UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

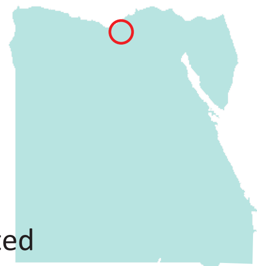
Industrial Energy Efficiency Project Motor Systems Optimization

Electric motor driven systems globally consume approximately 70% of the electrical consumption in industrial sector. This case reviews the optimization of motor systems in air cooler fans within a large industrial plant in the oil and gas manufacturing sector. The study revealed that for the system assessed in this plant 132,000 kWh (or EGP 100,000) per annum could be saved at an investment net cost of EGP40,000.

EGYPT

A Case Study of Alexandria Mineral Oils Co. (AMOC)

AMOC Snapshot



Industry:
Oil & Gas
Location:
Alexandria, Egypt
Products:
Base Oils, Uninhibited Transformer Oil, Automatic Transmission Fluids, Fully Refined Solid, Low Sulphur Gas

Implementation cost: 40,000 EGP
System: Air Cooler Fans
Annual energy savings: ~0.13 GWh
Financial savings: ~100,000 EGP p.a.
GHG reduction: ~720 tCO2eq (10 y)
Overall payback: 5 months

About AMOC

AMOC had been established in May 1997, as an Egyptian joint stock company, under the Egyptian investment law.
The Company consist of two complexes; Lube and Special Oils complex (design capacity of 259,000 MT/Y),
and Maximization of Gas Oil complex (design capacity of 1,250 million MT/Y fuel oil).

MSO at AMOC 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.

AMOC has joined the IEE project as a part of the cooperation with Egyptian Ministry of Petroleum represented by Oil and Gas Sector Modernization project (Group 4B).

The company consumes about 120,000,000 kWh of electrical energy annually where the tariff was about EGP0.77 (in 2017). Since motors consume the largest proportion of electrical energy, AMOC has focused on motor system improvements where the motor systems are subjected to assessment to emphasize all possible methodologies to optimize system energy consumption and reliability.

Summary of Optimization Strategies

System	Saving Opportunity	Annual Energy Savings [kWh p.a.]	Financial Savings [EGP p.a.]	Investment [EGP]	Payback [years]
Air Cooler Fans in Gasoil Units	Controlling back-up fan using VSD	82,300	63,300	40,000	0.6
	Shutting off the fan when not needed	50,000	38,000	0	0

The Case

The air coolers in gasoil units have a main fan which use air to cool fluid medium and have a backup fan which is used in case the main fan is not sufficient enough for cooling fluid medium to reach its set point. The control method of back up fan is variable pitch control where the controller adjusts the angle of fan blades (5 level of adjustment) to supply fluid medium with its demand of air to be cooled. The Levels of adjustment is from 0% to 100% with step of 25%. At 0% blade angle is adjusted to be zero (Zero flow rate) while at 100% blade angle is adjusted to be maximum (Maximum flow rate)

The backup fan means that it always works at zero degree (zero flow rates) unless fluid medium temperature exceeds certain degree, controller starts to adjust blade angle with 25% to increase supply of air to cool down the fluid medium.

If medium has not been cooled yet, controller start to increase blade angle step by step till reaches 100% and afterwards medium reaches it set point when controller readjust blade angle to zero degree and fan continues to work without any flow rate supply just in case of temperature rise again.

Since unloading time of the fan is relatively too long and the energy consumed is almost equal to that at full load, hence there is considerable waste of energy.

Optimization Strategies

After assessment, AMOC team recognized two applicable optimization strategies. First, Changing flow rate control of backup fan from variable pitch control method by the existing pneumatic controller to VSD. In this improvement opportunity, VSD solution would decrease maintenance cost due to getting rid of variable pitch control. The pneumatic controller annual maintenance cost of around EGP50,000 will be saved which will be subtracted from the cost of the new VSD (~EGP90,000). The second improvement opportunity is shutting off the fan when there is no need for cooling (during night or winter weather) for around 37% of annual operating time.

Some other strategies related to increasing the air flow rate were investigated but found not feasible.

Outcome

The company has decided to implement the two applicable improvement strategies. AMOC achieved total savings amount of 132,000 kWh (or EGP100,000) per annum against around EGP90,000 investment cost. There is considerable amount of yearly savings in maintenance cost of EGP50,000 in average after removing the old pneumatic pitch controller.

Lessons Learned

Applying a structured approach to MSO can often result in savings with no or low initial cost.

Energy efficiency improvement has a significant effect on enhancing maintenance activities.

Applying MSO can be a good motivation for the companies to widen their energy efficiency concerns and starting the implementation of energy management system (EnMS).

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