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The Economic Cost of Dewatering of the "Hajvalia" Mine

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Abstract: The "Hajvalia" mine is flooded after the war of the year 1999. The technical and engineering team of the mine has no access in the mine, primarily in the mine's productivity levels. In order to get mine access it is needed dewatering of the mine site. Amount and quality of the Pb-Zn ore in this mine, proves positive economic indicators for exploitation of these reserves and furthermore expanding of the ore reserves with exploration works. The feasibility study of the "Hajvalia" mine shows positive indicators as IRR=30.49% and NPV = 11.60 US$, with interest rate of 10%, for the 10 years of the time period. In this paper is given brief description of the mine's economic indicators and worldwide Pb-Zn demand as per justification of mine dewatering process i.e. profitability of the mine. The general cost related on dewatering of "Hajvalia" mine will be calculated in this paper. While it will be avoided calculation cost related on ensuring the stability and ventilation of the mine. Economical calculation will be based on the water volume inside of the mine, based on electricity consumption of the related pumps, needed in the dewatering process. Water volume (m^3) is while based on the volume of the flooded mine's space.

Key words: *dewatering, economic, cost, mine, pumps.*

Introduction

The "Hajvalia" mine is located in southeast of the Kosovo's capital city Pristina. The approximately content of the lead and zinc in the ore body of the "Hajvalia" mines is 8%, respectively 17%.This grad of the value metals content is one of the most important parameter in the context of the economic profitability of the mine. In the other hand, the flood caused ten years ago in this mine, submits serious doubts on the economic justification of the future investments, in order to rehabilitate this mine and bringing back under production. In this respect any kind of investigation with consideration of estimation of the dewatering cost of the mine, will help decision makers about future investments on this mine. So, the aim of this paper is to estimate the cost of dewatering of the mine, through calculation of energy consumption and taking in to account international practices.

Methods

Estimation of Dewatering Cost

During mine planning and design the cost dewatering usually is captured as capital cost of the investment, nevertheless during the mine production the dewatering cost can be found as operating cost.

Dewatering of the mine i.e. cost of the dewatering starts from the exploration stage, while the dewatering cost it selves depends on hydro-geological settings of the mineral deposits, depth of the mine (pumping head), water quality etc.

The dewatering system of underground mine depends on different kinds of parameters such are: transmissivity and storage coefficient, static water level, seasonality potential of inflows etc.. While the estimation of the Capital Cost and Operating Cost of dewatering of the mines can be given by formula:

$COST = KQ^x$ or **$COST = KQ^x T^y$**, where

K – is constant, Q and T – represents numerical factor or factors which have the greatest impact in the cost, x and y – are exponents (normally between 0.0 and 1.0), that assure the rate at which changes in the value of Q and T results in changes in cost (Mallo, 2011).

According to some international practices, the cost of dewatering in underground mining is rather low and it is approximately 2% of total investment and operational costs (S.Libicki, 1979).However, the "Hajvalia" mine is flooded and due some parameters cannot be included in the

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calculation of the dewatering cost, the dewatering cost is better to be based in the energy consumption from pumps.

The energy consumption in the process of dewatering process of "Hajvalia" mine can be calculated by following formula (Vosloo, 2008):

E_{ps} = M*g*H, where:

Eps - is daily energy used to extract water from the pumps [J]

M – Mass of the water needed to be pumped [kg]

g – Isgravity acceleration constant 9.81 [m/s^2]

H – Is total head of the pumping station [m]

Conversation i.e. to the above equation to kWh can be in this form: kWh=1000W*3600s=3.6MJ

Calculation based on electricity consumption:

- The amount of water inside the "Hajvalia" mine, M = 1000 [kg], approximately 1[m^3].
- g – is gravity acceleration constant, 9.81 [m/s^2]
- Pomp head or mine's depth, H = 500 [m]

The approximately depth of the "Hajavalia" mine was calculated as difference between head of elevation shaft (687m) and elevation of the ten level of "Hajvalia" mine (194 m) (LTD, 2006), see Figure1.

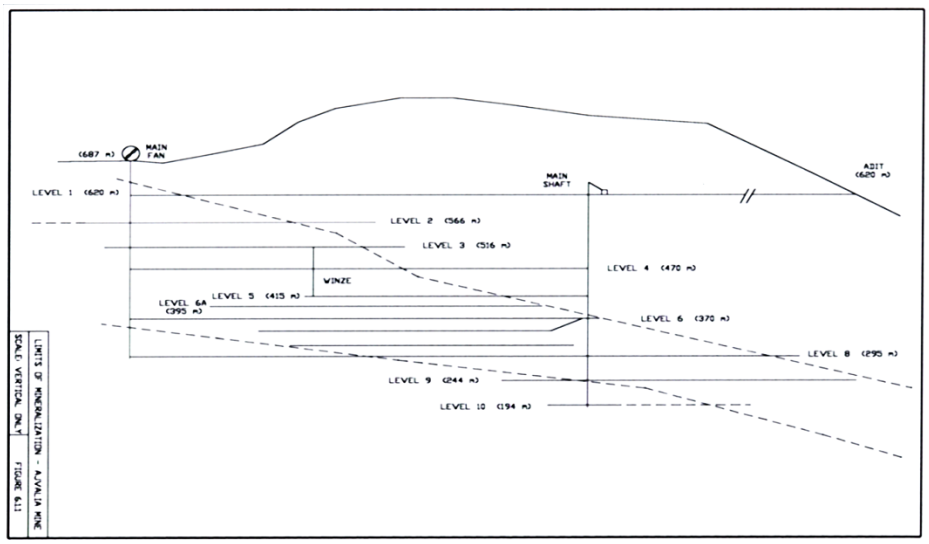

Figure 1. Schematic view of Hajvalia mine

E_{ps} = M*g*H = 1000 * 9.81 * 500

E_{ps}= 4,905,000.00 [J]

In subsequent text is given formula of conversation of energy (E_{ps}) to electricity energy (E_e):

E_e = Eps / t [w], where "t" is time [s].

With purpose of cost calculation and in order to convert the energy (E_{ps}) in to electricity energy (E_e) in the megawatt per hour (MWh) on following text is given conversation formula:

E_e = [(Eps / 3600) / 10^6], [MWh], and after calculation we take:

E_e = 0.0013625 [MWh], in order to calculate the dewatering cost per cubic metre, we just multiply (E_e) with the price that mine authority should pay for 1MWh of the electricity energy.

The cost that mine should pay per 1MWh electricity energy is 47.50 € (Kosovo, 2016).

$Cost_{(per\ cubicmetre)}$ = E_e * 47.50 = 0.07 [US$]

Total dewatering cost estimation

Total estimation cost of dewatering of "Hajvalia" mine is based on the volume of the mine's levels and other mine's spaces.

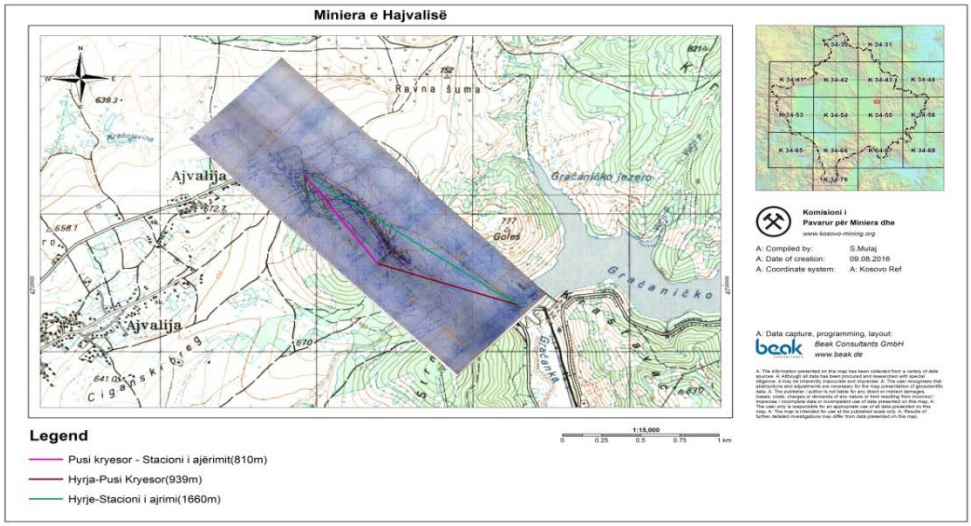

Figure 2. Hajvalia mine, distance between main objects

These are relevant data: distance between mine's entrance (adit) and ventilation shaft is about 1660 meters (Figure 2). Based in the Figures 1 and 2, we can suppose length of the mine's level with about 1600 meters. The volume of the ten mine's levels, plus 1/3 of this volume is considered as water volume inside the mine, while the cross section of the mine's level is about 6.50 m^2 (LTD, 2006), excluding supporting materials. Thus, based on above data the total amount of water inside the mine is 143,866.67 m^3, while the total cost, based on electricity consume (Tc) is calculated as follow: **Tc=143,866.67 * 0.07 =10,071 [US$].**

Conclusions

The accuracy of calculation of the total amount of water volume in the mine is relative, due to the lack of data on spaces within the mine, based on this fact prevail the dewatering cost per cubic metre. The cost amount does not take in consideration workforce cost, pump's cost, dewatering system installation and maintenance cost, but the nature of the calculation of these costs is not complex. Also, in the dewatering process of "Hajvalia" mine, should be consider environment protection especially, the quality of discharged water, even though the mines water has been tested at a neutral pH (LTD, 2006). Otherwise, important result of this paper considering mine dewatering cost, consist in determination of the cost per cubic metre of water based on electricity consumption, which can be used in the other cases, and it is very important parameter in the mining economy.

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