12th U.S./North American Mine Ventilation Symposium 2008 – Wallace (ed)
ISBN 978-0-615-20009-5

Extension of the main ventilation system at LKABs Kiruna Mine for the new main haulage level 1365 m

L. Mukka
LKAB Kiruna, Sweden

C. Blomgren,
Stockholm, Sweden

ABSTRACT: The existing main mine ventilation system for the production areas to the Kiruna mine was constructed during the period 1994-1996 and extended with 4 more shafts, including fan stations, for the sea ore body from 1997-1998. Two papers have been presented from this project at the 7th US Mine Ventilation Symposium in 1995 and at The 6th International Mine Ventilation Congress in 1997. In 2005, pre-studies for a new main haulage level were started. Different haulage methods were presented including ventilation systems. The pre-studies showed that the existing ventilation system, including fan stations for the new main haulage system in the production area, could be extended. However, a new system for the central area, which was not in the initial investment program, would be needed. In the beginning of 2006, a decision was made to design a new ventilation system for the central area to make it possible to get air to the development work for the new main haulage system, independent of the haulage method. This system was operational by the beginning of 2007. The new main haulage system, which was decided to be located on level 1365 m, only requires that the existing shafts be extended - the capacity of the fans seems to be enough. However, the problem is that the existing level 1045 m and the new level 1365 m have to be in operation in parallel for approximately 7-8 years. The challenge for the moment is determining how to ventilate the production areas for both levels at the same time, while simultaneously constructing the extended system. This paper will describe the problems associated with the extension of the main ventilation system and some potential solutions for these problems. The new main haulage level 1365 m must be in operation by 2012.

1 Introduction

LKAB started open pit mining of iron ore in Kiruna in about the year 1900.

In the early 1960s, the mining went underground. With that came the foundation of the ventilation system.

With the introduction of diesel-powered LHDs in the beginning of the 1970s, the system was expanded. As new main levels have been taken into operation, the ventilation system has been successively extended.

In 1993 a decision was made to construct a new main ventilation system for the main haulage level 1045 m.

The author has presented two papers concerning the design and construction of this system: “The KUJ2000 Ventilation System” at the 7th US Mine Ventilation Symposium in 1995 and “Experiences from the construction of a new ventilation system for LKABs Kiruna Mine” at the 6th International Mine Ventilation Congress in 1997.

In 2005 investigations were conducted concerning the installation of the next main production level, including a new mining and transportation system. The overall project is called KUJ 1365, which is a combination of the Swedish expression “Kiruna Under Jord (Kiruna Under Ground)” and level 1365 m. Simultaneous with the KUJ 1365 project, the analyses regarding the design and construction of the ventilation system required for the new mining system began.

Different alternatives for a new main haulage level were investigated. In 2007 it was decided that the main haulage level would be a train haulage level.

2 Main Ventilation System for The New Main Haulage System 1365m

2.1 Existing Main Ventilation System

The existing main ventilation system was constructed from 1995 to 2000 and consists of 20 raised bored shafts (10 each for intake and exhaust air shafts), each 3 m in diameter and 1000 m in length. The 60 degree inclined shafts are driven from the surface to the new main haulage level in three stages. The two upper stages are driven in line and connected with a steel tube in order to minimize the pressure shock losses.

The third stage is driven closer to the ore body at level 795, which will cause a bend in the airflow but provides shorter connections to the mining areas. See Figures 1 and 2.

The system was designed for a maximum airflow of 150 m^3/s for each shaft at a total pressure drop of 3700 Pa.

Main Ventilation System

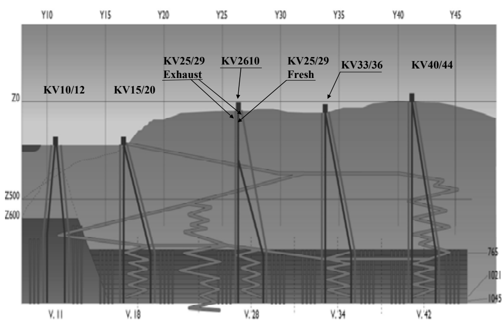

Figure 1

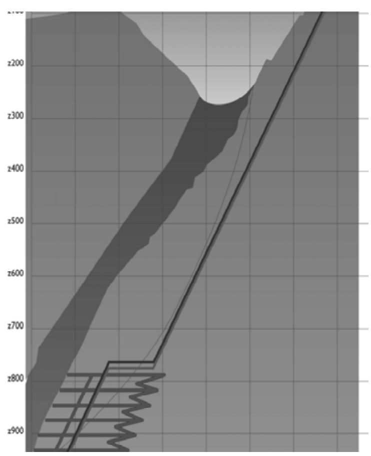

Figure 2

The surface entries of the ventilation shafts are laid out in such a way that only five groups of surface fan house installations are needed (i.e. two mining blocks, each with an intake and return air shaft, are serviced by each fan installation group). This was done in order to coordinate the location of heating, electrical distribution and roads on the surface. One group consists of one intake-air-and-heating station serving two shafts and two exhaust-air stations on each side serving the exhaust airshafts.

The fan stations are nearly the same in design. See Figure 3.

Because the fan stations KV 10/12 and 15/20 are located near workshops, an office area, and the town, they have been equipped with silencers for noise reduction.

Each shaft is equipped with one variable speed axial fan. During the winter, the intake air temperature, which is measured on the exhaust side of the fat at three locations, is preheated to +1^{0}C using hot water coils. This is done to avoid icing of the shafts due to most of the intake airshafts containing water. The heat is distributed to the intake air stations via a district pipe heating system and, for the most

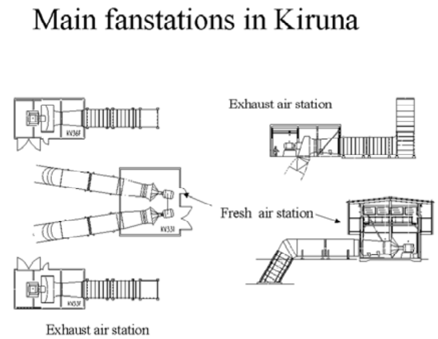

Figure 3

Each shaft is equipped with one variable speed axial fan. During the winter, the intake air temperature, which is measured on the exhaust side of the fat at three locations, is preheated to +1^{0}C using hot water coils. This is done to avoid icing of the shafts due to most of the intake airshafts containing water. The heat is distributed to the intake air stations via a district pipe heating system and, for the most part, with waste heat from the pelletizing plants. When temperatures are below approximately -15^{0}C, it is necessary to utilize oil and electric heating.

The air used for ventilation of the facilities underground (central area) comes from heating station CAV1 to shaft 5130 and heating station CAV2 to shaft 5120 (located on the surface) as well as from heating station 2610 to level 275 m and further to shaft 5280, see Figure 8. Separate shafts ventilate levels 775 m and below to 1045 m. They are connected to the current system at levels 275 m (fresh air) and 320 m (exhaust air). The ventilation systems for the production areas and for the underground facilities are indirectly coupled to each other through connections via train tunnels on levels 775 m and 1045 m, and also through the ramp systems 22 and 25.

2.2 New Main Ventilation System for The Production Area

Investigations for a new main haulage level with different haulage methods, as well as the main ventilation system, have been conducted from 2005-2007.

For ventilation of the production areas, it has been assumed that the amount of air used will be relative to today's, corrected for a higher production level (35Mtonnes/year) - from 720 m^3/s to 1010 m^3/s.

For ventilation of diesel exhaust gases, a rate of 0.08 m^3/s per installed diesel engine power has been used as a rule of thumb. The decision to use train haulage was made in mid 2007.

The investigations showed that the same infrastructure could be used for the main ventilation system, the main fan stations and the upper shafts.

The *only* required modification is the extension of the existing shafts - the capacity of the existing fans seems to be sufficient. The challenge in the new system is that the existing level 1045 m and the new level 1365 m must be in operation in parallel for approximately 7-8 years.

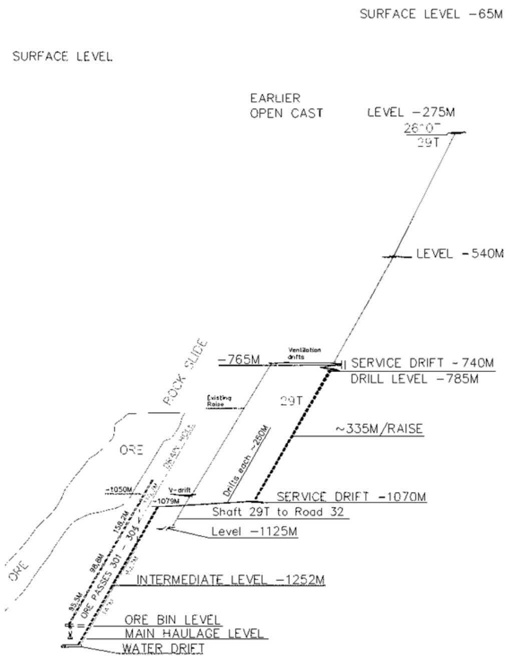

Figure 4

Because of the extension of the ore body to the north, the ore pass groups and ventilation shafts must be displaced north. Therefore it will be necessary to construct new fresh-air and exhaust-air shafts further north, each with a capacity of 150 m^3/s.

Existing fan station KV33 will be detached and used for ventilation of the main haulage level and dust cleaning from the crushers.

Existing ventilation shafts will be extended from level 765 m to level 1020 m.

2.3 New Main Ventilation System for The Central Area

The existing ventilation system for the central area is currently used to its maximum capacity. Further development of ramp 22 and development work for the new main haulage system requires a new ventilation system for the central area.

The decision to construct the new ventilation system was made in 2006 and the system was in operation in June 2007. See Figure 5 - CA Vent.

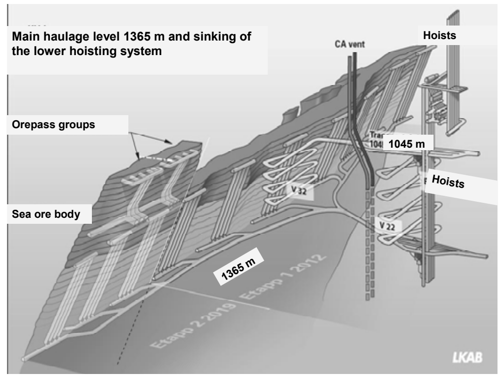

Figure 5

3 Summary and Conclusion

The existing ventilation system including fan stations was designed for the production areas to the main haulage level 1045m.

The pre-studies showed that we can use the same system for the next production areas to the main haulage level 1365m. We can use the same fan stations maybe only with some modification of the blade angles.

However, the problem is that the existing level 1045 m and the new level 1365 m have to be in operation in parallel for approximately 7-8 years.

The challenge for the moment is determining how to ventilate the production areas for both levels at the same time, while simultaneously constructing the extended system.

References

Mukka, Lennart, 1995, The KUJ 2000 Ventilation System The 7th US Mine Ventilation Symposium

Mukka, Lennart, 1997, Experiences from construction of a new ventilation system for LKABs Kiruna mine The 6th International Mine Ventilation Congress

Mukka, Lennart, October 2002, Mine Ventilation at Kiruna, Mining Engineering Magazine, pp 15-19