

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Opportunities exist to reduce the electrical energy consumption of mine compressed-air systems. This can be achieved by reducing the demand for compressed air and adjusting the supply to match the demand. EMS however only focuses on managing mine compressor systems in order to match the supply to the existing demand.

EMS is a combination of hardware and software which enables remote compressor control. The solution was implemented on ten mine compressor systems. Automatic compressor capacity control, according to pressure set-point schedules, was accomplished. Due to the importance of uninterrupted compressed-air supply, automatic compressor stopping, starting, loading and unloading were not allowed by any of the mines. These control actions were however manually initiated by an operator, based on onscreen EMS control schedules.

On all ten the compressor systems, an average monthly reduction in electricity consumption of 35% was achieved. It was stated in Section 1.3.2 that a reduction in electricity consumption of up to 50% is feasible for the typical compressed-air system. The obtained reduction is reasonable when considering that EMS is only focused on optimising the supply side of the compressed-air system, without minimising the demand.

The solution enabled operators to achieve substantial reduction in electricity cost on all the compressor systems. An average monthly cost saving of, R 1,188,843.00 during a summer month and R 2,227,625.00 during a winter month, was achieved. These reductions proved to be sustainable for the assessment periods of the individual compressor systems, ranging from two to nine months.

Suppose the compressed-air system contributes approximately 20% to the total electricity consumption at a mine, as discussed in Section 1.3.1. If an average reduction in consumption of 35% is achieved, the total electricity consumption of the mine is reduced by approximately 7%. If PCP penalties are enforced, this reduction will account for a significant portion of the mandatory reduction discussed in Section 1.4.

A reduction in compressor system electricity consumption finally translates to a reduction in production cost to the benefit of the mine. As the cost inflation of electricity is increasing at a much faster rate than

the general inflation, the cost percentage spent on electricity will increase even further. The mine stands to benefit the most from implementation of EMS. The reductions in electricity consumption achieved on the ten compressor systems, together with short payback periods, supports further implementations of EMS on other mine compressor systems.

Investigations on three other mine compressor systems revealed the DSM potential shown in Table 5-1.

Table 5-1: DSM potential on other mines

Mine	Baseline consumption (GWh/month)	Projected reduction (GWh/month)
K	18.11	6.88
L	12.69	4.82
M	8.40	3.19

Most mining operations in South Africa have functional compressed-air systems. Ample opportunities exist for further implementation of EMS on other mine compressor system.

5.2 Recommendations for further work

Optimisation of compressor control strategy

The compressor control strategy, described in Section 3.3, is a simple method of ensuring that compressors are not running unnecessarily. It does however leave room for improvement. In addition, compressor inlet valve positions can be monitored in order to ensure that the running compressors are operating at optimal efficiency. This will allow for more comprehensive compressor control, better matching the supply of compressed air with the demand.

EMS allows for compressor prioritisation according to operator preferences, as discussed in Section 3.3.2. However, these priorities cannot be automatically adapted according to system changes like compressor running hours or efficiency. More flexible compressor prioritisation will allow for compressor control to:

- Distribute running hours evenly
- Run the most efficient compressors for longer
- Select compressors according to capacity

Compressor prioritisation can then be automatically adapted according to the needs of the operator, either for the purpose of increasing time between compressor maintenance or improving overall compressor system energy efficiency.

Full automatic control

EMS automatically varies compressor capacities according to pressure set-point schedules. This has removed a portion of human negligence from compressor control. Automatic compressor starting, stopping, loading and unloading are however not allowed at any of the mines at this stage, as mentioned in Section 4.1. This decision from the mines can be appealed on the basis of reliable and consistent operation of EMS over an extended period of time.

Management of compressed-air demand

EMS is focused on the compressor system, which is the supply of the compressed-air system. Additional reductions in compressed-air system electricity consumption are possible by minimising the demand for compressed air. With EMS in place, reduced demand can be matched with a reduced supply. By expanding the developed energy management solution to include energy management of the underground compressed-air system, optimal reduction in electricity consumption can be achieved.

Expansion to other industries

The design of EMS makes it flexible enough to be implemented on most existing SCADA systems. This can be achieved by simply purchasing additional OPC licensing for the specific SCADA system. The feasibility of adapting and implementing EMS on existing and prospective industrial compressor systems is recommended to extend the study presented in this dissertation.