

is an oscillatory system. The rock layer, which is an oscillatory system, is characterized by frequency. Studies have shown that the frequency  $F_0$  of the harmonic attenuation signal is related to the thickness (power) of the resonator layer  $H$  by the ratio:  $F_0 = k / h$ , (1) where  $k$  is a coefficient with velocity dimension. For rocks, this coefficient, as it turned out, is equal, with an error not exceeding 10 %, 2500 m/s. Thus, by determining the natural frequency of the vibration process resulting from the impact, it is possible to determine the throughput of rock structures located in the studied zone of rock structures.

**Drawback**

The only drawback of this method is the small depth of the study, which does not exceed 2-3 kilometers. Therefore, explosion energy converters are used for deeper study. The explosion remains the source of the waves here. This explosion no longer occurs in the soil, but in a special explosive chamber. Explosive impulses are transmitted through steel plates to the ground, and a mixture of propane and oxygen is often used instead of explosives. All this makes it possible to significantly speed up the process of probing the subsurface.

**Conclusion**

Based on the given example, we can conclude that physics and geology are interconnected with each other, forming a single whole. Without knowing the physical laws and phenomena, such a science as geology would not exist. Without these laws, we would not be able to study minerals, rocks, the structure of the Earth's crust, and even more to search for minerals. Without these sciences, the world would be completely different.

**References**

1. Geophysics: Scientific and Technical Journal / Euro-Asian Geophysical Society (EAGO). — Moscow: Polipress, 2006. Retrieved from: [http://elibrary.ru/title\\_about.asp?id=8615](http://elibrary.ru/title_about.asp?id=8615) (access date: 27.03.2022).
2. Kuvshinov, K. A. Pulse-vibration source of seismic signals / K. A. Kuvshinov, B. B. Moises, P. Ya. Krauins // News of Tomsk Polytechnic University [News of TPU] / Tomsk Polytechnic University (TPU). - 2010. — Vol. 317, No. 1: Earth Sciences. — pp. 77-81. Retrieved from: [http://www.lib.tpu.ru/fulltext/v/Bulletin\\_TPU/2010/v317/i1/13.pdf](http://www.lib.tpu.ru/fulltext/v/Bulletin_TPU/2010/v317/i1/13.pdf) (access date: 27.03.2022).
3. Rezyapov, G. I. Seismic exploration : textbook / G. I. Rezyapov; National Research Tomsk Polytechnic University (TPU) ; National Research Tomsk Polytechnic University (TPU), Institute of Natural Resources (IPR), Department of Geophysics (GEOF). — 1 computer file (pdf; 27.7 MB). — Tomsk: TPU Publishing House, 2012. Retrieved from: <http://www.lib.tpu.ru/fulltext2/m/2013/m130.pdf> (access date: 27.03.2022).

**THE IMPORTANCE OF PHYSICS IN THE WORK OF A DRILLING ENGINEER**

**Tursunova A.**

Scientific advisor senior lecturer V.E. Mironova

**National Research Tomsk Polytechnic University, Tomsk, Russia**

The purpose of this article is to analyze the role of physics in the professional activity of a drilling engineer. To achieve this purpose it is necessary to solve several problems:

1. to give a concept of the drilling engineer activity;
2. to consider the laws of physics that are necessary for a drilling engineer.

Physics tells us about the laws of motion, equilibrium, the attraction of the earth, electricity and others. With the help of physics, people have learned what lightning, thunder, light, rain are. Physics is life itself, nature itself [5].

Richard Feynman in his lectures on physics said: "Physics is the most fundamental of all sciences, the most comprehensive; its influence on the entire development of science has been enormous. Indeed, after all, the current physics is quite equivalent to the long-standing natural philosophy, from which most of the modern sciences arose. It is not for nothing that students of all kinds of specialties are made to study physics; it plays a major role in many phenomena." Physics is a science that has a connection with many other sciences: mathematics, astronomy, biology, geology, chemistry, etc. [4].

Any machine, even the most complex computer works according to physical laws, thanks to accurate calculations of highly qualified specialists. Any applicant can become such a specialist by choosing a profession

for which physics is needed. It is quite difficult to cover the whole physical science [1]. The duties of a drilling engineer include drawing up a drilling schedule, forecasting the results of this process, coordinating work and necessary equipment, analyzing data on nearby wells, performing calculations for fixing wells, calculating the risk of well collisions, etc. [4].

Oil is not found in underground caves but exists in microscopic pores of sedimentary rocks. There are many interesting physical quantities, including hydraulic permeability, resistivity. A hydrocarbon collector is a rock containing voids and is capable of containing and filtering fluids (oil, gas, water). The vast majority of reservoir rocks are of sedimentary origin. One of the most common types of reservoir rock is quartz sandstone. To measure resistivity, there are three common methods that are currently used:

- Electrodes;
- Electromagnetic induction;
- Propagation of electromagnetic radiation.

Resistivity does not distinguish oil and natural gas but neutron scattering occurs. Hydraulic permeability is another key physical characteristic of the reservoir rock. The greater the hydraulic permeability is, the easier it is to extract oil from the reservoir [2].

What is the role of physics in the drilling profession? The researcher Fred Dupriest began teaching a physics-based drilling course at Texas A&M, the first of its kind, in 2013. It is currently taught by Neunart, and this course remains unique, students are taught physics at the initial stage of drilling, as well as ways to identify and reduce performance constraints. At the initial stage of the project Fred Dupriest provides training in the physics of drilling mechanics, workflow, step-by-step tests and communications in order to involve everyone in drilling operations. What physical effects occur with drilling of oil and gas wells? These are the effects of impact. During the drilling process, a failure may occur in which one equipment damages another due to the impact. When drilling, Hooke's law is applied. Also, with the help of a physical law, it is possible to solve the main problem of the penetration rate. During the drilling process, the physical properties of the formations are constantly measured: temperature, electrical conductivity, magnetic susceptibility, radioactivity. This process is called logging. Unconventional engineering solutions are used for ultra-deep drilling. There are also physical problems and ways to deal with them: the drop between the hydrostatic pressure of the drilling mud column and the lithostatic (rock) pressure of the rock. To balance it due to special fillers, the density of the drilling mud is increased to about 2 g / cm<sup>3</sup>. Since the reservoir temperature at great depths exceeds 100-200 degrees, special equipment is needed to work on such wells: metal parts and joints, lubricants, drilling mud, specialized measuring equipment.

Conclusion.

Such physical quantities as force, pressure, mechanical stress are used to describe drilling processes and also to consider the properties of rocks undergoing drilling. Elasticity, compressive and tensile strength, plasticity are the most important mechanical properties of rocks that affect a number of processes occurring in the formation during development and operation of deposits. These concepts are physical, it is impossible to define them without knowledge of the basic physics.

#### References:

1. Physics in my profession [Electronic resource]. Retrieved from: <https://flamenco.ru/fizika-v-moei-professii-soobshchenie-fizika-v-tvoei-professii-celi-nashego-zanyatiya/> (access date:10.03.22).
2. Physics in Oil Exploration [Electronic resource]. Retrieved from: <https://physicstoday.scitation.org/doi/10.1063/1.1480782> (access date:15.03.22).
3. Physics in the profession of an oilman [Electronic resource]. Retrieved from: <https://tfmarket.ru/life/fizika-v-professii-neftyanika-professiya-neftyanik-raznye-grani.html> (access date: 18.03.22).
4. Potapova A.P. Study of the physical foundations of the oil and gas industry [Electronic resource]. Retrieved from: [http://elib.cspu.ru/xmlui/bitstream/handle/123456789/4314/%D0%9F%D0%BE%D1%82%D0%B0%D0%BF%D0%BE%D0%B2%D0%B0\\_%D0%90\\_%D0%9F\\_%D0%92%D0%9A%D0%A0.%20%D0%91%D0%B0%D0%BA.pdf?sequence=1&isAllowed=y](http://elib.cspu.ru/xmlui/bitstream/handle/123456789/4314/%D0%9F%D0%BE%D1%82%D0%B0%D0%BF%D0%BE%D0%B2%D0%B0_%D0%90_%D0%9F_%D0%92%D0%9A%D0%A0.%20%D0%91%D0%B0%D0%BA.pdf?sequence=1&isAllowed=y) (access date: 20.03.22)
5. Why do you study physics [Electronic resource]. Retrieved from: <https://moitvoru.ru/index.php/home/russkij-yazyk/sochineniya-8-klass/1597-zachem-nuzhno-izuchat-fiziku-sochinenie> (access date: 10.03.22).

## THE SPECIFIC NATURE OF INTERDISCIPLINARY EDUCATION IN THE TRAINING OF MODERN ECOLOGISTS

Zavarukhina K. I.

Scientific advisor senior lecturer V. E. Mironova

*National Research Tomsk Polytechnic University, Tomsk, Russia*

The modern development of technology has led to the degradation of the unfavorable environmental situation and the rise of a global environmental crisis. Every day humankind produces about 5 million tons of garbage, loses thousands of hectares of forest and consumes at least 12.5 million tons of food, a third of which in the end is simply thrown away [3]. The losses of society, which are driven by the increase in environmental disasters, may destroy all the results of economic progress in the near future. The development of ecological competence, sensible and careful attitude to resources, ecosystems and the planet as a whole is necessary for further comfortable and safe existence [1]. In this regard, it is proposed to conduct environmental education and training from the first year in general by introducing environmental knowledge into the content of socio-political, general education, general scientific and special disciplines [2]. Modern graduates, who are responsible for further development of technologies, face the challenge of organizing them in such a way as to minimize the impact on the environment, increase the volume of waste-free and energy-efficient production [7].

The basis of students' acquisition of knowledge in the field of environmental protection lies in the formation and development of scientific concepts in the process of learning. Concepts must be formulated correctly in order to objectively reflect the scientific world. It is important that the formulated ecological concepts reflect the interaction of a man and the environment holistically and objectively. In nature there are principles of ecological self-regulation, and each person must consciously take them into account, as well as anticipate the consequences of interference in the natural environment [5,6,8].

The purpose of this article is to study the features of interdisciplinary education of modern ecologists and to collect the data necessary to establish interdisciplinary connections in this field.

The research material included the works of such scientists as Aristotle, Theophrastus, and Pliny the Elder, these works were devoted to the history of animals - ecological classification, habitat, daily activity, etc., the basics of geobotany and the economic nature of zoecological concepts. Also, the research material includes more modern works by such scientists as Broglie, who conducted one of the first environmental experiments - the effect of atmospheric pressure on animals. Linnaeus, who described the concept of equilibrium in nature, assessed the leading influence of climate conditions