- the calculations are made, tables are filled, schedules are built according to the data received.
- it is made a comparative analysis of the results obtained with the theoretically calculated values, if possible.



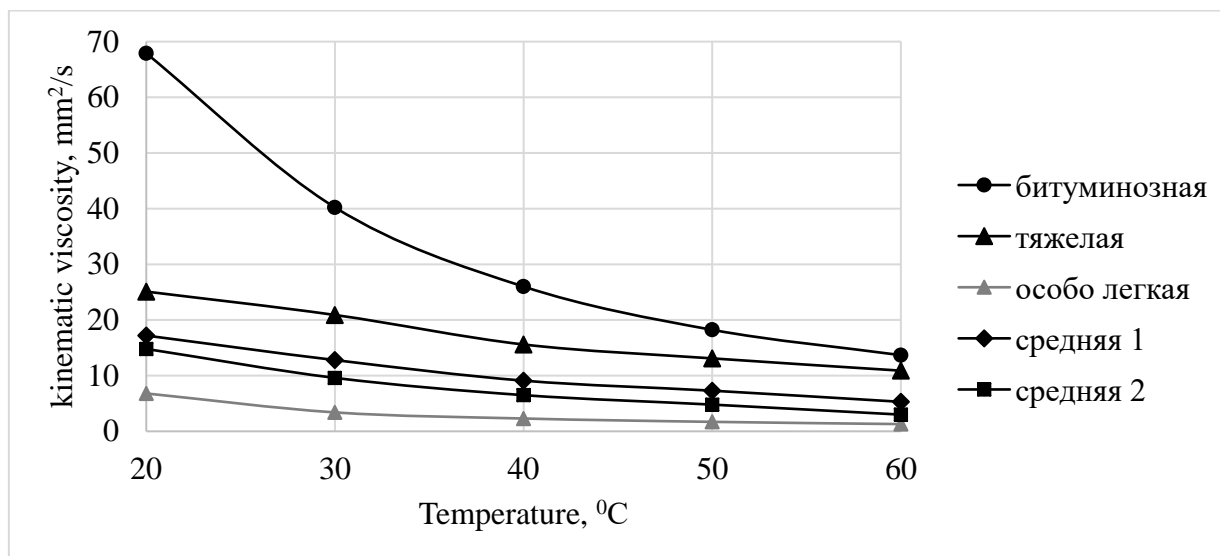
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- a comparison of the results obtained in different groups, because the objects of research are different for all, are of great interest for the students.

- it also seems necessary to compare the variation dependence of various parameters (for example, density and kinematic oil viscosity) on temperature and determine which dependencies are linear, and which are not.

So, when carrying out practical work to determine the kinematic oil viscosity using the capillary viscometers (Askhamov A.A., Konyshva A.V., Gapsalamov A.R. (2016)), the students conduct viscosity determination at a temperature of 20⁰C (GOST), and at the temperatures of 30, 40, 50, 60⁰C, heating the viscosimeters with oil in a thermostat. By analyzing the data obtained, the students can observe a non-linear change in viscosity depending on temperature in practice. And also, comparing the oil analysis results in the groups, one can see that the change in temperature has different effects on the oil viscosity of different density (Fig. 1), in the viscosity of bituminous oil when it is mixed with extra light oil (Fig. 2) and hexanes and toluene solvents (Fig. 3).



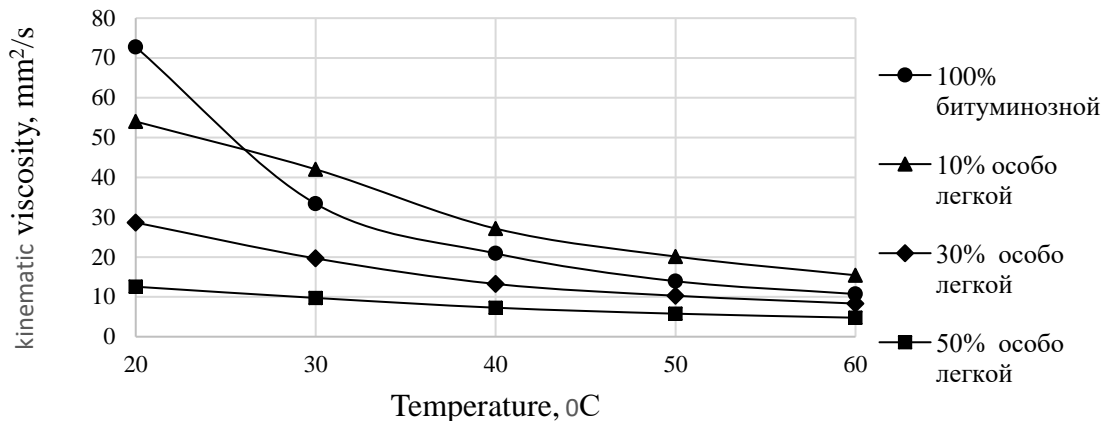
битуминозная	bituminous
тяжелая	heavy
особо легкая	extra light
средняя 1	medium 1
средняя 2	medium 2

Fig. 1. Dependence of the kinematic viscosity of oil on temperature



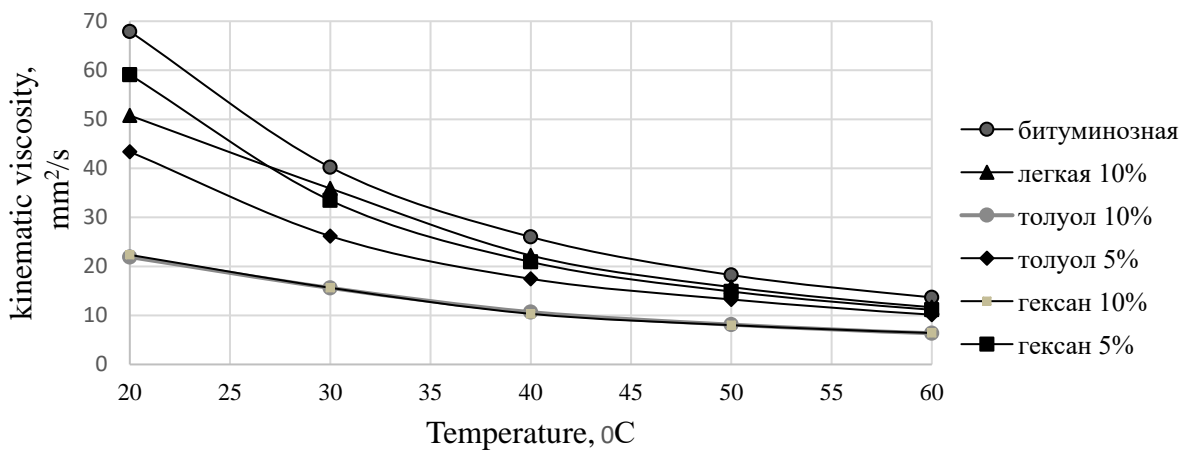
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100% битуминозной	100% of bituminous
10% особо легкой	10% of extra light
30% особо легкой	30% of extra light
50% особо легкой	50% of extra light

Fig.2 Dependence of bituminous oil viscosity and its mixture with extra light oil on temperature.



битуминозная	bituminous
легкая 10%	light 10%
толуол 10%	toluene 10%
толуол 5%	toluene 5%
гексан 10%	hexane 10%



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гексан 5%	hexane 5%
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Fig.3 Dependence of viscosity of bituminous oil mixtures with solvents on temperature

Using the calculation formulas and reference tables for working with their samples, the students are asked to fill in the following table and write down the measurement units for each type of viscosity:

Kinematic viscosity	Dynamic viscosity	Conditional viscosity	Specific viscosity	Flowability

The students are encouraged, using scientific and educational literature, to explain the dependencies obtained, and first of all to take into account that the viscosity most accurately reflects the intermolecular interaction of hydrocarbons and heteroatomic oil compounds. And pay attention to how the temperature affects the bituminous oil viscosity, to explain how this can be used to extract it.

Comparison of the oil viscosity dependence on temperature and the oil density dependence on temperature, allow students drawing conclusions about linear and nonlinear changes in the physicochemical properties of oil from temperature, the dependence of changes in a number of parameters on the oil chemical composition.

4. CONCLUSIONS

Conducting laboratory works and preparing a report on them helps the students to correlate the results of their research with similar data in the theory of issue, to familiarize themselves with various methods for determining the physicochemical oil parameters, to compare the individual indicators obtained in groups, to illustrate the results obtained by tables and graphs, revealing the creative abilities of students.

5. SUMMARY

Thus, it can be argued that the educational technology chosen by us in the form of a laboratory workshop is effective, as it is an incentive to positive motivation of students, contributes to the cognitive activity of students, and allows forming the professional skills.



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