Alternative Solutions to Improve Efficiency by Energy Audit at Aniket Metals Pvt Ltd, Vapi

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Abstract— To reduce energy consumptions for efficient energy use, energy audit and process analysis of industrial machines are essential. Energy audit is the best solution for the energy conservation where the system is well analysed and report gives possible changes in the system. Compared to other non-residential buildings, industrial building having generally larger thermal loads, ventilation losses. Energy audit analyses the effect of various energy saving actions on the energy consumptions of the site. Energy audit identifies energy use, where and how loses are occurring. Improvement in energy efficiency gives the benefit to industry in terms of profit may be directly or indirectly. The main objective of this paper is to demonstrate the ways for energy conservation. The detailed energy audit was performed and data was analysed to find the corrective actions which can be taken to reduce energy consumption and improve overall efficiency of the plant. Post audit data can be collected to analyse the effectiveness of actions taken.

Key words: Efficiency, thermal loads

I. INTRODUCTION

The factory of M/s Aniket Metals Pvt Ltd. is situated at Survey no. 23/5, Village – Manda, Nargol Sarigam Road, Sarigam, Ta. Umargaon, Dist. Valsad – 396155. They are manufacturing SS sheets & SS Utensils, with installed capacity 24,000 M.T. & 400 M.T. respectively. The factory receives SS Flats as raw material and processes the same through shearing, annealing, rolling, quenching, pickling, and surface grinding, rolling first Stage, etc. and finally polished SS sheets are being dispatched to their customer. The factory is also producing SS Utensils.

The factory houses equipments like pumps, compressors, furnace, motors, conveyer belts and other machining equipments. Among these equipments pumps, compressors, furnace and motors had the scopes of energy saving.

II. FURNACE

At Aniket Metals Pvt Ltd. there is total 1 reheating furnace installed for heating steel plates. The heated material is drawn out at a temperature of 950/1100°C for hardening and Rolling.

Furnace insulation is poor due to which skin temp was found much higher recommended values. Average surface temperature of the furnaces was found to be 111 °C while desired surface temperature is about 70 °C. Main reason of high surface temperature is degrade/poor insulation provided construction the skin temperature may be reduced by replacing the existing insulation by better quality refractory/insulation bricks. Controlling the furnace temperature is very important because at higher operating temperature associated losses would also be higher.

To improve furnace efficiency following actions were taken.

1) Replacement of inefficient burner by new one with controlling device of air fuel ratio.
2) Installation of recuperator
3) Installation of temperature controller
4) Replacing refractory & Insulations.

	Audited Data	Proposed Data
Fuel Consumption/day	1148 m^3	432 m^3
Material Heated/day	8049.6 kg	8049.6 kg
Furnace Efficiency	9.11 %	24.23 %
Fuel Cost/day(approx)	37,000 Rs.	14,000 Rs.

Table 1:

III. PUMPS

There are four pumps installed of about 2/5 HP. Out of four pumps one 5 hp pump is working 12 hours/day. Average consumption is about 50 kWh per 12 hours. Total consumptions per year considering 330 days per year will be 16500 kWh. The pumps are very old and working hardly 30 % efficiency as usually found. If the same are replaced by new efficient pump set with 60 % efficiency we can get benefit as under.

% energy saving equation = (η2- η1)*100/η2
Efficiency of new pump η2 = 60 %
Efficiency of old pump η1 = 30 %
% energy saving = 50 %

For 5 HP pump:

	Audited Data	Proposed Data
Energy Consumption/Year	14750	7375
Energy Cost/Year(Approx.)	1,08,700	54,350
Efficiency	30 %	60 %

Table 2:

For 2 HP pump:-

	Audited Data	Proposed Data
Energy Consumption/Year	5900	2950
Energy Cost/Year(Approx.)	43,500	21,750
Efficiency	30 %	60 %

Table 3:

There are total 3 such pumps.

IV. MOTORS

Standard squirrel-cage induction motors are widely used as prime movers for driving machines. In general, even at ideal condition, it wastes 8- 10% of the total electrical power during (electrical to mechanical) conversion.

There is a wrong notion that a lesser capacity motor is advantageous. But any under capacity will lead to overloading the motors thereby reducing considerably its speed, and machine production. So, any small advantage seen

in consumption is not true if we take the production loss also into account. Similarly an over capacity motor will also lead to excess consumption.

A. Nominal limits of motor efficiency [1]:

Nominal limits for Standard Efficiency IE1 and premium Efficiency IE 3							
Sr. No.	Motor Rating in KW	Number of Poles					
		2		4		6	
		IE 1 Eff.	Premium IE 3 Eff.	IE 1 Eff.	Premium IE 3 Eff.	IE 1 Eff.	Premium IE 3 Eff.
1	0.75	72.1	80.7	72.1	82.5	70	78.9
2	1.1	75	82.7	75	84.1	72.9	81
3	1.5	77.2	84.2	77.2	85.3	76.2	82.5
4	2.2	79.7	85.9	79.7	86.7	77.7	84.3
5	3	81.5	87.1	81.5	87.7	79.7	85.6
6	4	83.1	88.1	83.1	88.6	81.4	86.8
7	5.5	84.7	89.2	84.7	89.6	83.1	88
8	7.5	86	90.1	86	90.4	84.7	89.1
9	11	87.6	91.2	87.6	91.4	86.4	90.3
10	15	88.7	91.9	88.7	92.1	87.7	91.2
11	18.5	89.3	92.4	89.3	92.6	88.6	91.7
12	22	89.9	92.7	89.9	93	89.2	92.2
13	30	90.7	93.3	90.7	93.6	90.2	92.9
14	37	91.2	93.7	91.2	93.9	90.8	93.3
15	45	91.7	94	91.7	94.2	91.4	93.7
16	55	92.1	94.3	92.1	94.6	91.9	94.1
17	75	92.7	94.7	92.7	95	92.6	94.6
18	90	93	95	93	95.2	92.9	94.9
19	110	93.3	95.2	93.3	95.4	93.3	95.1
20	132	93.5	95.4	93.5	95.6	93.5	95.4
21	160	93.8	95.6	93.8	95.8	93.8	95.6
22	200 up to 375	94	95.8	94	96	94	95.8

Table 4:

It is recommended that the existing old IE1 type motors may be replaced by premium IE3 type motors to get benefit of better efficiency and to reduce the running cost of motor. We can take example of 37 KW 2 pole IE 1 type motor to be replaced by premium IE 3 type motor as under.

B. Comparison of Power Consumption of IE 1 and Premium IE 3 motor:

	Audited Data	Proposed Data
Power Rating kW	37	37
Motor Efficiency	91.2	93.9
Per Day kWh Consumption	486.84	472.8
Average Energy Cost/Day (Approx.)	3600	3500
Annual Saving (Approx.)	33000	

Table 5:

C. Motor capacity and load factor:

All latest motors have flat top efficiency characteristics when the loading is in the range of 60%- 90% as shown in Figure above. So, while deciding the required capacity of a motor, care should be taken that the level of loading falls within that flat region throughout its operation.

D. Avoiding motor burnouts:

OVERLOAD RELAY is the only protecting device available in the motor control panel for motor burnout prevention. Therefore any defect in this device will lead to motor burnout.

E. Efficiency / power factor vs. load:

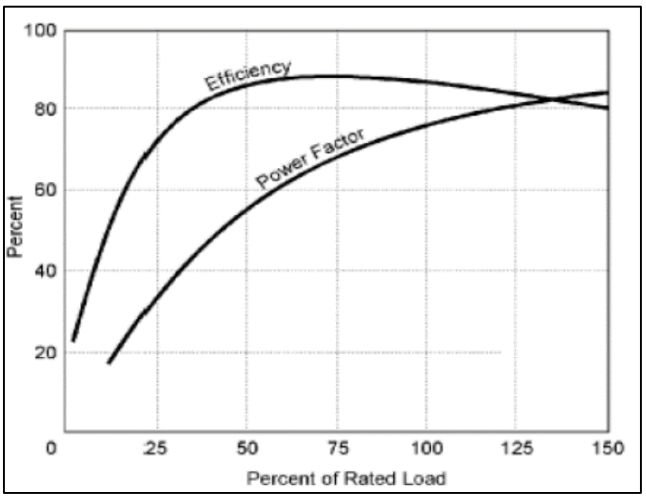

Fig. 1:

F. Statistical data of motor:

Name	Number
Total motors checked	72
Motors for rated data not available	20
Motors found OK	18
Motors overloaded	20
Motors under loaded	14

Table 6:

G. Remark:

It is suggested the following action may be taken to regularize normal operation of motor.

1) Over loaded motors may be changed by correct size to avoid frequent burning.
2) For under loading motor, motor connections may be changed from delta to star. By this way hp rating will be reduced.
3) As far as possible motor should not be reused after second failure. By every failure motor efficiency is reduced by 7%.

V. TRANSMISSION BELTS

In the Installation, there are motors operated on V-Belts. These V-Belts consume 10-15% extra power due to transmission loss, improper alignment, loose/tight and groove gap slippage. Thus transmission losses of V-Belts are approximately estimated as 10-15%. Now Nylon poly weave Flat-Belts are introduced in India to reduce these transmission losses. Therefore it is proposed to replace all V-Belts with pulleys by flat poly weave nylon belts with pulleys and reduce transmission losses to only 3%. According to practical estimating, about minimum 5% power can be saved by replacement of V-Belts.

VI. CONCLUSION

Reduction in energy consumption is necessary for increase in efficiency of the system and to get the cost benefit too. Solutions for improvement in efficiency may require investment but after payback period it is beneficial to industry. Based on energy audit data certain improvement measures can be taken which can result in successful saving of energy consumption. In furnace, it is found that energy

consumption is mainly reduced by replacing refractory & insulations. By installing of temperature controller and new efficient burners about 2,36,000 m3 of fuel could be saved during a year of operation. Replacing of old inefficient pump with new ones could result into an annual saving of 16,225 units of electricity. The over loaded motors could be changed by correct size to avoid frequent burning. For under loading motor, motor connections may be changed from delta to star.

REFERENCES

[1] Classification and EC-Regulations of Motor Efficiencies http://nvemr.be/pdf/danfoss_classification_EI4709E.pdf

