

Comparison of the dewatering of underground and open pit coal mine pumping systems in (BCCL), Dhanbad, Jharkhand, India

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Abstract. In the pumping system of mines are very important factor which is considered. The purpose of a dewatering system for underground and open pit coal mine is to control ground water levels and to reduce pore water pressure in the ground so dewatering systems are also important part of the both mine activity. It is observed in the response of the average yearly water discharge in the underground and open pit coal mines. It is observed in the response of the average yearly water discharge in the underground and open pit coal mines.

Keywords. Underground and open pit Coal Mine, Dewatering, Mine Pumping, BCCL, and Moonidih Project.

1. Introduction

Mining is one of the contains minerals excavation below the earth. Therefore pumping systems role is most important in the mining operating systems. Correct estimation for the mines water inflow to the mine operating is most important role of the pumping systems. Mining is one of the old arts practiced [1]. In the India two types of mining operated one an open pit coal and second is underground coal mining . A division of Bharat Cocking Coal Limited, Moonidih underground coal mine is one of the largest underground coal mines in the Asia [2]. The mine is located western Jharia area, Dhanbad district of the Jharkhand state. This mine is located in the south central part of the Jharia coalfield. This mine has achieved the production level of 1.2 mega tone per year. This project was opened in 1967 by two vertical shafts. The present annual production of the mine is about 0.17 mega tones in the year 2012-2013. It is being planned to increase production through long wall power support to reach a target of 0.267 mega tones in the year 2013-2014 and thereafter 0.8 mega tones yearly.

Muraidih open pit coal mine at the Muraidih, Shatabdi, Barora Area-1, (BCCL). Dhanbad district of Jharkhand. This is located on the western end of Jharia coalfield. Its leasehold area is about 717.66 hectare and it has a reserve of 115 million tonnes. In FY 2013-14, produced 1534501 tonnes of coal using shovel-dumper combination and earned profit of ₹ 13561.2 lacs.

The comparison of the dewatering of underground and open pit coal mine pumping systems in Bharat cocking coal limited, Dhanbad, Jharkhand, India and the basic comparison between underground and open pit coal mine [3].



Table 1. Show in this table comparisons between underground and open pit coal mine systems.

	Underground mine	Open pit
Deposits	Relatively small, high grade or deep with sub-vertical ore zone	Relatively low, large grade or shallow, with sub-horizontal ore zone
Geology	Structurally control veins and breccia's	Lithology controlled stock works, disseminated zones.
Resources/ Reserves	Generally difficult or not cost effective to prove up large resources/ reserves	Generally cost effective to establish 10+15 years resources/ reserves life
Productivity	500 + 8000 tonnes per day	5000+ 100000 tonnes per day
Environmental	Generally easier to permit, limited footprint. Relatively cheap to reclaim	Large footprint from pit, waste dumps and tailings, relatively expensive to reclaim
Mine Life	To >100 years	10 to 25 years, rarely longer

1.1. Open pit coal mine drainage:- It is employed in open pits characterized by favorable hydro-geological conditions and a service life of 15-20 years. When loose, sandy, and pebbly deposits are encountered, in which excavation of drainage drifts of the underground drainage is extremely difficult, the surface methods may be the only possible ones. The surface methods include a diversion systems (ditches, troughs and flumes leading all waters to the deepest point in the pit, forming sumps) and sumps, drilling horizontal drain holes on the pit banks, and setting up pumps wells (suction filters). The first method is the most common methods of track ling the water inflow to a pit. The depth of a sump is fixed for effective operation of the pumps as well as foe allowing the settlement of the solids contained in the inflow. The over-all size of the pump is decided considering the estimated peak water inflow rate and the relative pumping capacity provided [4]. Open pit coal mine drainage is compulsory to ensure that mining processes can continue unrestricted. The grey water in open pit coal mines naturally contains abrasives materials such as smallest broken stones, sulphur, clay etc. So mining dewatering pumps are intended to work in the harshest environments.

1.1.1. Underground coal mine drainage:-The method is employed in extremely water-logged deposits, especially when the water bearing rocks, particularly those in which the drainage drifts are run, are relatively stable. Also, the amount of water flowing to the heading face during the drivage of the drainage drifts is expected to be insignificant so that it will not interfere with the driving operation. The method involves the excavation of a series of dewatering (drainage) mine workings (drainage drifts, storage sumps, pumping stations of the central and district mine drainage, etc.) internal mine drains are started, from the drainage drifts, towards the pit, in the form of up-boreholes and stemmed filters, while tubular through filters (pump wells) are sunk from the ground surface, specially from the deepest point of the pit [5].

It is employed in underground coal mine characterized by favorable hydro-geological conditions and a service life of 100 years. Underground coal mine drainage is compulsory to state that mining processes can continue unrestricted. The grey and black water in an underground coal mines naturally mixed abrasives such as small broken stones, small coal particles, sulphur, clay etc. An underground coal mine dewatering pumps are intended to work in the harshest environments.

1.1.2. Underground and open pit coal mine pumping systems:- For Coal mine production need equipment for its safety i.e. able to drain out all inflows during coal production as well as handle production situations, hence a coal mine underground drainage system is very important equipment [6]. For production and safety purpose pumping system is the most important part of an underground coal mine activity.

The following some special types of mine water pumps are used in the underground coal mines pumping systems.

- (i) Centrifugal pumps
- (ii) Multi stage centrifugal pumps
- (iii) Turbine pumps
- (iv) Mono or Roto pumps
- (v) Three-throw ram pumps

The volumetric displacement pumps and kinetic energy pumps, both are basic types of pumps are used in an open pit and underground coal mines pumping systems for water discharge. The volumetric displacement pumps are used generally for comparatively small quantities of water but pumped at a high pressure. The universal encountered are three-throw ram pumps and mono pumps both are requires maintenance if as they tend to handle mine water containing suspended solids. The kinetic energy type pumps are normally used for larger volumes of water at lower head and hence the single stage centrifugal pumps are not normally a mine water device. But the multi stage centrifugal pumps or turbine pumps are in common use in shaft bottom schemes and larger in bye dewatering stations. The turbine submersible pump is of this family. The turbine pump is, however, does not work too well suspended solids often found in mine water and hence settling sumps.

Underground and open pit coal mine dewatering pumping systems typically are either low pressure with the pumps spaced out along the discharge transport line at roughly even TDH requirement locations; or else high pressure systems where pumps are located close-coupled in series at one location. Specializes in dirty slurry mixed water or full slurry pumping systems utilizing centrifugal slurry pumps of either low pressure or high pressure design. Booster pump station layout is used for remote location of the various stages of pumps spaced out along the discharge line.

Solid cast iron structure and narrow design characterizes of the roto or mono and three-throw ram pumps, and this pump is best for an open pit, for provisional or permanent installation and offers high-pressure pumps performance unrestricted by sand, small coal particles, small stones or extra abrasives particles.

Roto or mono and three-throw ram pumps can supply for heavy-duty use and heavy flows that can be installed dry or submerged and available in higher-grade material anti-corrosion versions for severe conditions. Surface-mounted axle-driven pumps are also used in underground and open pit coal mines, if the depth requirements are limited.

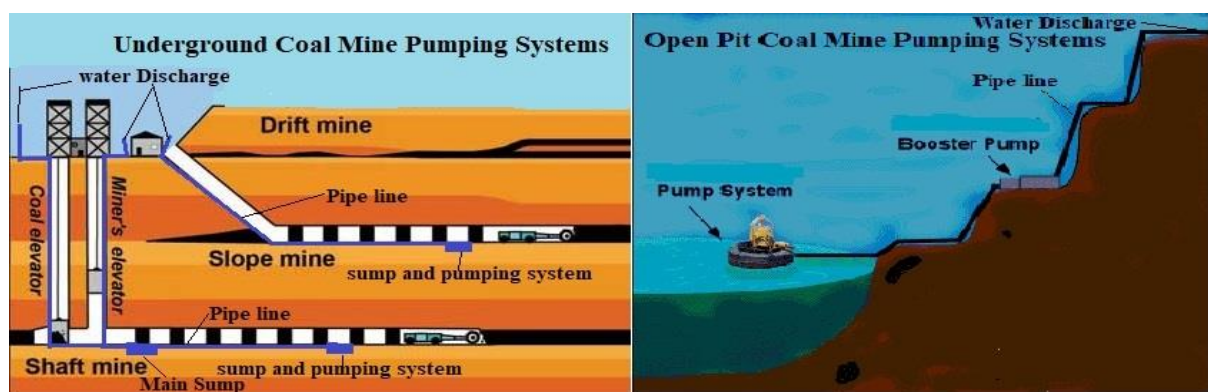


Fig.1 Underground and open pit coal mine pumping and piping systems [7].

1.1.3. Underground and open pit coal mine dewatering systems:-The purpose of a dewatering system for underground and open pit coal mine is to control ground water levels and to reduce pore water pressure in the ground so dewatering systems are also important part of the both mine activity.

Underground dewatering and drainage is needed to state that mining operations continue unrestricted. Water seepage from rock faces in mine shafts, quarries, often contains abrasives such as small sand particles, clay particles, drilling cuttings, and other hypothetically damaging objects etc.

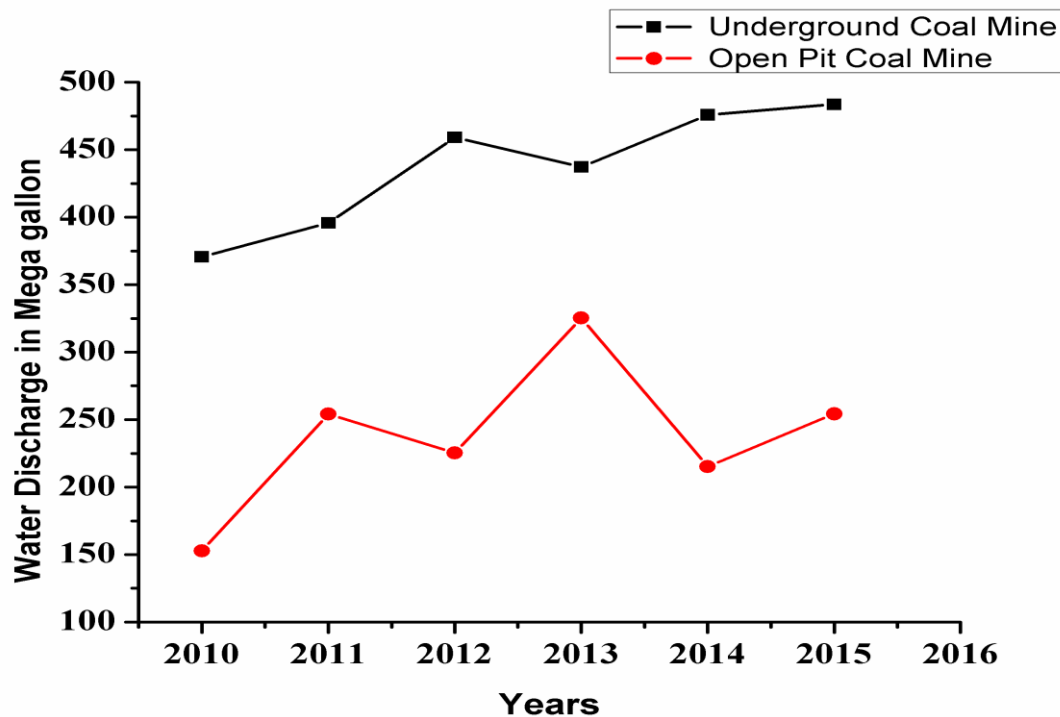


Fig. 2 Comparison of the water discharge in the underground and open pit coal mine.

2. Objectives

In this paper our objective is comparison to the dewatering of underground and open pit coal mine pumping systems in comparison of the mine structure and water discharge more effort pumping systems and minimize reduced water hazards in an underground and open pit coal mines.

3. Methodology

This research process starts with conducting the some literatures study of the comparison to the dewatering of underground and open pit coal mine pumping systems. Our main purpose is to comparison the pumping systems and minimizes reduced water hazards in an underground and open pit coal mines operation. This research is conducted taking into consideration of the research stages presented in fig. 1. along with the flowing research methods are showing in the outlines below. The utility of using pumping systems to the both mines should be contacted.

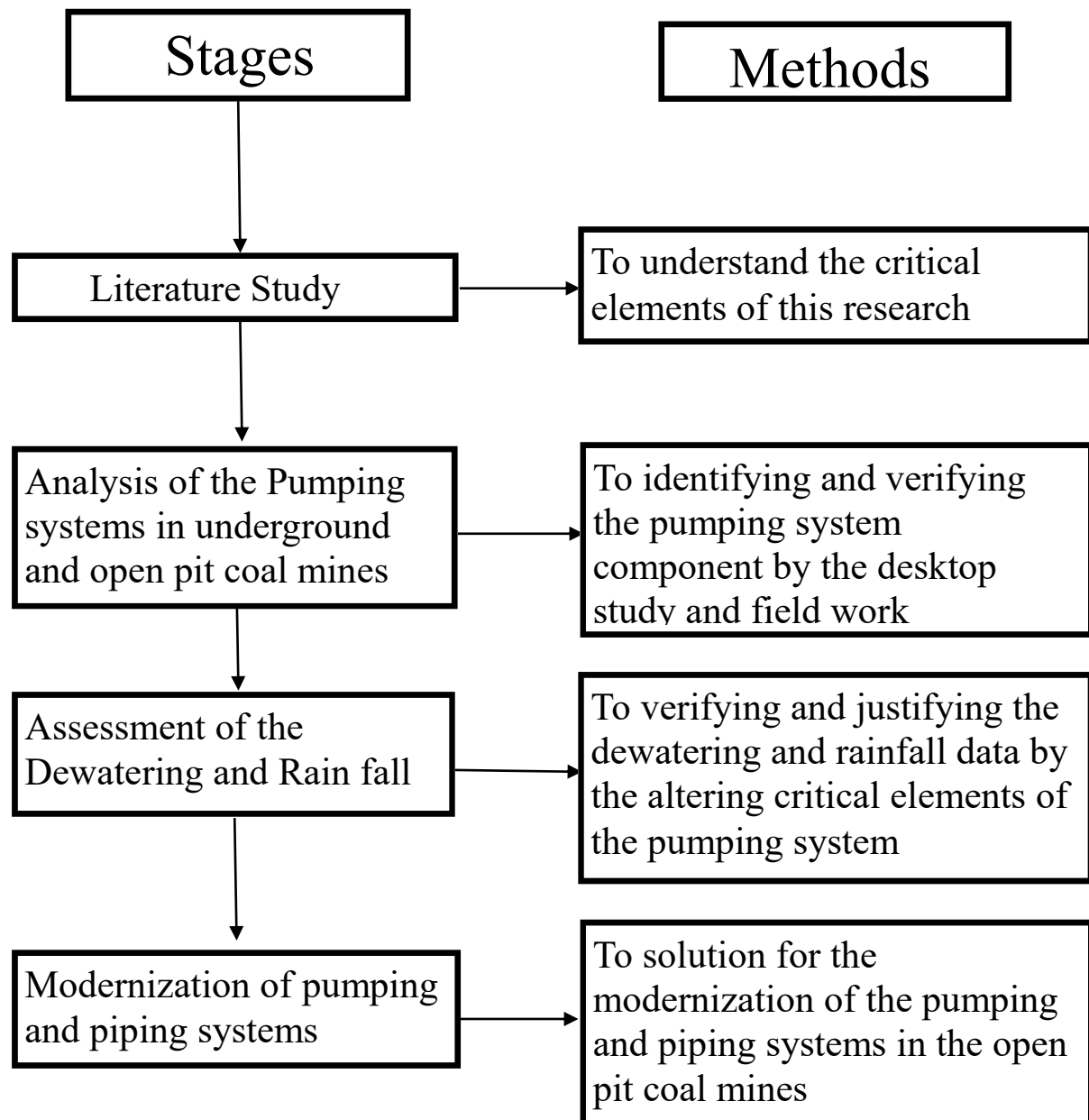


Fig. 3 Flowchart of the conducted research process of the stages and methods are used.

Stage 1- The first stage of this study comprises of identifying the critical elements of this research through published literatures and texts.

Stage 2- In the second stage of this study comprises of identifying and verifying the pumping system component by the desktop study and field work.

Stage 3- In the third stage of this study comprises to verifying and justifying the dewatering and rainfall data by the altering critical elements of the pumping systems.

Stage 4- The final stage of this study; to solution for the modernization of the pumping and piping systems in the open pit coal mines.

4. Description of the study Area:- The area under investigation is known as moonidih coal mining area, situated on south region from Putki.

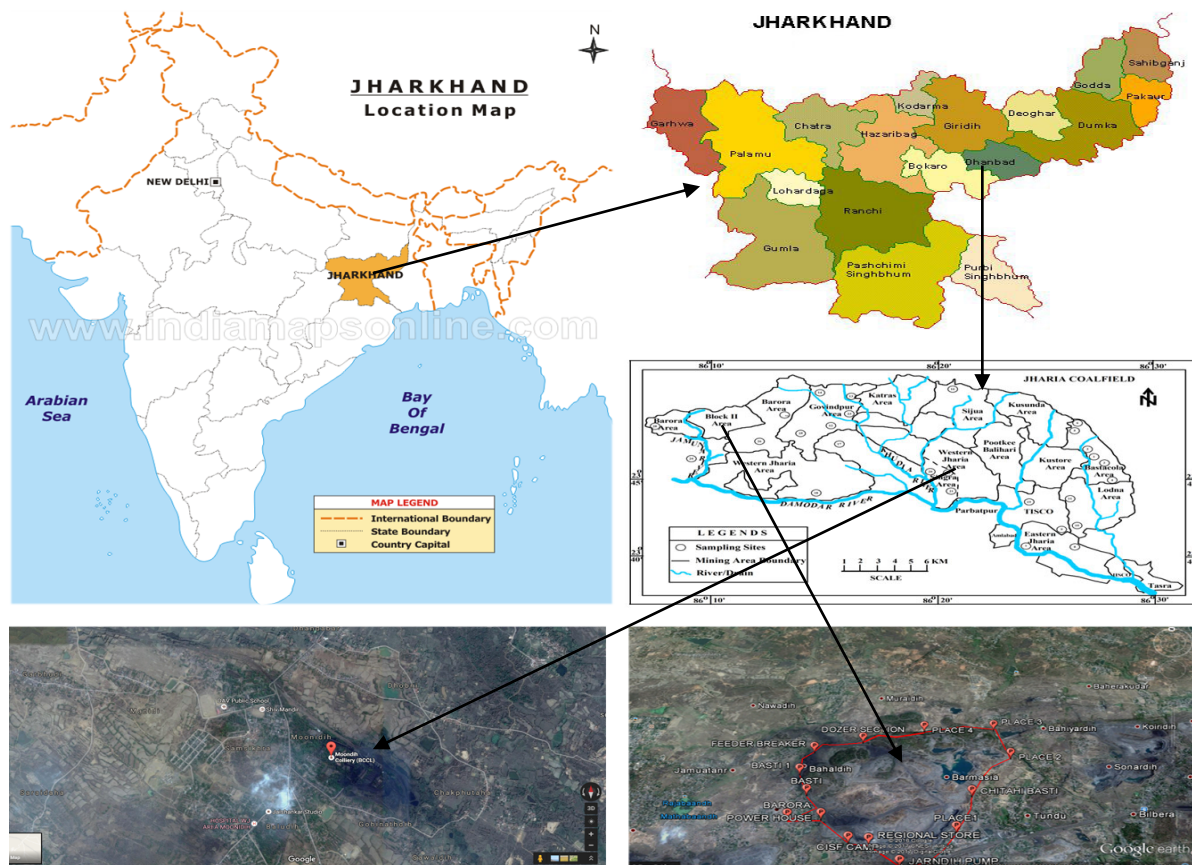


Fig. 4 showing location map of the study area of the Moonidih underground and open pit coal mines (BCCL), Dhanbad, Jharkhand, India [8]. (not to scale)

One of the biggest underground coal mines in the Asia as well as in the Jharkhand state of the Dhanbad district has been selected for this research. The Moonidih underground coal mine is located in the Dhanbad district of the Jharkhand state at a distance of 11 km Dhanbad railway station, 180 km Ranchi airport and 292 km Kolkata railway junction, bounded by latitudes $23^{\circ}42'47''$ to $23^{\circ}45'42''$ N and longitudes $86^{\circ}19'21''$ to $86^{\circ}22'26''$ E. at the height of 256.032 meters from mean sea level (MSL). The average rainfall in this area is about 106.75 mm in this area about 20 million tons of coal are annually washed in coal washeries. The Western Jharia Area coalfield.

An open pit coal mine dewatering pumping system at the namely Muraidih, Shatabdi, (BCCL), Barora area- 1 is located on the western end of the Jharia coalfield in Dhanbad district of Jharkhand state at a distance of 291.6 km from Kolkata railway station, 25.9 km from Dhanbad railway station and 35.2 km from Bokaro railway station. It is bounded by latitudes $23^{\circ}47'36.08''$ N and longitudes $86^{\circ}13'38.10''$ E. at a height of 226 metres from the Mean Sea Level (MSL). The average annual rainfall in this area is approximately 1079 mm and about 33.67 million tonnes of coal are annually produced.

5. Results and discussions

In this research paper present the comparison between the dewatering of underground and open pit coal mine pumping systems in the both mining pumping systems are depends on mining structure. In underground coal mine structure is inclined shape operate and the open pit coal mine structure is pit bench shape operate so pumping systems are also used different. And the pumps in the open pit pumping systems are more effort for the water discharge because the open pit structures are pit bench shape so this mine pumping system are used more bends and valves and if the more number of bends and valves are used. So that condition water frictions losses are high that cause water discharge is low and electrical energy is consumed high and cost is high so that is the main reason for mine economic effects and the rainy season the open pit coal mine pumps are drown in sump. So that is the cause of more maintains cost is high and the underground coal mine pumping systems that type of case are not apply in the underground coal mine.

It is observed in the response of the average yearly water discharge in the underground and open pit coal mines. From fig. 2 it is evident that the water discharge has yearly increased and decreased considerably over the year from 2010 to 2015. One can observe from the fig. 2 that the water discharge in the Moonidih underground and another is open pit coal mine area of Jharkhand where study is conducted has remained nearly constant i.e. within the range of the Moonidih underground coal mine 370.628-483.639 mega gallon and the Muraidih open pit coal mine 125.254-354.2595 mega gallon, but with this both mine water discharge has variations. It is evident from fig. 2 that with the course of sometime the water discharge has decreased and increased as compared to both mine. It is clearly visible from above figure that with the Moonidih underground coal mine increasing discharge of water in the year from 2010 to 2015, in the year 2010(370.628 mega gallon) water discharge has minimum and the year 2015 (483.639 mega gallon) maximum water discharge and in the open pit coal mine from year 2010 to 2015 water discharge some time increasing and sometime decreasing, but in the year 2013 (125.254 mega gallon) minimum water discharge and the year 2015(354.2595 mega gallon) maximum water discharge. The reason for this kind of behaviour can be explained as following. From in this year 2010 to 2015 water discharge is higher than Muraidih open pit coal mine. Along with in the moonidih underground coal higher pumping capacity is install and the muraidih open pit coal mine also higher pumping capacity is install but in the open pit coal operate bench type so used more bends and valves so that is the main reason for low water discharge comparison underground coal mines.

6. Conclusions

The paper has discussed comparison of the dewatering of underground and open pit coal mine pumping systems in Bharat cocking coal limited. In this research directions discussed here will reduce the gap between the comparison of underground and open pit coal mine pumping systems through academic and mining industry, thus, the optimized and reliable pumping system models for dewatering mines will have extensive acceptability among the mining engineers.

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