UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

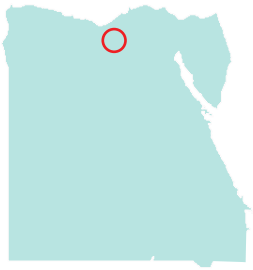
Industrial Energy Efficiency Project
Motor System Optimization

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 cooling tower fans and pumping water system in order to identify opportunities for saving the energy efficiency, use and consumption by that system. The study revealed that for the major motor systems savings assessed in this plant save 1,174,060 kWh (or 643,165 EGP) per annum.

EGYPT

A Case Study of Beshay Steel Company

Beshay Steel Snapshot



Industry: Steel Industries
Location: Sadat City, Menoufia, Egypt
Product: Billets, Re-bars and wire rods

Implementation cost: 2,485,000 EGP
System: Cooling tower fans and pumps
Annual energy savings: ~1,174 MWh
Financial savings: ~643,165 EGP/year
GHG reduction: ~633 tCO_2eq (10 y)
Overall payback: 3.8 years

Beshay Steel group is one of the largest steel producers in Egypt and the Middle East established in 1960s. The company now is capable of producing over 2 MTPY of steel long products, re-bars, wire rods and merchant bars. The majority of the production meets the demands of the local market and the balance is exported. The group is divided to 3 parts; International steel rolling Mill (ISRM), Egyptian American Steel Rolling Co. (EASROC) and Egyptian Sponge Iron Steel Co. (ESISCO)

MSO at Beshay Steel 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.
As leading steel manufacturing company, Beshay is committed to implement and continually improve an effective and transparent energy management system in its entire energy intense works for the good of our nation and our community. It needs to reduce operating costs to remain competitive in the global market.
There are some developed saving opportunities for the company to reduce energy consumption, consider energy performance improvements, comply with the national environmental and legal requirements and focus on employees' awareness and capacity building. Since compressors consume a large proportion of electrical energy, Beshay has focussed on compressed air consumption improvements.

Summary of Optimization Strategies

Saving Opportunity	Energy Savings (kWh/year)	Financial Savings (EGP)	Capital Cost (EGP)	Payback (Year)
Cooling Tower Fan: Blade Angle Adjustment	650,000	364,000	175,000	0.5
Cooling Tower Fan: VSDs Installation	30,000	16,000	740,000	> lifetime
Cooling Tower Fan: Replace Belt by Gearbox	260,000	146,000	470,000	3.2
Cooling Tower Fan: Upgrade Motors to IE3	139,000	78,000	1,000,000	12.8
Mill Pump: Install VSD	95,060	39,165	100,000	2.55
Total:	1,174,060	643,165	2,485,000	3.8

Case Description

The 1st system is the cooling tower which composed of 18 fans set out in 6 sections of 3 fans each, in which eight fans are driven by 30 kW and ten kW motors. This simplifies the study as only one or two fans need to be assessed, with the results being replicated across the other fans. The second system included the pump motor system in the WTP. For mill and thermo pumps there are three pumps for each system.

From the breakdown of loads, the WTP was found to share 11 % of the total motors loads and the total fan motor systems energy consumption represents 21% of the total WTP.

Optimization Strategies

Using the MSO methodology of a systems approach, the mechanical load of the fans was studied in detail. The heat capacity of the cooling tower is 10°C cooling water from 45°C to 35°C. During certain times the full 10°C of cooling is not required. Optimization strategies were developed based on this varying production requirement and also by assessing the method of power transmission along the motor system.

In the cooling towers fans system, the measures ranged from no/low cost measures such as blade angle adjustment to medium cost measures such as retrofitting of energy efficiency transmissions. It also included VSD installation on some of the motors, and replacement of motors with high efficiency equivalents.

In the pump motor system through the site survey conducted to the WTP, it is noticed that the water pumps had valves on the discharge side of the pumps, and those valves were set at 30% open which implies a great saving opportunity can be achieved through optimizing those pumps.

Outcome

The outcomes of the first system assessment have shown that blade angle adjustments would improve the system efficiency allowing shutting down 4 to six fans and saving from 19% to 28% of the total system energy consumption, depending on the season.

Furthermore, the replacement of transmission belts with more efficient gearboxes would improve energy performance by a further 10%. VSD installations and replacement of existing motors with high efficiency units have long paybacks. Beshay have chosen to implement Option 1 only.

Regarding the pump motor system, only one solution (using VSD on the mill pump) is applicable with energy saving varying according to reducing pressure from 5 to 4.5 (reducing energy consumption by 10.5%), from 5 to 4.25 (reducing energy consumption by 18%) and from 5 to 4 (reducing energy consumption by 25%).

Lessons Learnt

- Possibility of changing blade angle is much promising than using VSD
- Using high efficient gearbox will introduce reasonable savings
- Using VSD with such applications isn't economically feasible.

Beshay intends to use the same knowledge to ensure that all motor systems are optimized.

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