FLOWNEX®
SIMULATION ENVIRONMENT

MINING VENTILATION

This case study demonstrates the steady-state simulation of a compressed air network used in the mining industry. Compressed air is used widely in the mining industry for the operation of various mining equipment such as drilling. In order to maintain production the various shafts must be supplied with adequate pressure from the compressed air network.

MINING INDUSTRY

CHALLENGE:

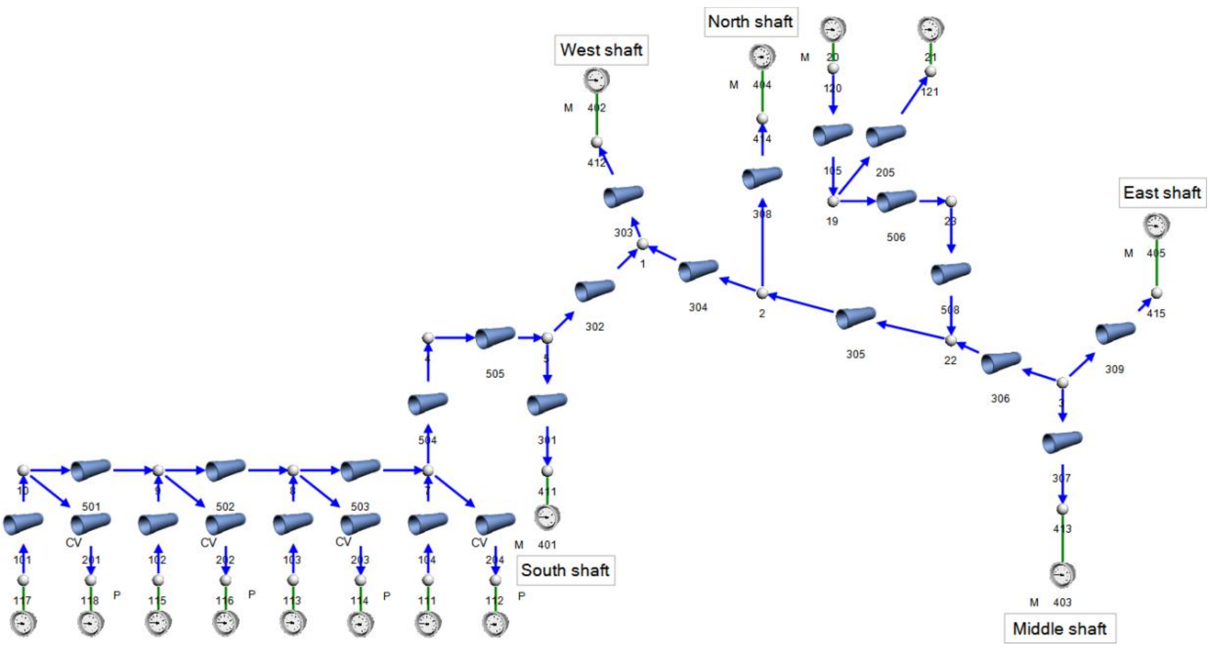
Compressed air is used widely in mining for the operation of pneumatic equipment. Due to the constant variation in demand during production and constant expansion in mining area, the pressurized system needs to maintain acceptable pneumatic delivery pressures in the various shafts.

BENEFITS:

The Flownex simulation will verify whether the compressed air network can maintain the required minimum shaft pressures when the production figures increase in the future expansion of the mining activities.

SOLUTION:

The steady-state simulation of a compressed air network used in the mining industry is demonstrated in this example. The forecasted production figures were used to ensure that the compressed air network will be able to supply all the shafts with the minimum pressure of 580 kPa when the production is increased. It was seen that the current layout is adequate for the next year after which an additional compressor is needed at the North shaft compressor house.



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SYSTEM DESCRIPTION

The layout of the compressed air network is shown in Figure 1.

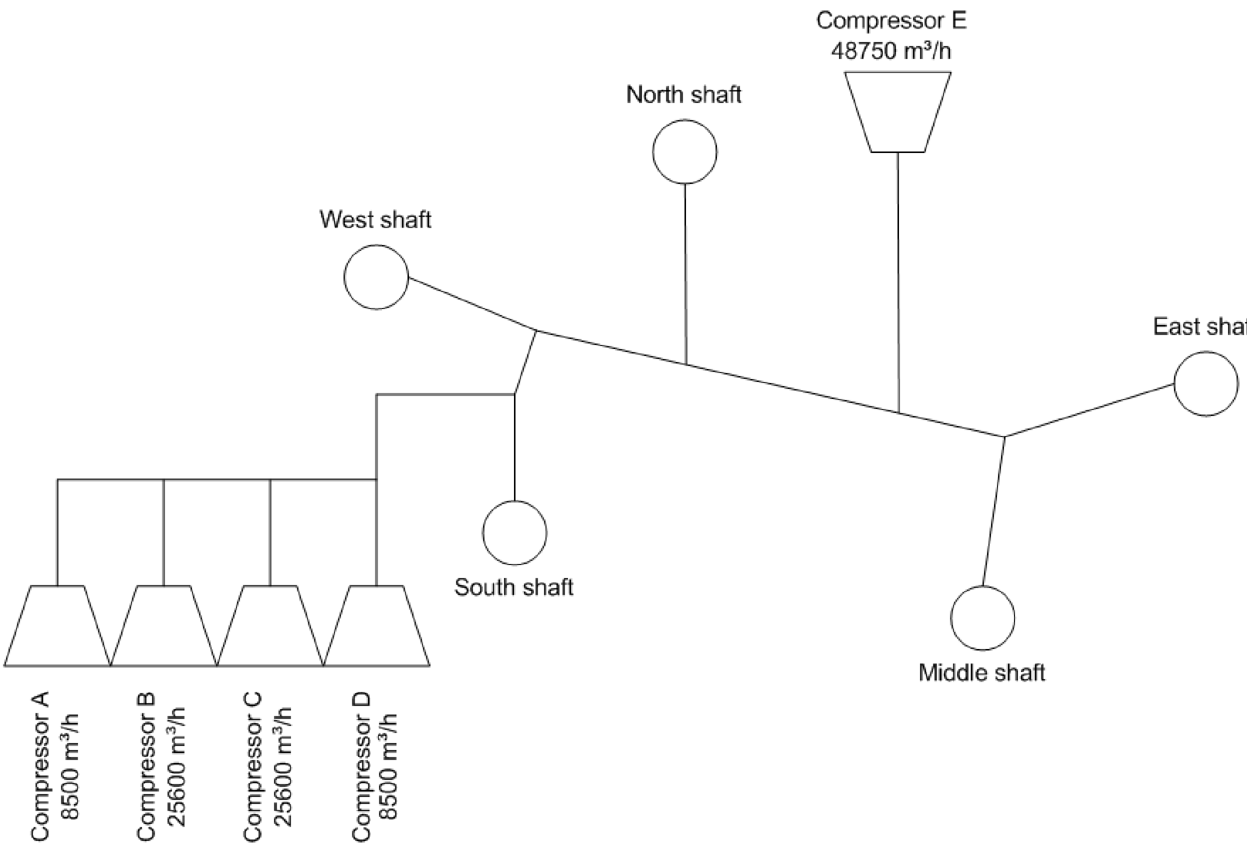

Figure 1: Schematic layout of the compressed air network.

The network consists of five shafts located about two kilometers from each other. Compressors A to D are located in a compressor house near South shaft and compressor E in a compressor house near North shaft. All the shafts have different production levels and thus require different amounts of compressed air. The minimum pressure needed at the shafts to maintain production is 580 kPa.

The objective of the simulation is to model the steady-state operation of the current compressed air network using the current production figures.

OBJECTIVE OF SIMULATION

The objective of the simulation is to model the steady-state operation of the current compressed air network using the current production figures. The investigation must then establish whether the compressed air network can maintain the required minimum shaft pressures when the production figures increase in the future expansion of the mining activities.

The production figures can be converted to air consumption per shaft as shown in Table 1.

Table 1: Current and forecasted air consumption per shaft.

Shaft	Current air consumption - 2006 (kg/s)	Forecasted air consumption - 2007 (kg/s)	Forecasted air consumption - 2008 (kg/s)
South	3.36	4.15	5.5
West	2.0	2.5	3.5
North	12.12	10	8
Middle	3.78	6	10
East	7.56	7.56	7.56

FLOWNEX MODEL

The Flownex model of the system is shown in

Figure 2.

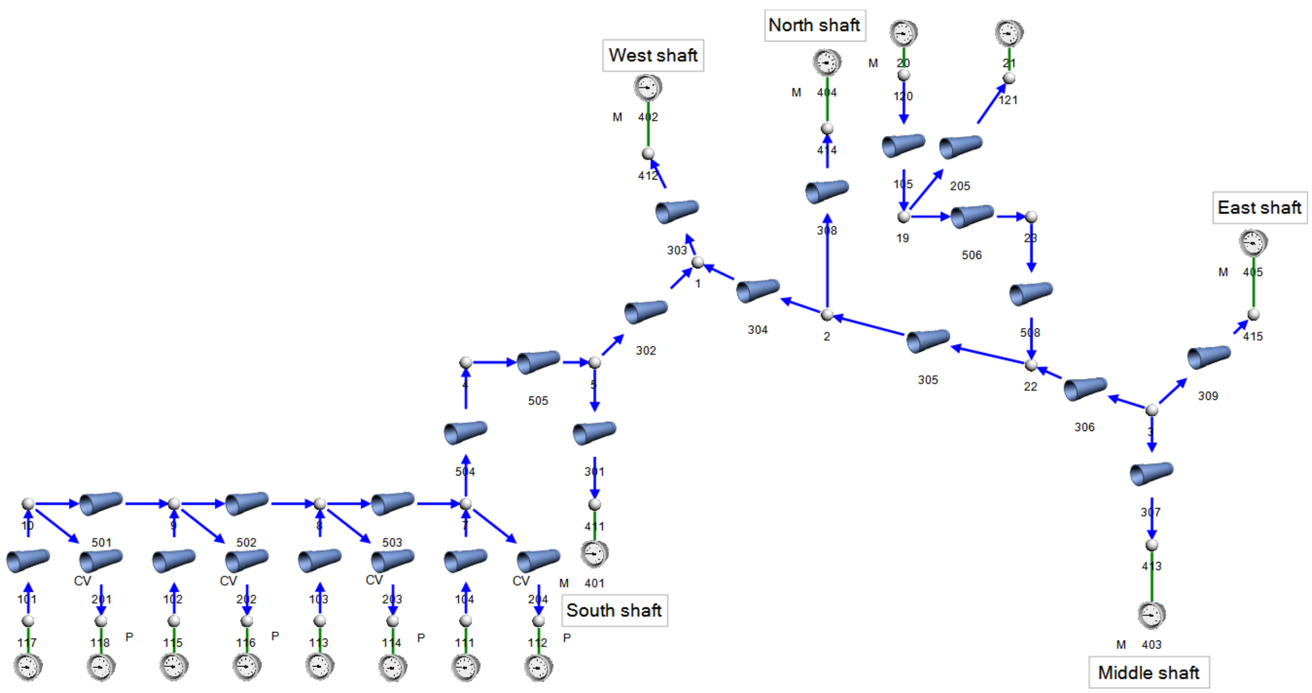

Figure 2: Flownex network of the compressed air network.

All the pipes are assigned a roughness of 45 µm and all the pipe lengths are increased with ten percent to account for secondary losses. Due to a lack of compressor performance characteristics the compressors are modeled in a simple manner by assigning a fix mass flow through a pipe. A pipe with a check valve is then used to simulate the compressor blow off set pressure. Table 2 shows the compressor specifications and mass flow rates that are calculated at nominal conditions (Atmospheric Pressure: 89.4 kPa, Ambient Temperature: 20 ºC, Air density: 1.06 kg/m³).

Table 2: Compressor specifications and flow rates.

Comp Nr.	Pressure setpoint (kPa)	Rated volume flow rate at nominal conditions (m^3/hr)	Mass flow rate at nominal conditions (kg/s)
A	620	8500	2.51
B	620	25600	7.56
C	620	25600	7.56
D	620	8500	2.51
E	620	48750	14.39

DESCRIPTION OF SIMULATION

Three different scenarios are simulated:

1. Simulation of the current network, using 2006 production figures.
2. Simulation of the current network, using 2007 production figures.
3. Simulation of the current network, using 2008 production figures. (An additional compressor can be added at the North shaft compressor house).

RESULTS

Table 3 compares the Flownex results for the different scenarios.

Table 3: Comparison between the different scenarios.

Parameter	Units	Scenario 1	Scenario 2	Scenario 3
Pressure at South shaft	kPa	617.89	617.13	615.71
Pressure at West shaft	kPa	609.15	607.15	603.86
Pressure at North shaft	kPa	600.97	601.44	601.92
Pressure at Middle shaft	kPa	605.50	602.39	598.57
Pressure at East shaft	kPa	592.43	589.70	587.06
Compressor blow off *	%	16.50	12.50	6.69

*Blow off is the percentage of supplied mass flow that is being blown off i.e. excess air.

All the pressures are above the required 580 kPa at the shafts. In scenario 3, the current installed compressors were not able to supply enough compressed air and an 8500 m^3/hr compressor was added to the North shaft compressor house.

CONCLUSION

The steady-state simulation of a compressed air network used in the mining industry is demonstrated in this example. The forecasted production figures were used to ensure that the compressed air network will be able to supply all the shafts with the minimum pressure of 580 kPa when the production is increased. It was seen that the current layout is adequate for the next year after which an additional compressor is needed at the North shaft compressor house.

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