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Ventilation planning at the Minerales Monclova's Mines

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ABSTRACT: Minerales Monclova, S.A. de C.V. (MIMOSA) is owned by Grupo Acerero Del Norte (GAN). This company has 4 underground coal mines and 1 open pit to feed it's steelmaking facilities located in the city of Monclova in the North of México in the state of Coahuila. The current underground mines are Mine 3, 5, 6 and 7 and the future projects are Mines 8 and 9. In the last years Mines 2 and 4 have been closed because they finished their coal resources. The remaining mines have bigger production and developments requirements in order to accomplish the goals of the company. The mines have been working in deeper and gassier areas. These conditions have required improvements in the ventilation design and methane control systems for all the mines. In some cases the ventilation of some of the MIMOSA'S mines has been increased 80%, and besides this, an intensive methane drainage program has been applied using horizontal in-seam boreholes and gob wells. The short-term ventilation plan includes the construction of 3 new vertical shafts with 5 and 6 meters diameter for Mines 5, 6 and 7 and the purchasing of bigger new main and backup fans for each one of these mines. One of these vertical shafts and the purchasing of the first 2 fans is already in process. This paper will explain the evolution and results of the ventilation and methane drainage systems in MIMOSA and the ventilation planning for the future years.

1 Introduction

The geological history of México shows that there has been three events that were suitable for the development and formation of coal beds. The first event happened from the Upper Triassic to Middle Jurassic Epochs; the second event of favorable geologic conditions took place at the end of the Late Cretaceous Epoch during the Maestrichtian age; and the last third event happened during the Eocene Epoch, Lutetian - Bartonian Age.

The Mexican coals that have been more explored and developed, because of their economic potential, are the Maestrichtian coals in the Coahuila State. Most of the coals in the Sabinas and Monclova sub-basins are metallurgical, whereas the coals from the Fuentes – Río Escondido basins are steam coals (long flame type); the latter ones are being used by the Mexican government company (Comision Federal de Electricidad, CFE) to generate electricity in their plants of Nava, Coahuila.Total annual production of steam and metallurgical coal of the State of Coahuila, (Figure 1) is approximately 15.4 million metric tons., Six million is metallurgical coal and 9.4 million is steam coal used to generate electricity. The largest coal mining complex of the country is the Coal Division of Grupo Acerero Del Norte (GAN).

This group has two coal mining partner companies. Minera Carbonífera Río Escondido, S.A. (MICARE) operates in the Río Escondido Basin and it is in charge of the steam coal production and Minerales Monclova, S.A. de C.V. (MIMOSA) is the one in charge of the metallurgical coal production.

The annual run of mine coal production of MICARE is 7.0 million of metric tones and MIMOSA currently has an average of 5.0 million metric tones in the underground mines.

The main difference between both companies is that the MICARE'S mines are non gassy and the MIMOSA'S mine are very gassy.

MIMOSA is currently operating the underground mines 3, 5, 6, and 7 and 2 open pits in the Sabinas sub-basin. Besides these mines, 2 coal washing plants are operated to clean the coal.

The coal is medium to high volatile in rank and is used to supply steel making operations owned by the group (GAN) in the city of Monclova, located 140 km (100 miles) far from the MIMOSA'S mines.

MIMOSA'S coal reserves in the Sabinas sub-basin are 240 million of metric tons and 60 million in the Saltillito Basin.

This paper will explain the evolution and results of the ventilation and methane drainage systems in MIMOSA and the ventilation planning for the future years.

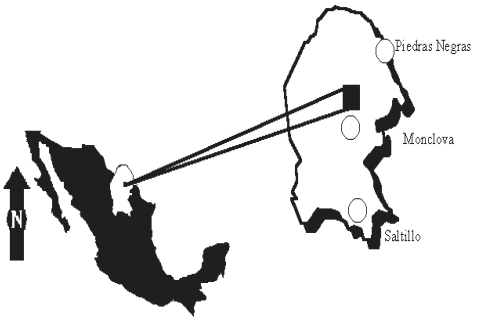


Figure 1. Location of the MIMOSA's mines in Coahuila,

2 Background

The first origins of the coal mining in Coahuila are dated in 1866, when the Mexican emperor Maximiliano sent an Austrian engineer named Jacobo Küchler, to investigate the economic potential of the coal deposits of the state of Coahuila, because he wanted to develop and improve the industry and communications. He was thinking to use the coal to provide combustible for machinery and for the railroad locomotives.

In 1884 the coal mining activity in the Sabinas basin began with small operations near to the outcrops in the town of San Felipe. At the end of 19th century, the coal mining in this area finished and other mines were opened in the beginning of the 20th century in the same way (near to the outcrops) in the Sabinas Basin which is 55 kilometers long and 25 kilometers wide. (Figure 2)

Figure 2. Location of Coal Basins in Coahuila

Each mine is equipped with a longwall system and the development of the longwall panels is performed with Alpine AM-50 and IBS SM130 roadheaders using a dual-entry system.

The total methane liberation in the ventilation systems of the underground mines is an average of 400,000 m^3 of methane per day. (Figure 3)

MIMOSA implemented methane drainage systems in Mines 2, 4, 5 and 6 from 1992 to 1999 under a horizontal directional drilling contract with Resource Enterprises (REI) from the United States, under this contract; REI drilled almost 30,000 meters of in-seam boreholes with an average length of 600 meters per hole.

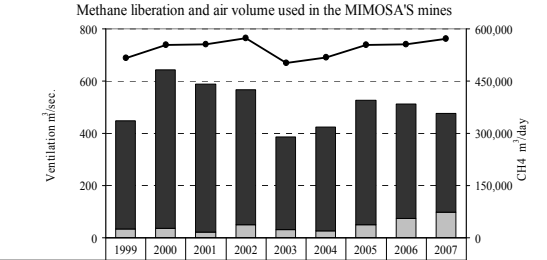
Since 1999, MIMOSA has been doing its own degasification drilling with short in-seam holes with an average depth of 200 meters, and in 2005 a directional drilling program started with MIMOSA'S own people after a training period with REI.

3 Current Ventilation Situation

The typical layout for the MIMOSA'S mines is the following:

The current operation depth goes from 180 to 300 meters due to the different location of the mines in the coal basin.

The methane concentration in the coal seam is in a range from 8 to 18 m^3/ton. The access to each mine is



	1999	2000	2001	2002	2003	2004	2005	2006	2007
CH4 vent. m3/day	309,658	454,810	424,829	386,986	266,026	299,290	356,659	328,147	284,256
CH4 deg. m3/day	25,402	27,302	15,466	38,362	22,982	19,008	38,362	55,901	73,613
Total air m3/s	689	738	741	765	669	690	739	741	763

Figure 3. Ventilation and methane generation

arches, one slope is used for materials supply and people and the other is used for the main belt installation to move the coal to the surface. In the past, this belt was 1 meter wide and now it is 1.4 meters wide.

The mains have 4 entries supported with steel arches and the longwall panels have an average length of 2 km and 250 meters wide. These dimensions were increased in the last years from a length of 1 km. to the current 2 km. and the width was 200 meters instead of the actual 250 meters. To achieve the ventilation demands for all these changes the size of the airways have been upgraded from 8 m^2 supported with steel beams and wood timbers to the actual 15m^2 supported with steel arches.

The 2 entry system is used for the longwall system and a wrapped around bleeder system is used for the ventilation.

In the developments a blowing ventilation system is in use. The ventilation for the development faces is provided with bisected auxiliary fans (SPENDRUP 112-80-1760 and SMJ 1.25) with 110 kW (150 hp.) (Figure 4)

The air is supplied to the faces using flexible ducting with 1.07 meters diameter (42"). The developments ventilation system was improved in the last 2 years, the old fans with 55 kw (75 hp.) and 0.762 mm diameter ducting (30") were replaced with the current bigger fans and ducting.

With this system, the distance between crosscuts has been increased from 50 to 120 meters.

Currently the total air volume handled by the primary fans of the mines is 765 m^3/s. Each mine has a main fan on the surface connected with the mine through a circular shaped vertical shaft 4.5 meters diameter. The shaft walls are supported with smooth concrete and the return air of the mines is exhausted with JOY M-96-50 primary fans with 1,100 kw (1,500 hp.) motors and the airflow in each mine depends on the amount of equipments and the methane generation (Figure 5).

The gassiest mine is Mine 7 and also is the one with more ventilation. Currently it has 265 m^3/s (Figure 6) this mine started the first longwall in March 2007.

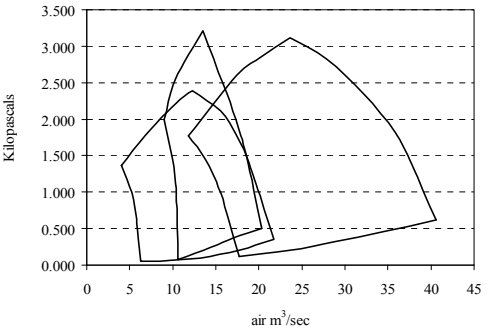


Figure 4. Auxilliary fans capacity

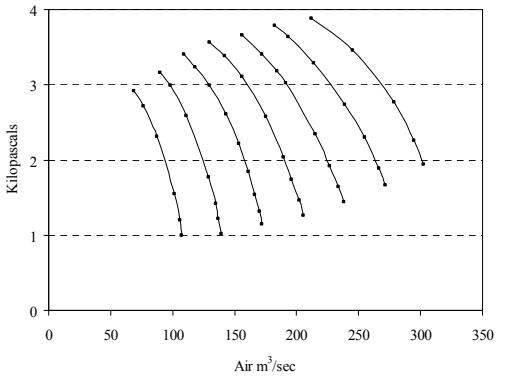


Figure 5. MIMOSA'S primary fans capacity

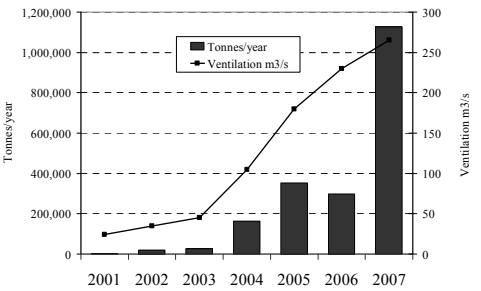


Figure 6. Mine 7 Statistic

With all these changes, the ventilation of Mines 5, 6 and 7 has been increased in the last years at least 50% in each mine, but the production and developments schedule for the future is greater and the current main fans do not have the capacity to cover the ventilation needs. Hence, the ventilation project for the mines has been reviewed and the purchasing of new bigger primary fans and the requirement of new vertical shafts for the ventilation of Mines 5, 6 and 7 has been defined.

This is in order to lower the mine resistance of the mines to accommodate the larger air volumes required.

4 Methane Drainage

In 1991 MIMOSA was bought from the government by GRUPO ACERERO DEL NORTE and it started working like a private company.

There was an increase in the production and advance requirements and also the operation of the mines changed to new deeper and gassier areas.

A methane drainage program with horizontal directional drilling started in 1992 under a contract with REI Drilling Inc. from the United States of America.

Under this program approximately 30,000 meters were drilled. The methane is conducted to the surface trough an underground pipeline system and a vacuum pump is installed on the surface.

MIMOSA continued this drilling project until 1999 and after that; the methane drainage drilling has been done with MIMOSA'S own people.

Since 1992 a total of 99,431 meters have been drilled, this is an average of 6,600 m/year.

The methane generation of the ventilation systems is an average of 108 millions of m^3/year and the methane drainage systems of the mines produce 14 millions of m^3/year. (Figure 7)

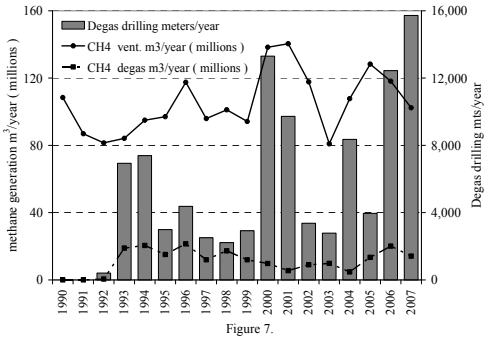


Figure 7.

Besides the horizontal drilling a gob well drilling program started in 1999 in Mine 5 and since that year, a total of 45 gob wells and almost 12,000 meters have been drilled for the gob wells.

5 Ventilation Project Process

The ventilation projections for all the mines are reviewed using the VNETPC 2003 software, this software has been in use in MIMOSA since 1989 for the ventilation planning of all our mines and also for analyzing any major change in the ventilation systems.

With this software in the last 18 years the correlation between the predicted results and the real numbers has been from 93 to 95% and sometimes higher. The average friction factors for the MIMOSA's entries have been

obtained from ventilation surveys performed in all the mines using the gauge and tubing method (Table 1).

Table 1. Friction factors used for airways

Airway type	Friction factor Kg/m^3
Belt entry 15 m^2	0.0228
Materials 15 m^2	0.0106
Return 15 m^2	0.0141
Belt & materials in parallel 15m^2	0.0037
2 returns in parallel 15 m^2	0.0035

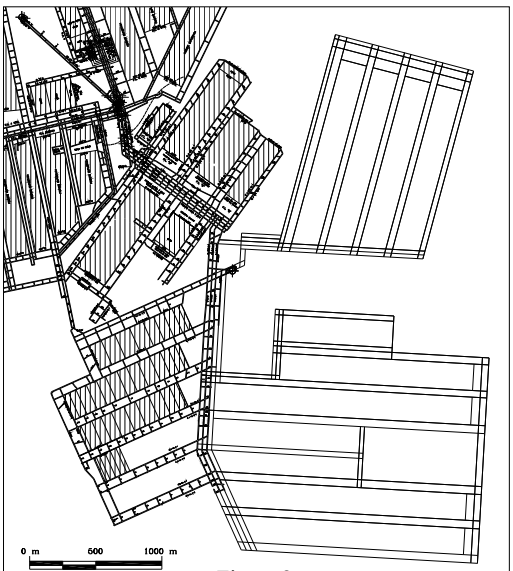


Figure 8

The information of the main fans supplied to the fan data bank of the software is obtained of the manufacturer's fan curves and then an air density correction is applied, because the average air density is about 1.12 kg/m^3 vs. the standard of 1.2 kg/m^3 and then several situations of the mining plan are analyzed.

6 Ventilation Requirements Determination

With the statistical information of methane emissions and ventilation requirements for the development and longwall sections considered in the mining plan plus the air needed for other areas, which also have to stay ventilated and the air leakage, the total future air volume requirement is defined.

7 Ventilation Analysis

Several simulations were performed to review the project of the mine but for this paper only one will be showed. Mine 6 currently has an air volume of 140 m^3/s with 2.6 Kpa fan pressure, 2 development sections and 1 longwall.

The analysis to accommodate 3 roadheader development sections and 2 longwalls will be used, (Figure 8) and the assumptions for the ventilation simulations will be the following:

- Friction factors according to Table 1.
- Entries cross section is 13 m^2. (The original size is 15 m^2, but the reduction was considered necessary due to some floor heaving)
- Entries perimeter 13.5 meters
- Cross section for overcasts 10 m^2.
- Shaft diameter 5 meters
- A primary fan SPENDRUP 355-184-880 in the blade setting number 3 was simulated.
- The current shaft was considered an auxiliary intake in order to low the mine resistance.

8 Ventilation Simulation Results

The mine ventilation projection for 2010 was simulated, the schematic is showed (Figure 9)

- With the proposed arrangement, the fan operating point predicted is 300.75 m^3/s with a pressure of 2.63 Kpa, in the blade setting number 3 for the main fan SPENDRUP 335-184-880.

The air volume predicted for the different sections of the mine is:

- Developments section 1 – 43.48 m^3/s
- Developments section 2 – 63.48 m^3/s
- Developments section 3 – 42.19 m^3/s
- Longwall 1 total return – 79.79 m^3/s
- Longwall 2 total return – 85.02 m^3/s

The comparison between the current situation with the JOY M-9650 primary fan and the actual mine resistance without the new vertical shaft and the projection with the new shaft and the new bigger fan is in Figure 10.

9 Conclusions

- The ventilation project designed for MIMOSA's Mine 6 will allow the mine to work with 3 development sections instead of the actual 2 and with 2 longwalls 2 km long instead of the actual 1 longwall 1 km. long.
- The projection indicates that the total air volume in the mine will be twice than the current one
- (300 m^3/s vs. 140 m^3/s) with the same fan pressure.
- To accomplish this goal, the old shaft has to be used like auxilliary intake to low the resistance of the mine.
- The current primary fan has to be replaced.

- A new vertical shaft for exhausting the ventilation of the mine has to be drilled (this is already in process)

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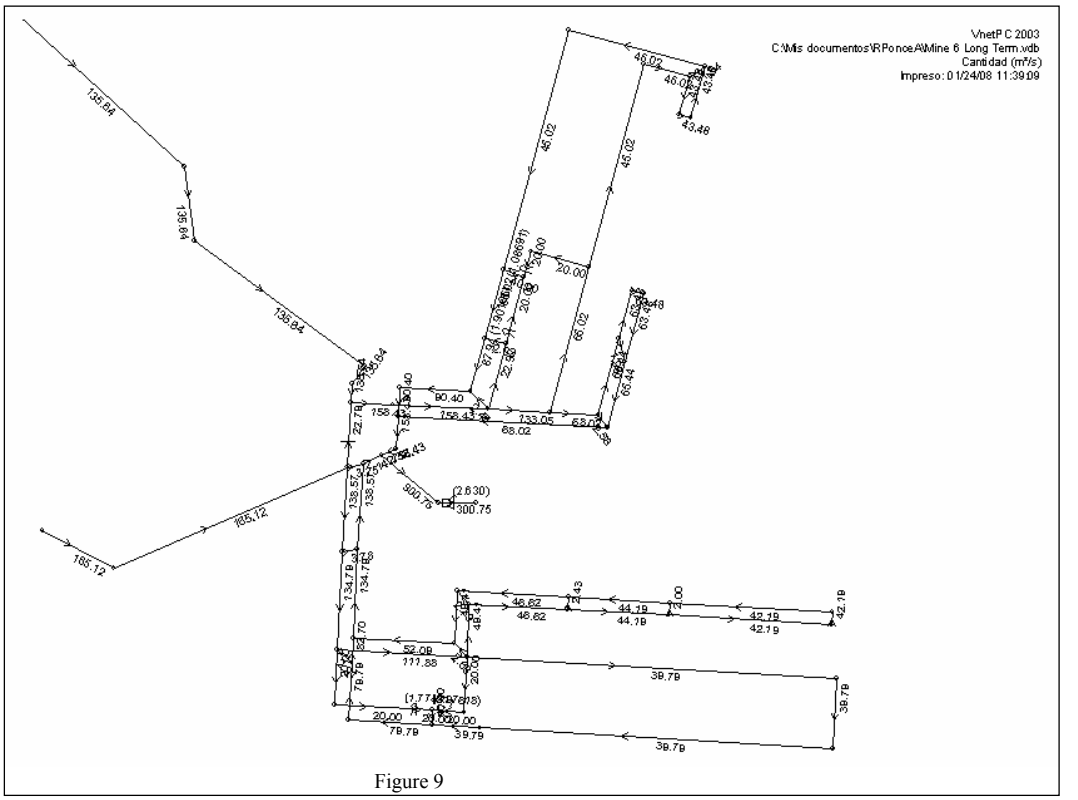

Figure 9

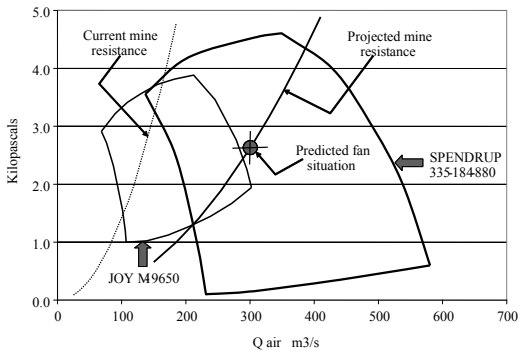

Figure 10

The resistance of the mine to the ventilation after all this changes will be 5 times lower than the current.

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