Negative Effects of Groundwater On Mines and Investigation of Drying Methods in Mines in Northern Afghanistan

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Abstract- It is known that during mining operations, the emergence of groundwater always causes numerous problems in the country's mines, especially in the mines in the north of the country. On the one hand, the emergence of groundwater during extraction causes the slowness and speed of the extraction processes, and on the other hand, huge amounts of money must be spent to remove the aforementioned waters. Therefore, in this work, I wanted to examine the issue and search for and discuss appropriate solutions. The dangers to mines caused by the emergence of groundwater include: subsidence, dissolution, and landslides. In this work, an effort has been made to use the experiences of advanced and civilized countries that have gained useful experiences in the past and to adapt them by considering the geographical conditions of our country. One of the appropriate solutions is the method of drying mines, which has been discussed in detail in this work. After studying and evaluating the structure of various mines, certain results have been obtained and, in the end, specific suggestions have been presented to the competent authorities to eliminate the aforementioned dangers.

Keywords: Groundwater, subsidence risks, dissolution, subsidence. Mine drying.

I. INTRODUCTION

Negative effects of groundwater on mines: Groundwater creates numerous problems in the mining process in coal mining at Northen Afghanistan. Of course, the dangers of groundwater for underground mining are mentioned phenomenon. Among the methods of drying mines during mining operations is common in open-pit mines, the mechanism of which is explained below.

Methods of drying mines during open-pit mining operations: If the groundwater level is lower than the veins of useful materials, the aforementioned waters do not affect the progress much more serious and costly than for surface mines. It is worth noting that the dangers to minerals not only slow down mining operations, but also the cost and expenses of disposing of the aforementioned waters often amount to about 30-40 percent of the total costs of the mining process. Therefore, the disposal and softening of groundwater requires the use of various measures to obtain appropriate solutions to the mining operations. The term water-bearing mines refers to those mines in which the groundwater is higher than the layer of useful materials or under the layer of useful materials there is a pressurized aquifer where the piezometric level of water is higher than the soil of useful materials. Drying mines is carried out in order to prevent deformation of preliminary and operating excavations in unstable rocks that are created by hydrostatic and hydrodynamic pressure, and also in order to create relatively more favorable conditions for the work of miners and mining equipment:

- Ensuring the stability of the sides and slopes, slopes and carriers.

Reducing the moisture content of extracted useful materials to improve their quality.

Ensuring normal working conditions in mines and equipment transportation.

If the useful materials are located in the rocks and the water flow is low, the water is drained from the quarries in an open way. Most often, drying is carried out in water-bearing mines by collecting them through drainage structures before they are included in the quarry. Because during the extraction of crushed and water-saturated rocks, the production capacity of excavators (excavators) and the transfer bridge of idle rocks decreases, friction and adhesion decrease, and the ground for the occurrence of slips occurs, which makes it difficult to carry out the work of the quarry. If the drying is incomplete, the bottom of the pit and the moving railways suffer excessive subsidence, wet rocks stick to the buckets of the excavators, the windrows of the cars and the walls of the wagons, and block the loading areas. Coal that is not completely dried in the layer after extraction must be dried because in a wet state it exceeds the specified norm and the production capacity of the briquette machine decreases (Fig.1).

Fig.1 Scheme of drying water in some open Mines [13].

II. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

No research or treatise has been written about the dangers of groundwater in Afghan mines so far, but the issue of problems and dilemmas that arise during mining is obvious to everyone and has been widely reflected in international books and journals, especially in European countries and the Russian Federation (Ural), and I have used their findings in this work. It is worth mentioning that in my previous article, I had only studied the geological dangers of mines in the north of the country, especially coal mines, which was published in the Science and Technology Journal of Kabul Polytechnic University. I hope that by writing this article, the way will be opened for further research on the aforementioned subject and the attention of other researchers will be attracted.

The purpose of writing this article is to find appropriate and reasonable solutions to prevent problems that arise during mineral extraction and other underground excavations, because without complete knowledge of the laws and movement of groundwater, the extraction process cannot be successfully managed. All work related to the drying of the quarry area is divided into two stages in terms of execution time:

1- Preventive, preliminary drying

2-Parallel drying or during operation

Preventive drying: The quarry area is carried out one or two years before the extraction of useful materials during its stripping and is completed by rejecting surface water, lowering the groundwater level and drying the cutting and outlet cutting area to provide normal conditions for the extraction of useful materials in the area of the first round of work [10].

Parallel drying (during operation): It is carried out simultaneously with the mining operation to dry the successive (or subsequent) areas that are prepared for the extraction of useful materials. Preventive drying during the stripping of mines is always converted into parallel drying and is carried out within the quarry area until the end of mining. That is, it is carried out when there is a well-permeable non-pressure aquifer of small thickness in the overburden and the pressure water in the soil of the useful materials belonging to the rocks is strong and stable. The drying method and types of drainage structures must meet the following requirements:

1-The duration of the drying work must correspond to the progress of the stripping and extraction work or the period of delivery of the quarry to exploitation.

2- Drying must be carried out with the minimum consumption of water necessary for its operation.

3-The reliability of the method used must be ensured.

The success of all mining operations is related to the effectiveness of the selected drying method (related to the duration and degree of drying), which guarantees the strength and stability of the slopes and work without disruption of the mechanisms. Even the accumulation of water in the cover rocks is not allowed, as they facilitate the penetration of water and the formation of landslides. The cost of extracted useful materials is reduced by harmonizing the selected extraction systems and drying methods. The drying plan of a quarry or mine consists of three stages:

a) Technical-economic documentation

b) Design instructions

c) Working drawings

Technical-economic documentation is prepared based on the hydrogeological research documents carried out by geological exploration organizations at the stage of preliminary exploration and exploration. At this stage, the need for protecting the quarry from water is determined, the methods and drying systems, the construction period of drainage structures and necessary equipment are determined by the technical-economic parameters of drying

When preparing the working plans, the accepted methods of drainage are made using accurate hydrogeological supplementary materials. Before completing the drainage plan instructions and preparing the working plans, during the underground and mixed drainage methods, exploratory control drilling is carried out under the columns of drainage shafts and on the terraces of the proposed drainage systems along with experimental drainage.

III. MATERIALS AND METHODS

Drying methods and schemes: In the selection and selection of the drying method and the number of locations of drainage structures, as a rule, the physical-mechanical and hydrological properties of the rocks, the number of aquifers under drying and the depth of their location, the reserves of groundwater contributing to the hydration of the mines and the permeability of the rocks under drying have an effect. Taking into account the above-mentioned indicators and the degree of hydration of the mines, four categories of complexity of the drying conditions have been determined: simple conditions, moderately complex conditions, suspended conditions and very complex conditions. Simple drying conditions exist in mines consisting of solid karst rocky rocks and semi-rocky rocks in which there is one or rarely two aquifers, mainly with low permeability. Groundwater in such mines can be easily drained, because their porous bedrock is stable and strong and is not subject to the processes of displacement, polyunification, suffocation and swelling (regardless of their degree of permeability). The need to build special buildings for the drainage of such mines is not felt. Groundwater in the mines is drained directly by mining excavations by pumping water to the surface by mine pumps (Donbass and Kuzbass coal mines). Drainage trenches (or gullies) and water-repelling ditches are used. In areas with long and severe winters, drainage through a dense network of drainage buildings is more reasonable, since a large area of rock can be drained from one point.

Water-bearing mines consisting of alternating and stable gravel, mud and semi-rock stable rocks, rock stable rocks covered by unstable gravel-mud and karst rocks or broken by tectonic faults are complex in terms of drying conditions, and in such mines, drying works are carried out with all their volume, which provides conditions for the normal development of mining operations. When extracting useful materials by open method, surface, underground and mixed drying methods are usually used. In addition, the protection of the quarry from the negative effects of surface waters is also taken into account.

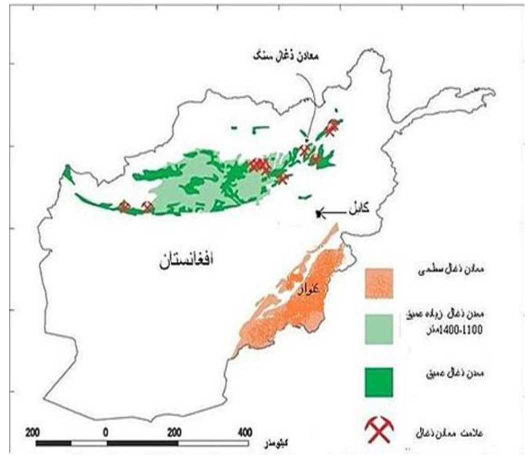

Fig.2 General schemes of Coal Mines in Afghanistan [13].

3.1. General characteristics of surface drying methods: Surface drying methods that are carried out from the ground surface or from the slopes of the quarry are:

1- Deep drainage by wells lowering the water level or by water absorption wells:

2-Yarovsky drying;

3-Horizontal drainage at shallow depths;

4-Horizontal drainage in carrier slopes;

Deep drainage by means of a system of water-lowering wells is widely used in the mining industry. The use of water-lowering wells is more effective for removing and reducing the pressure of the aquifer located in the soil of the useful material layer and consisting of stable rocks. However, water-lowering wells are effective for drying stable aquifers. However, water-lowering wells are also widely used for drying the aquifers located in the roof and soil of the extracted useful material layers.

Deep drainage: It is summarized in the drainage of the aquifer layers of the carrier with the help of Burmese wells equipped with deep artesian pumps outside the technical boundaries of the carrier for permanent drainage and on the working sides of the carrier, in the depressions and at the bottom of the carrier for temporary drainage.

Drying by water-lowering wells does not require large expenditures by constructing drainage structures in a short time, and by changing the number of wells and their locations, the water level can be lowered to the required level in all areas of the mine operation process easily. [10]

The shortcomings of drying by using water-lowering wells include the use of high energy capacity during pump testing, high cost, a large number of service personnel, the complexity of centralized water removal, and also the severe wear and tear of water pumps. With this drying method, water cannot be completely removed, but a water column of 15-35% of its natural thickness remains on the top of the non-pressure aquifer, which must be drained by filtering in the carrier. Water-lowering wells are usually designed for a long period of time. It is necessary to consider the mentioned wells in the depressed areas of the aquifer soil in highly cohesive and highly karstified areas. It is possible to reduce the operating costs by drilling wells with a large diameter (1.0 to 0.5 m), using reliable pumps with high flow rates and filters with excellent structure. Practical experience has shown that the use of water level lowering wells in well-permeable rocks is known to be very effective for drying non-pressure aquifers with a thickness of more than 10 m and a filtration coefficient of more than 1-3 m per second and pressure aquifers with a filtration coefficient of joint rocks of more than 0.5 m per second. While the natural groundwater level located at the top of the useful materials is higher than the level of the aquifer, water absorption wells are used to dry the aquifers, through which water is pumped to the lower layers.

Layered (pit) drying is used when lowering the groundwater level to a temporary depth of up to 20 meters. For this purpose, several well trains are considered with successive pumping of water from them by pumps located in the slopes of the carriers. Multi-layered (multi-tiered) drying is used when constructing trenches, cutting trenches and outlet carriers. When drying by layered (pit) method, along with drying the first layer, the dried rocks are deepened by wells to a depth of 3-5 meters, and then the second layer is assembled, etc.

The advantage of the multi-tiered method is that the operation of the pumping equipment and their reliability are easily monitored and controlled, since if one layer fails, other layers can be put into operation. Among the shortcomings of this method are the following: a large volume of excavation and drilling work and blocking of trenches by tunnels and pumps, especially for drying fine-grained and medium-grained clayey ridges and silty crowns with a filtration coefficient of up to 1-2 meters per day. Mobile water level lowering devices and aquafilters (needle filters) are used because other water level lowering wells are less effective. Shallow horizontal drainage is used to dry the aquiferous cover that is located above the productive rock mass and contains the basic aquifer (Figure 3).

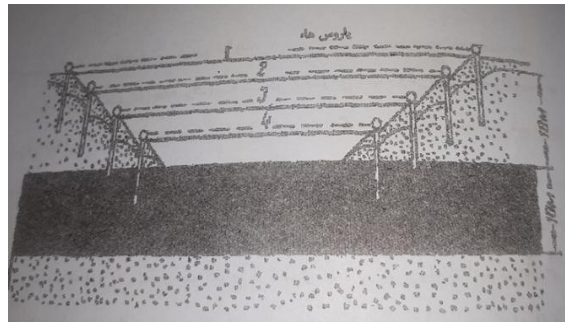

Fig.3. Multi -tiered Methode for drying Mines [13].

This type of drainage is implemented by digging open drainage ditches or closed drainages. If the ground surface and the impervious layer of the rocks under drying have a sufficient slope, then the drainage water will be felt. Horizontal drainage is possible if the permeability of the aquifer is good, its thickness is less than 20 meters and the possibility of draining the drainage water outside the boundaries of the carrier by the flow itself is possible. Drainages are divided into blocking and systematic (parallel) contour drainages from the point of view of their location in the plan(Fig.4).

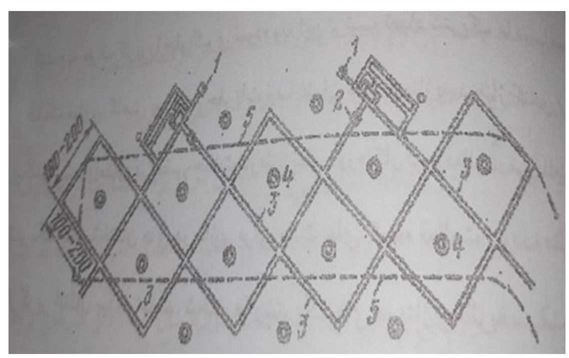

Fig.4. Parallel counter drainage for drying Mines [13].

1. Contour drainage (ring) in the form of a water channel around the entire perimeter of the carrier area is considered in cases where water enters the carrier from all directions, for example, when carrying out work in an open way in a marine valley.

2. Blocking drainage in the form of a drain (water channel) along one side of the carrier or along two

adjacent sides in order to prevent The water content in the carrier and the water intake moving from the feeding area towards the carrier are considered. The source of the water supply may be the river bed or an underground stream moving from the aquifer area. [10].

The dam drainage in some of the lower reaches of the carrier that exposes the weakly aquiferous layer is considered in the form of open and shallow ditches in the floor of the aquifer or in the form of closed drains with drainage pipes around which mud and gravel are placed. Drainages near the sides of the carrier to provide strength to the side of the carrier that has an aquifer also have the above-mentioned form.

Horizontal drainage in the lower reaches of the carrier is considered in the form of drainage wells in the sides of the carrier and other workings to dry the aquifers that are hidden by the carrier. Wells drilled in the form of parallel trains or in the form of V-shaped rays can be used for this purpose. Economical method for drying the sides of the quarry.

General characteristics of underground drying

Underground drying is carried out by laying drainage columns and digging trenches in the working layer or perpendicular to the layers (if the layers have a sloping slope). The underground drying method is effective in difficult hydrogeological conditions of mines in the presence of thick aquifers in the soil ceiling of the useful material layer located at great depths. The advantage of the underground method is the possibility of drying in poorly permeable rocks (k = 0.5-3) meters per day, the simplicity and ease of organizing the removal of hard and quarry waters, and the relatively low cost of operating the underground drainage system. [4]

If the groundwater of the aquifer is thin and located in solid and porous rocks with good water flow, then the drainage well and trenches can automatically provide quarry drying. In case The presence of sand-clay deposits in the roof and soil of the extracted useful materials. Drainage pits and shafts are used for the device of drainage structures and the removal of water from the layers under drying in the quarry. Impact filters, vacuum filters, pore filters, water-lowering wells. Water discharge wells are usually used as drainage structures. To carry out drying underground, one or more drainage well columns are laid with excavations close to the well columns. It should be tried to lay operational drainage shafts instead of drainage shafts by placing them outside the technical boundaries of the quarry area in order to dry the quarry and extract useful materials outside their boundaries [4].

Pit columns are placed in low-lying areas of the useful material layer so that the pits (wool) are directed towards the channel close to the well column. In this case, it should be noted that drying out in the case of drilling a column of wells in such conditions is more severe due to the dehydration of the aquifers. The number of drainage shafts, the location and extension of the trenches depend on the shape of the quarry area, the conditions of the location of the aquifers, the direction of movement of permeable groundwater, useful materials and water-bearing rocks, the desired amount of lowering the water level and the duration of the drying out. The trench is laid at an angle of approximately 60-70 degrees to the exposed direction of the well (floor) and is passed through the aquifer at a height of 1-2 meters from its soil in the case of a horizontal inclination [3].

If the dynamic groundwater reserves in the mines are high, that is, when the replenishment of groundwater reserves under natural conditions occurs continuously, then a contour drainage foundation is laid at the border of the quarry area, which prevents the groundwater flow moving towards the quarry and thus reduces the number of trenches in the area under drainage. The excavations and contour drainage structures operate for a long time, and in some cases during the entire period of quarry work. The trench network operates with drainage structures for short periods and moves along with the quarry front. Drainage shafts and trenches are dug and destroyed in separate areas depending on the speed of the quarry front, and drainage wells and filters operate from several weeks to several months. The water included in the trench is driven into the net transfer trench of the water flow. In order to prevent flooding and silting of the excavations during the penetration of piles, barriers are built in the trenches. These barriers may be permeable and water-filtering. Water-permeable barriers are placed to block possible areas of penetration and water in them. Temporary drainage barriers are installed if the water pressure is up to 0.3-0.2 MPa. Temporary drainage barriers are considered to block the water until the installation of pumps that can remove all the water during the penetration and inclusion in the excavated trench. Filtering barriers are considered to block the water during the penetration and inclusion in the excavated trench. Water filtering barriers are installed in cases where the water flow is not greater than the capacity of the operating pumps and the water carries with it a large amount of silt and gravel that make the stratum at large distances. [4].

IV. DISCUSSION AND RESULTS

The shortcomings of drying using wells that bring water to the surface are: the use of high energy capacity in dewatering, high workload, a large number of service personnel and the difficulty of centralized water removal, as well as the high wear and tear of working pumps. Using this method, drying cannot be done completely, but on top of the non-pressure aquifer, a water column of 15-35% of its natural thickness remains, which must be drained by filtering in the carrier. Water level lowering wells are usually considered for a long period of time. Practical experience in the past has shown that the use of water level lowering wells in well-permeable rocks is known to be very effective for drying non-pressure aquifers with a thickness of more than 10 meters and a filtration coefficient of more than 1-3 meters per second and pressure aquifers with a filtration coefficient of joint rocks of more than 0.5 meters per second. However, in cases where the natural groundwater level (W.t) located at the top of the useful materials is higher than the level of the aquifer, it will be better and more effective to use water absorption wells through which water is pumped to the lower layers to dry the aquifers.

•The advantage of the underground method of drying in poorly permeable rocks ($k = 0.5\text{-}3$) meters per day is the simplicity and ease of organizing the removal of hard and loose water and the relatively low cost of operating the underground drainage system.

•The use of water-lowering wells in well-permeable rocks has been recognized as very effective for dewatering non-pressure aquifers with a thickness of more than 10 meters and a filtration coefficient of more than 1-3 meters per second and pressure aquifers with a filtration coefficient of joint rocks of more than 0.5 meters per second.

• The main disadvantage of the underground method of dewatering in carriers is the high cost of dewatering as a result of drilling water-drying shafts with a very dense network of joints and the need to lay their foundations for two to three years before the start of stripping works.

• The disadvantages of dewatering using water-lowering wells include the use of high energy capacity during pump testing, high cost, a large number of service personnel and the complexity of centralized water removal, as well as severe wear and tear of water pumps.

CONCLUSION AND RECOMMENDATIONS

Drainage shafts with a system of strata are also used to collect and then discharge surface and groundwater by means of water intake wells dug at the surface of the earth to drive water from the carrier to the drainage strata. The main disadvantage of the underground method of drying in the strata is the high cost of drying as a result of digging water drying shafts with a very dense network of strata and the need to lay them for two to three years before the start of stripping work. The main disadvantage of this method is also the reduction in the stability and strength of the coal seam when excavators and other mechanisms move over the drainage strata created in the coal seam. The high cost of the underground drying method is greatly reduced by making the network of pipes less dense. Also, replacing pipes with drainage pipes that are laid next to the carrier after digging and passing the cutting trench, that is, during the operation of the carrier, reduces the cost of this method to a greater extent (about 20%) [4].

1- Recommendations are made to the competent authorities to prevent untechnical and unregulated mining, so as to prevent the waste of minerals on the one hand, and to minimize the occurrence and extent of risks in mines on the other.

2- The responsible extracting institutions and organizations should obtain the necessary information about the status of groundwater in the vicinity of the mine before starting the mining process.

3-It is recommended to the responsible authorities to provide rescue and first aid equipment in order to reduce and minimize human risks.

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