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AN EXPERIMENTAL STUDY TO IMPROVE UNDERGROUND LONGWALL COAL MINE VENTILATION SYSTEM

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Abstract - An experimental study will be undertaken in an operating mine to analyze ventilation systems and to make suitable recommendation for currently in use within longwall workings at Singareni collieries company limited. The ventilation is major essential part of underground mine workings, so the mine workings are moving deeper which results in increased ventilation issues such as higher respirable dust levels, greater seam gas contents, spontaneous combustion, increase strata heat and less amount of air flowing in mine working field. This thesis is to study and evaluate the resistance of an entire mine, for evaluating some experiments is to be conducted by ventilation measuring equipment's. The experiments involve in measuring the Total pressure, Quantity air flowing in mine, chemical composition of air. The chemical analysis is done finding the methane concentration in the mine. From the above experimental data, we compute the resistance of the entire mine. The suitable recommendation is made for improving the quantity, velocity, Eliminating the methane layering and also recommend the preventive methods for leakages if any. This thesis study is to improve safety and comfort conditions.

Key words: Resistance of a mine, Chemical composition of air, Quantity of air flowing.

1.INTRODUCTION

Mining is the method of excavation of valuable minerals from the earth, usually from an ore body, lode, vein, seam, reef or placer deposit. These mineral bodies are present in the deeper strata of the earth's crust. The mining can broadly be separated in two categories i) Underground Mining ii) open-cast mining. In mining, while excavation progresses, we go deeper into the earth's crust because of near exhaustion of shallow deposits, mining operations are planned to reach greater depths, which create two major problems like strata and environmental problems. Mining at greater depths needs strategic planning and execution to overcome the operational problems and issues related to mine environment. The environmental problems are nothing but ventilation issues, i.e. (air and lighting) in the underground workings. In underground mines, production, productivity, health and safety of workers rely upon environmental conditions existed in working place. The efficiency of the workers, mostly depends upon the good air conditioning situations. Comfortable workplace environment is one of the main contributing factors in achieving targeted production in highly mechanized mines. The underground mines are turning towards mechanized systems instead of manual workings, in that longwall working is highly productive mining method. Longwall mining is an underground mining method that can maximize coal production in coal beds that contain few geological discontinuities. In these operations, a mechanical Shearer progressively mines a large block of coal, called a panel, which is outlined with development entries or gate roads. This is a continuous process in an extensive area, where the roof is supported only temporarily during mining with hydraulic supports that protect the workers and the face equipment (Fig. 1). As the coal is extracted, the supports automatically advance and the roof strata are allowed to cave behind the supports (Karacan et al., 2007a). The longwall workings need high pressure and quantity of air to circulate such a long lengthy panel workings. For maintaining these condition ventilation surveys is recommended.

1.1 OBJECTIVES:

The objective of this thesis is to obtain the frictional pressure drop (P), and the corresponding airflow (Q), for each of the main intakes, returns and gate road ways of the ventilation network. From these data, the following parameters may be calculated for the purposes of both planning and control of ventilation.:

- The resistance of a mine.
- The distribution of air flow in the roadways.
- These results can be analyzed in modelling software for best ventilating circuit.

This thesis also to be made for a qualitative survey in mine and discovering for the methane detection if any.

1.2 Air Flow Principles:

The fundamental principles of airflow may be set out as follows:

a.Air flow in a mine is induced by pressure difference between intake and exhaust openings.

b.The pressure difference is caused by imposing some form of pressure at one point or a series of points in a ventilating system.

c.The pressure created must be great enough to overcome frictional resistance and shock losses.

d.Airflows flows from point of higher to lower pressure.

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e.Mine ventilating pressures, with respect to atmospheric pressures, may either be positive (forcing) or negative (exhausting)

2. Air Distribution in Different Coal Mining Methods:

Bord and Pillar Method:

There are a large number of openings in a working district in this method. As a result, the air has to be guided to the working faces by means of numerous control devices such as stopping, doors and air-crossings etc. Air is coursed through the different faces in the working panel with the help of line brattices at the face and temporary stoppings generally made up of brattice curtains in the galleries. However, this results in a substantial leakage through the brattice leading to poor face air velocity. Panels separated by solid coal barriers reduce the number of permanent stoppings and to that extent reduce the leakage.

Longwall Method:

Ventilation of longwall faces is easier needing less control. Each face is normally ventilated by a separate split. Leakage is much less in the working district as compared to bord and pillar mining. Longwall workings with hydraulic stowing admit practically no leakage through the goaf, but there is fair amount of leakage across the goaf in longwall caving districts, particularly with advancing faces.

Table -1: Sample Table format

Diameter of duct (m)	<1.25	1.25-2.5	>2.5
No. of points	6	8	12

The locations of the points are at the centre of area of the relevant annulus on each diameter and may be calculated from

$$r = D\sqrt{(2n-1)/4N}$$

Where,

r = radius of point n from the centre

n = number of the point counted outwards from the centre

D = diameter of the duct (m)

N = number of points across the diameter

Central or Bidirectional Ventilation System

This system is commonly adopted in in-the seam coal mines where both the intake and return shafts are located close by the centre of the property. Intake and return air from any district travel in opposite directions through parallel roadways usually separated by stoppings erected at the cross-connections between them. Also return air from a district has to cross the intake in order to join the main return. The central system of ventilation allows a substantial leakage because of the large number of stoppings and air crossings used so that only 40-50% volumetric efficiency is achieved by these systems. Mostly preferable in mines with higher gas emissions. Splitting is mainly in parallel connection and equivalent resistance Req is given by the relation:

$$1/\sqrt{R} = 1/\sqrt{R1} + 1/\sqrt{R2} + 1/\sqrt{R3} + \ldots\ldots\ldots\ldots$$

Combined Ventilation System

Here in these types of ventilation system the ventilation of development headings is bidirectional in nature while the ventilation of the extraction panels is unidirectional through goaf connected to the return airways called bleeders.

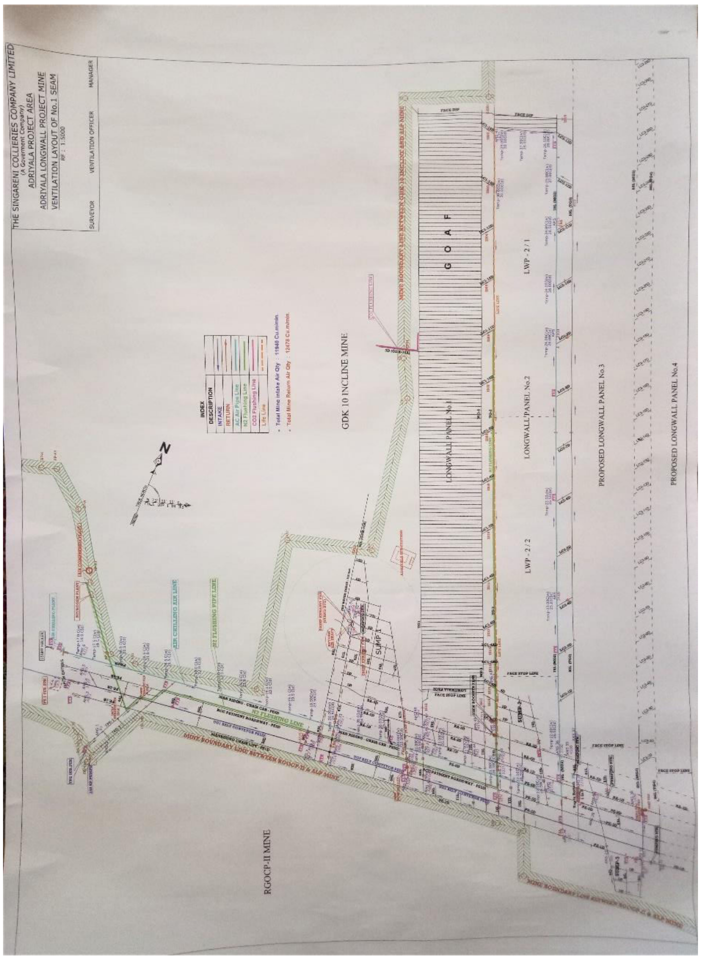

Fig1: **Ventilation plan layout of Longwall Project**

In gassy coal mines of Degree II and III the quantity of air should be more than the minimum stated above and a reasonable figure should be 8m3/min per person employed. The quantities of air stated above must reach the working faces. As there is leakage from intake to return at the ventilation stoppings, ventilation doors, air crossings, and ventilation air locks on the surface and other places, more air should pass the downcast shaft/incline. Therefore, the quantity of air going down a mine should be as follows (per minute)..

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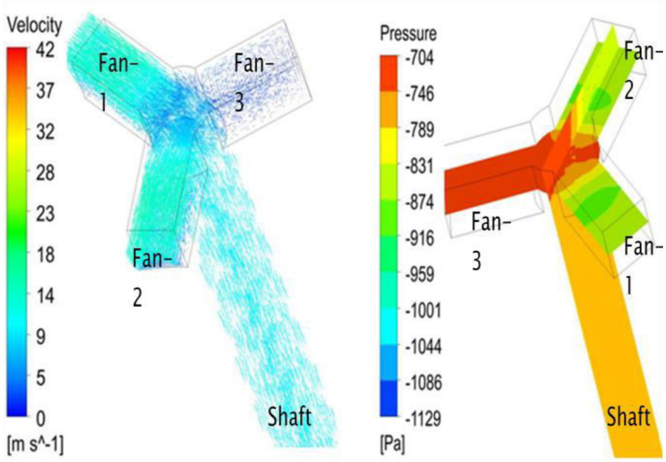

Fig2 - (a) Velocity vectors

(b) Pressure distribution

3. CONCLUSIONS

Based on survey following are the findings:

- The quantity of air entering into the mine by PE-1, PE-2, PE-3 and PE-5 is 202m3/s, similarly of air shaft bottom same quantity of air is leaving the mine.
- The quantity of air flowing through longwall face was 27.1 m3/s.
- The quantity of air flowing through 85L (from PE-1,2,3 dip) is 38.8 m3/s. The amount of air used for cooling electrical appliances, pumps and substations is 83.6m3/s. Thus, total quantity of air used effectively is equivalent to 149.3 m3/s.
- 2.It is clear from the above findings we can conclude that 52.7 m3/s air is short circuiting to the return air shaft bottom from intakes.
- 3.Our actual air requirements are (On the assumption that there is will be only one longwall face under extraction and two gate roads in progress).
- 50 m3/s is for longwall face.
- 20 m3/s is for cooling hot water flowing through 80L.
- 25 m3/s is for pumps and substations
- 25 m3/s is for conveyor belt systems.
- 50 m3/s is for two gate road ways.
- 25 m3/s is for dip workings.

The specific cooling power of the air at faces 450 w/m2 or more

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