Materials of Conferences

DEVELOPMENT OF OIL AND GAS FIELDS AT THE NORTH: INFORMATION SUPPORT OF THE PROBLEM

Rykova V.V., Gorte Y.D.

State Public Scientific-Technological Library of the Siberian Branch of the Russian Academy of Sciences, Novosibirsk, e-mail: bmc_87@mail.ru

The information flow on oil and gas fields geology, exploration and exploitation is very significant, but dispersed in bibliographic tools. Researches carried out on this topic need to be accompanied by information support using new information technologies. SPSTL SB RAS provides information support of scientific research through the creation of electronic bibliographic resources. Materials touching various aspects of oil and gas fields geology, exploration and exploitation are concentrated in the databases «Problems of the North» and «Nature and natural resources of Siberia and the Far East and their protection and rational use» generated by the Division of Scientific Bibliography. The first one covers issues on exploration, evaluation of hydrocarbon resources, extraction, storage and transportation of oil and gas under permafrost conditions, the second – fields geology and prospecting. DBs of SPSTL's own generation are formed on the basis of the legal deposit of national literature and foreign literature entering the scientific institutions of SB RAS, and include various types of documents: books, articles from periodicals, serial publications and scientific journals, conference proceedings, dissertation abstracts, deposited manuscripts, guidelines, patents, maps and atlases, etc. Records of DB contain a bibliographic description, an annotation, geographic and subject headings, translations of foreign publications. Search for material in DBs is possible by key words from the title, abstract, or translation, authors, editors, year and place of publication, geographic or subject heading, publication type and language.

The documentary flow (DF) on «Development of oil and gas fields of the North» was selected out of DB «Problems of the North», which exceeds 10,000 documents from 1987 to 2010 in Russian and foreign languages. A brief scientimetric analysis of DF was made. The analysis of DF dynamics revealed its stable growth since 1995 indicating a renewed interest of scientists and experts in this subject. Low publication activity of the Perestroika period is explained by extremely poor funding of research.

The greater part of DF documents are represented by articles from periodicals (33%). More than a half of DF are proceedings of conferences and articles in collected papers (31% and 23% correspondingly). Abstracts of dissertations and monographs are about 7% of DF, patents – 3%.

The geographical analysis of DF identified the key areas of research: the north of West Siberia (70%), the European North (including the Arctic shelf) (20%). Materials for foreign North are presented mainly by works on the Northern slope of Alaska (USA) and the Mackenzie Delta (Northwest Territories of Canada), the Athabaska basin (Alberta, Canada).

The DF thematic structure highlighted three main spheres of research: geological (the study of hydrocarbon resources of the northern territories); technological (the development of techniques for drilling in the northern fulfillment and technologies for the extraction of oil and gas in permafrost and on the Arctic shelf; ecological (studying effect of oil and gas extraction on northern ecosystems and environmental issues). Information from our DB can be found at the Library Internet site www.spsl.nsc.ru.

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GEOMECHANICAL PECULIARITIES OF DESTRUCTION OF FRAGILE MATERIALS WITH USAGE OF PLASTIC MEANS IN PERCUSSIVE REGIME

Tsygankov D.A.

Institute of mining of the Siberian branch of the Russian Academy of Sciences, Novosibirsk, e-mail: dmtsygankov@fastmail.fm

Based on the analysis of features of natural stone, as well as the condition of problem of geomechanical provision for its processing, the author of this report came to the following conclusions:

1. Natural stone, like other kinds of solid raw materials, has a number of specific main and additional features. Thereby a technologist of mining production faces the problem of accounting physical and mechanical characteristics, mineral composition of a rock, and presence of a crack system in it, possibility to use waste products of the main and repeated production, solidity, ornamentality, safety, seasonal prevalence of works, and also size and shape of the future monoliths (blocks) at the same time.

2. According to the modern world trend, the overall production of natural stone in blocks and products of it increases. It makes the problem of increase in its breaking efficiency through introduction of new methods, means, and technologies of its realization urgent.

3. A gradual shift of the leading region of production and processing of natural stone from Europe to Asia takes place in the world.

4. Russian branch of mining and production of items of natural stone faces a number of serious problems, the most important of which are: a lag from the world standards of enterprises' equipment with modern technics and technologies, quality of the output; disparity in requirements of size and shape of the processed monoliths that are accepted by the world practice; lack of permanent market for the production; insufficient development of domestic raw material resources and personnel problems.

5. Regardless of big number of researches of theoretical and applied character on the mechanics of natural massive destruction, the number of unsolved problems remains considerable. One of the ways to solve many of the problems of mining production was the method that was introduced by O.I. Chernov in 1970-ies. It is called the method of direct fluid rupture (DFR) and is aimed to collapse roofings of stope mining output, degassing of coal layers and containing rocks, and also to destruct natural stone through blast holes.

6. A character feature of natural stone production is the implementation of several methods of rock destruction while breaking the same monolith, that distinguishes it from other kinds of solid raw minerals.

7. The share of natural stone that is produced via blast hole methods remains significant. Therefore, an implementation of DFR method with plastic substances that possess a number of advantages, compared to their analogues, as well as the technology of mining production, created on its foundations, is very perspective.

8. Compared to the analogue bore-wedge method, advantages of the method of direct fragile materials destruction with plastic substances are in the ability to: shorten the length and number of blast holes in layers of planned break-offs; shortening of solid production waste products through decrease in curvature of break-offs' surface on rear flatness; preservation of shape of blast hole mouth area; usage of serial percussive tools of different main purpose with its minor adjustment. Compared to the analogue method of destruction with powdery NDM (non-explosive destructive means) its advantages are that it: does not require sealing of horizontal blast hole mouths; allows plastic substances to enter crazings and transfer an impact on their walls; allows us to introduce plastic substances in any volume; can regulate temperature regime of implementation through using compositions with different additives; provides for better technical and sanitary conditions of work.

As a result of theoretical and experimental circle of research on definition of legislations of formation of crazing that is received in fragile materials under the impact of plastic substance from a blast hole and definition of legislations of plastic substance spreading inside a crazing, formed by its ousting from the blast hole, we have concluded that:

1. Possibilities to destruct fragile materials with fluids (water, oil, etc.) are limited by the necessity to use high-pressure force pumps and obligatory technically-complex seling of blst holes' mouths, and impossibility to form flat surface of a rupture, as well as efficiency loss when a crazing enters free surface.

2. In case of implementation of plastic substances to destroy fragile materials, even break-off flatness is formed, and the process of breaking goes on even in case when separate crazing areas enter free surface. No technically-complex sealing of blast holes' mouths and additional volume of plastic substance is needed, as during the process of destruction it isn't filtered through the destroyed material.

3. Ousting of fragile materials with plastic substances along and across blast holes' axes in dynamic or quasi-static regime is considered to be a perspective scheme of destruction of fragile materials.

4. To create extensive crazings of necessary size with usage of plastic substances due to a force that lead to curvature of a crazing surface along with a growth in its size, a combnation of blast holes in a scan line can be used instead of one separate blast hole.

5. Under multiple ousting of a plastic substance from a blast hole into a crazing that is formed in fragile material, its shape comes to a circle.

6. An increase in volume of plastic substance that is introduced into a crazing, formed in fragile material, increases the lag of its border from the border of the crazing.

One of the main stages of the work is the study of the development nature of a crazing that is formed along and across a blast hole axes, from which plastic substance is ousted. As a result of the research we have established that along with increase in its size, the shape of the longitudinal crazing evolves from an ellipse to a circle, and transversal crazing has more expressed circular character and is almost independent from its further size increase.

According to the research, unlike fluids, plastic substances does not fill the formed crazing completely, thus making a «free area» between the line of a crazing and the line of the filling plastic substance. The further study has shown that the distance between the crazing line and the filling line depends on the regime of charging, consumption, and rheological features, as well as physical-mechanical features of the destroyed rock.

As the result of laboratory experiments we have concluded that in order to form a crazing of the right shape with even surfaces it is necessary to provide for permanent consumption of plastic substance during its ousting from a blast hole into the crazing of low extent (up to 150 mm^3/s). Additionally, under laboratory tests on organic glass blocks we have found out that plastic substance, placed in a crazing under dynamic charging, accumulates pressure. This pressure can be hold in it for several days and serve as a cause of further spontaneous destruction of samples.

In has been established that in case of outer loading over the destroyed sample (presence of mining pressure), the primary crazing growth is observed along the direction of this loading, and the distance between the crazing line and the filling line increase independently from the loading direction and its presence.

As we have already said, due to the lack of dynamic calculations of fragile materials' destruction with plastic substances of sufficient accuracy, this calculation can be carried out according to quasi-static principles under conditions of low consumption (up to 150 mm^3/s) of plastic substance during the destruction. Besides, plastic substances can be used to destroy rocks of any known solidity (σ_p = 80 MPa).

As the result of a circle of theoretical and experimental research on definition of legislations that link a blowing energy to the parameters of the formed crazing and plastic substance in it, we have established that:

1. An increase in blowing energy of a tool and linked increase in consumption of plastic substance that is introduced into a crazing, formed in fragile material, increases the lag of its line from the crazing line, correlation of a crazing volume and the volume of introduced plastic substance, and also the overall energy output for its ousting into a crazing.

2. The area of the filling of a crazing that is formed by a blast method across the blast hole axis with usage of plastic substances forms an elastic element, size of which depends on the blowing energy, blast hole parameters, solidity of the destroyed rock and limit of its fluidity.

As follows from the bibliography analysis, carried out by the author, the most perspective is the breaking of blocks of size 2–2,8 m wide and 1,2–1,7 m high. For that it is necessary to plan sizes of blocks as equal or even to these numbers. Besides, to achieve an optimal weight (60 tonnes) it is necessary to evaluate the required block length according to the provided sizes of length and width, and also consider a blowing tool that can form crazings of the required size with usage of plastic substances.

As the result of the experiment series it has been found out that an increase in blowing energy of a tool under the same correlation between blast hole diameter and depth, but with alteration of plastic substances and destroyed materials leads to an increase in number of fractions that are formed during the break-off.

As pressure spreading in plastic substance goes on with a decreasing dependence, a possibility of start and extension of a process of further across crazing development, formed at the level of blast hole stall, will be linked to the necessity to use a tool with greater blowing energy, compared to the longitudinal crazing that is formed sequentially along the blast hole length, starting with its mouth.

Therefore, tools that have lower frequency with the same blowing energy should be selected as the pressure that is accumulated in plastic substance and lags to spread (decrease), resists to the transition of new pressure and, therefore, prevents further destruction of fragile material.

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