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Modeling Water Treatment Plant with High Efficiency Motors (HEMs)

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Abstract- Water Treatment Plants (WTPs) consume huge electricity because many electrical drives are used. This paper presents a study on the analysis of electrical energy used in WTPs and reveals the findings that an increase in the efficiency of the motor drives system used leads to a significant energy saving. In some of the WTPs in Malaysia, hundreds of Ringgit Malaysia can be saved by remodeling the motor drives system deployed in WTPs. In the new operational model, Energy Efficient Motors are used, also referred as HEMs, which lead to demand reduction in terms of energy input for the same load as compared to standard motor category.

Keywords: Water Treatment Plant Motors, New Operational Model

Introduction

References (1-5) only serve as a guide in this study, but are not directly related to the study undertaken here. What motivates us in this study is the fact WTPs consume huge electrical power due to the motors used. So, in this study motors are selected to be modeled for energy saving in WTPs.

Mitigation of Water Treatment Plant with (HEMs)

As in [3] and the WTP shown in Figure 1, in reference to Figure 2:

$$ES=HPx0.746\ (1/\eta s - 1/\eta e)\ txc \quad (1)$$

Annual energy savings can be calculated as follows:
Where:

t = running time per year (hours/year)
c = cost of electrical energy (RM/kWh)
ηs = SEM efficiency
ηe = HEM efficiency
ES = energy cost saving per year
0.746 = Conversion factor from horsepower to kW

Input data:
Motor size = 100 HP
ηs =91.6 %
ηe =93.8 %
Annual hours of use = 8064 hours
Marginal cost for electricity = RM 0.25/kwh
KW (saves) = 100 *0.746 *(1/0.916 – 1/0.938)
=1.9098 kW

Energy cost savings = 1.9098 kW * 8064 hr * RM 0.25/kW
= RM 3,850/year

Results and Discussions

The operation of the WTP is remodeled using HEMs of various rating sizes and for various sections of the WTP the numbers of motors installed are as in Table1.

The results clearly show that the total saving of the energy cost is almost half million per annum indicating this new model operation is economically viable.

Fig.1. Motors used as pumps in the WTP

TABLE.1. Results showing the total energy cost saving as consequence of modeling the WTP with HEMs of various power ratings.

Motor size and number of motor used	Energy cost savings (RM/year)
100 HP (50 Motors)	192,500
50 HP (75 Motors)	144,375
20 HP (120 Motors)	92,400
Total Energy cost savings (RM/year)	429,275

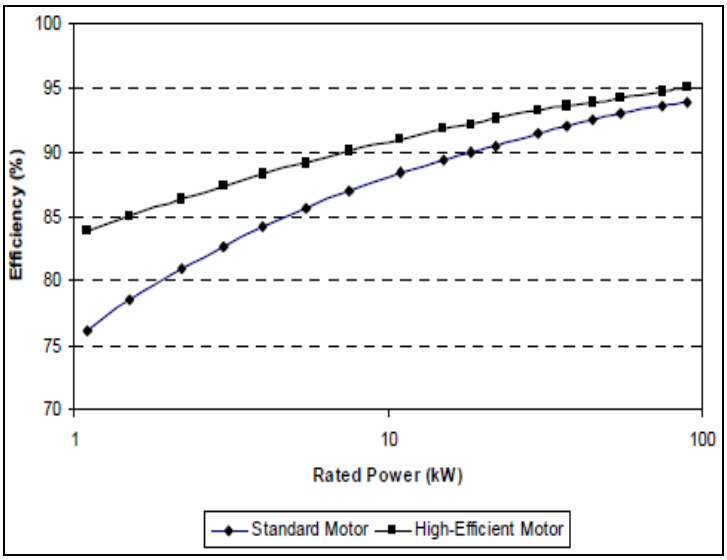

Fig. 2. Comparison of HEMs and standard motors: Full load efficiency

Conclusion

The operational model of the WTP using HEMs is not only just economically viable, but it leads to profits as a result of energy saving cost. This is extremely attractive for the sustainability of the WTP operation and to protect the environment from pollution as result of less power input required for the same load requirement. It is recommended all WTPs now should resort to use HEMs in their operation.

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