UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

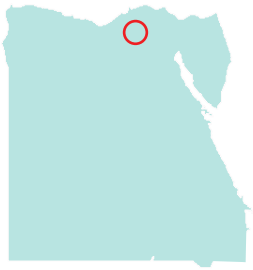
Industrial Energy Efficiency Project
Motor System Optimization

Electric motor driven systems globally consume approximately 70% of the electrical consumption in industrial sector. This case reviews the optimisation of motor systems regarding the hot pump well and compressed air systems within a large industrial plant in the Glass manufacturing sector in order to identify opportunities for saving the energy efficiency, use and consumption by that system. The study revealed that for the major motor system savings assessed in this plant save 2,283,480 kWh (or 1,151,900 EGP) per annum at an investment cost about EGP 64,000.

EGYPT

A Case Study of Sphinx Glass Company

Sphinx Glass Snapshot



Industry: Construction
Location: Sadat City, Menoufia, Egypt
Product: Float glass products

Implementation cost: 64,000 EGP
System: hot well pump and Compressed Air System
Annual energy savings: ~2,28 GWh
Financial savings: ~1,151,900 EGP/year
GHG reduction: ~1,241 tCO_2eq (10 y)
Overall payback: Immediately

Sphinx Glass is a float glass plant established in Egypt in 2008, and majorly owned by Construction Products holding Company "CPC", one of the region's largest manufacturers and supplier of full range of building materials. Located in Sadat City over 220,000 square meters, the plant works at an annual capacity of 200,000 tones. Sphinx Glass has licensed the technology of PPG Industries Inc. - USA to ensure producing the highest quality in glazing, automotive, silvering and coating quality

MSO at Sphinx Glass and the IEE Project

The Industrial Energy Efficiency Project (IEE) is a program developed and initiated by UNIDO to promote energy efficiency in industry as part of its primary objective of "promoting and accelerating inclusive and sustainable industrial development in developing countries and economies in transition."

The Motor Systems Optimization (MSO) Project forms part of the IEE Project and has the specific objectives of developing local personnel to become competent in the application of energy efficiency in industry in order to unlock the potential for energy savings within their respective local industries.

Sphinx Glass Company is considered as a pilot plant for the IEEP in the MSO as well as other components. The company is one of the pioneer companies in Egypt, working on the manufacturing of glass product. They are in the process of developing an Energy Management System (EnMS) with the assistance from the IEEP, and the MSO serves pretty well in developing saving opportunities for the company.

Summary of Optimization Strategies

Saving Opportunity	Energy Savings (kWh/year)	Financial Savings (EGP)	Capital Cost (EGP)	Payback (Year)
Install VSD's for hot well pump	420,480	182,900	55,000	0.3
Compressed Air: Voltage unbalanced correction	75,000	39,000	---	Immediately
Compressed Air: Fixing leaks	1,240,000	645,000	2,000	Immediately
Compressed Air: Scheduled maintenance	73,000	38,000	---	Immediately
Compressed Air: Optimization of setting pressures	110,000	57,000	---	Immediately
Compressed Air: Air usage policy	365,000	190,000	7,000	Immediately
Total:	2,283,480	1,151,900	64,000	Immediately

Case Description

The motor system was chosen as a MSO case. The main significant energy users is the motor system that affecting on our plant electricity consumption. Sphinx has 3 cascaded Pumps driven by an electric Induction motor of 110 KW rated power for each. Hot Well Pump which represents 2% from our yearly electricity consumption. The pump capacity is 1480 m3/h and designed Head is 13 m.

Sphinx Glass has 3 parallel pumps, one of them always in operation and the other 2 are in stand by for any sudden emergency case. The pump is controlled by ABB Soft Starter for soft start up and soft stop during operation. The pump is operated at a pressure of 1.8 bar and Throttling valve closed with 50 %.

Optimization Strategies

Using this systems approach a number of optimization strategies were identified.
The system was assessed first by estimating the motors loading and voltage unbalance in the three motor systems.

After the initial assessment, Sphinx Glass has carried out an audit to identify air leaks, review maintenance records and existing procedures. Furthermore, Sphinx Glass has reviewed all end uses of compressed air and assessed their "actual demand" compared to the current "perceived demand".

Finally, the installation of new VSDs to drive the motors' compressors was assessed for technical and financial feasibility.

Outcome

Sphinx Glass has decided to implement Options 1 to 4 of the possible solutions identified, since each addresses a different aspect of the motor system. Voltage unbalance correction was carried out through the replacement of damaged capacitors.
Several leaks were identified during the assessment with some of them being major leaks exceeding 20 mm hole diameters. Fixing leaks have resulted in the biggest savings the company was able to achieve in the system.
Due to these combined measures, Sphinx were able to switch off one of the three compressors and operate it as a stand-by unit. Furthermore, the company has also identified improper uses of compressed air and was able to reduce the system pressure without affecting production operations.

Lessons Learnt

Using a systematic approach to motor systems optimization, it was able to identify low cost savings and were able to reduce their compressed air system consumption by approximately 45%. This corresponds to a 4.7% savings of the total annual electricity consumption of the whole plant.
In addition, Sphinx Glass has saved the potential purchase of a new compressor and its associated life cycle energy cost.

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