ENERGY AUDIT AND OPTIMIZING ENERGY CONSUMPTION IN PADDY PROCESSING INDUSTRY

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Abstract:

Energy consumption in processing Industry is major problem in profits. Main objective of this research is to examine and compare the Energy consumption in the Paddy Processing Industry in Chennai with other Industry and literatures. An Energy Audit were conducted in Paddy Processing Industry located at Chennai, India, it is observed that the cost of energy per Ton of processing Paddy is higher than the benchmarks, detailed analysis were conducted to identify the problems, found that most of the machinery were ran at no load frequently due to lack of supply chain process Energy optimization techniques and suggestions were introduced based on the literatures. The results and data were provided for further research.

Keywords: *Energy audit, Energy consumption, optimization, Paddy processing, Power factor.*

1. Introduction

This investigation concerns energy consumption which was done at Paddy Processing Industry at Chennai, India. The paddy processing industry process the paddy to convert Rice from Paddy. Rice is the one of the most important food in the world. The following machinery was used in processing the Rice from paddy:

1. Dryer
2. Chain Conveyor
3. Bucket elevator
4. Pre Cleaner
5. Rubber Roll husker
6. Husk aspirator
7. Paddy Separator
8. De-stoner
9. Abrasive Whitener
10. Friction whitener
11. Sifter
12. Mist Polisher
13. Length Grader
14. Blower
15. Boiler
16. Packing Machine

A. Dryer

Fixed batch drying were carried out using Electric heaters

B. Chain Conveyor

Chain Conveyor is used to transfer the material from dryer to the next machinery.

C. Bucket Elevator

It is used to carry the paddy from downstream to the bin above Pre Cleaner

D. Rubber Roll Husker

It removes the husk from Paddy.

E. Husk aspirator

It separates the Husk from Rice.

F. Paddy Separator

It separates the paddy from the rice.

G. De-stoner

It removes the stone from the Rice.

H. Abrasive Whitener

It polishes the Rice using Abrasives.

I. Friction Whitener

It polishes the rice by friction between Rice.

J. Sifter

It separates the polished Rice with Unpolished Rice, Broken Rice and impurities.

K. Mist Polisher

It is used to polish the Rice by Blowing the air.

L. Length Grader

It separates the Whole rice with Broken Rice.

M. Blower

It is used to generate Airflow for material handling

N. Boiler

It is used to generate steam for par-boiling of Rice.

2. Methodology

Pre-Study;

A. Identify the list of machinery in the plant

Identifying the plant machinery is the first step in the process. Prepare the list of machinery along with connected load.

B. Calculate the standard load in Amperage of the power connected to the machinery.

C. Run the machinery in the empty load and measure the amperage.

D. Run the machinery with raw materials for usual production condition.

E. Measure the amperage of the machinery on full load.

F. Compare and calculate the power factor for all individual machinery.

G. Evaluate the production cost.

3. Results and discussion

The following observations were made during Energy Audit:

Table 1 Machinery list with connected load

Machinery Name	Power in HP	Actual load in Amps
Aspirator	1.00	1.60
Intake Conveyor	3.00	2.24
Intake Elevator	3.00	3.89
Jute Remover	1.00	1.80
Rotary Feeder	1.50	1.80
Rubber Husker	50.00	65.00
Powder Elevator	3.00	2.75
De-Stoner	20.00	25.00
Paddle Conveyor	5.00	4.21
Elevator	3.00	3.11
Feeder	1.00	0.58
Conditioner	7.50	5.09
Miller	120.00	120.00
Air lock	1.00	1.36
Blower	15.00	16.60
Feeder for cooler	1.00	0.60
Cooler	2.00	2.20
White Polisher	7.50	8.20
Rice conveyor	3.00	3.50
Rice Elevator	3.00	2.40
Vibro sieve	2.00	2.36
Compressor	3.00	3.46
Office lightings	0.75	1.60
Plant Lightings	1.20	5.63
Boiler	2.00	2.20
Total	**260.45**	**287.18**

Table 2 Power Factor Calculation

Machinery Name	Actual load in Amps	Standard load in Amps	PF
Aspirator	1.60	3.10	0.885
Intake Conveyor	2.24	4.50	0.413
Intake Elevator	3.89	4.50	0.717
Jute Remover	1.80	1.70	0.996
Rotary Feeder	1.80	3.40	0.664
Rubber Husker	65.00	63.20	0.719
Powder Elevator	2.75	4.50	0.507
De-Stoner	25.00	27.40	0.692
Paddle Conveyor	4.21	7.50	0.466
Elevator	3.11	4.50	0.574
Feeder	0.58	1.80	0.321
Conditioner	5.09	10.00	0.376
Miller	120.00	147.00	0.553
Air lock	1.36	1.70	0.753
Blower	16.60	21.00	0.612
Feeder for cooler	0.60	1.80	0.332
Cooler	2.20	3.35	0.609
White Polisher	8.20	11.20	0.605
Rice conveyor	3.50	3.10	0.646
Rice Elevator	2.40	4.50	0.443
Vibro sieve	2.36	2.70	0.653
Compressor	3.46	4.50	0.638
Boiler	2.20	3.50	0.609
Total	**287.18**		**0.61**

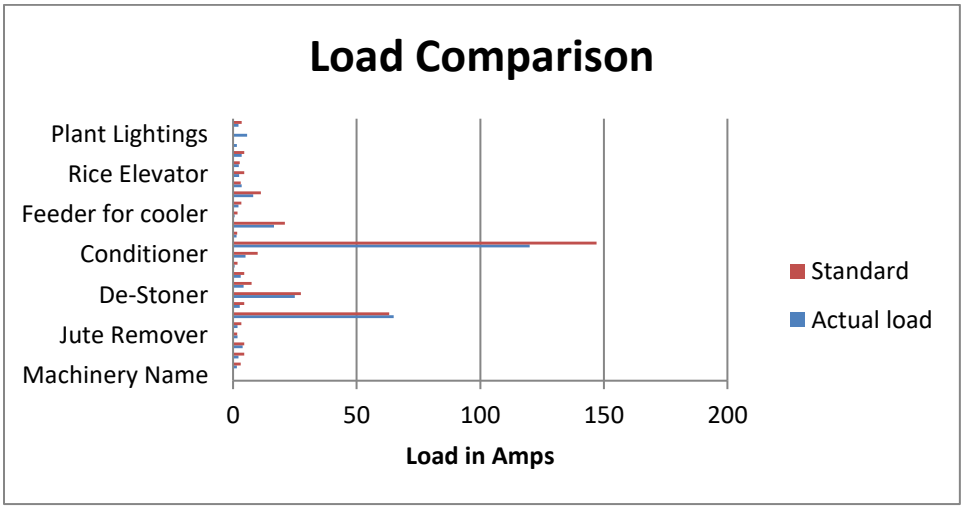

Fig. 1 Connected load vs Actual load

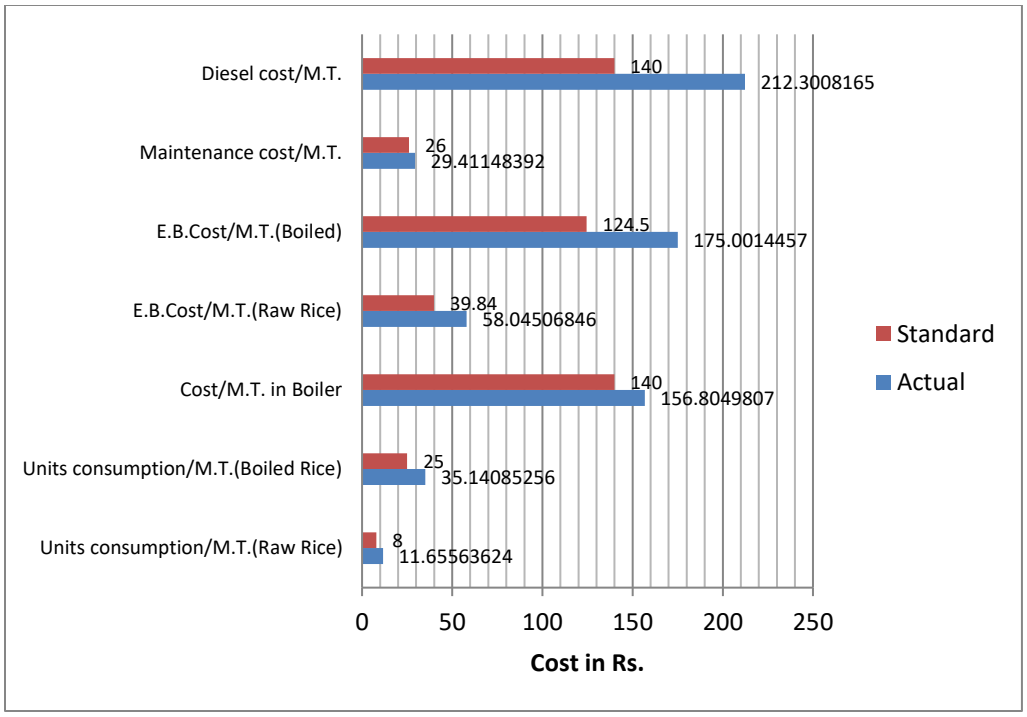

Fig. 2. Cost Comparison

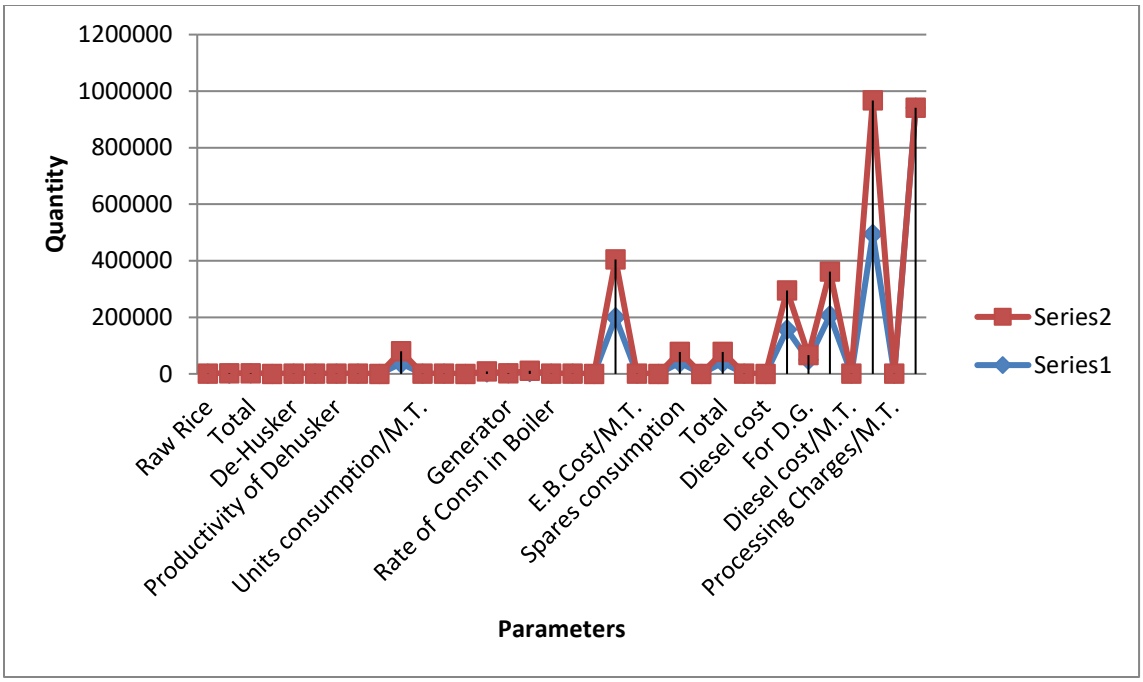

Fig. 3. Production Comparison

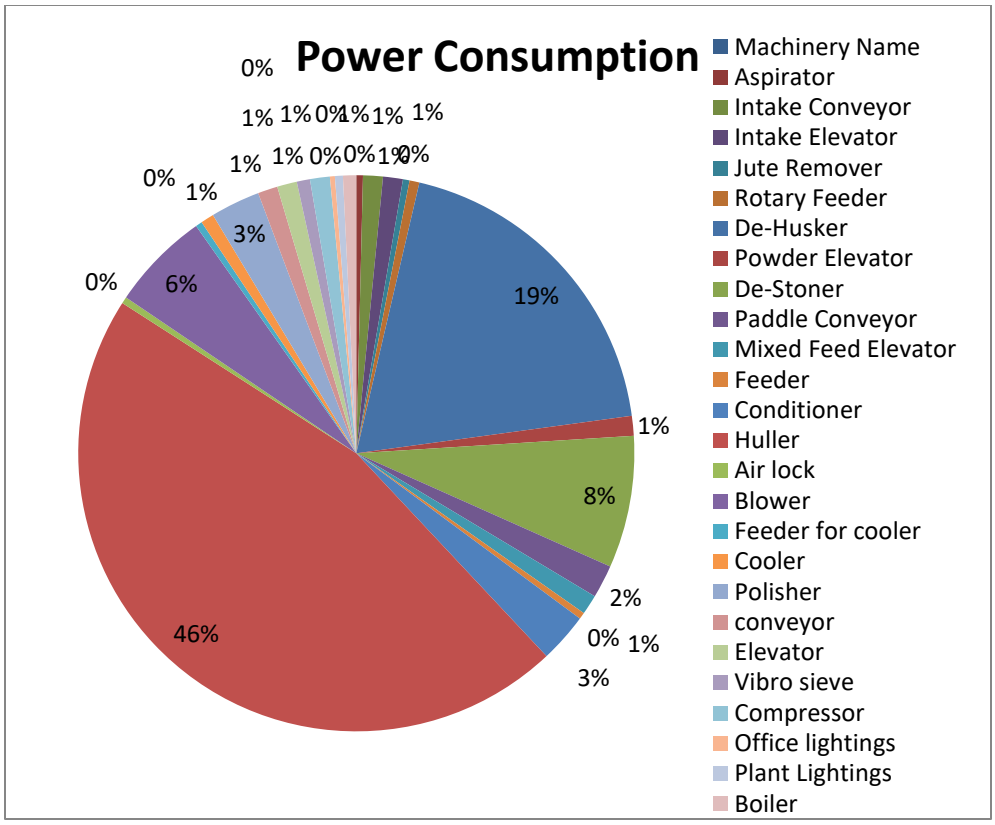

Fig. 4 Power Consumption Analysis

The Table 2 shows the power factor calculated using connected load with actual load.

The machinery with connected load were listed in Table 1, the Fig. 1 clearly shows that all the machine were worked under load. The cost production is high comparing to the standard. Fig. 3 shows the production comparison with standards. Fig. 5 shows the power consumption among machinery.

4. Conclusion

During the energy audit it is observed that in the Bucket elevator the buckets are not carrying materials in its full capacity due to dust formation in the bucket, so it is consuming more power than actual, identifying the cleaning frequency is the major problem, for that we suggested to provide ammeter for all the Elevators and all other machinery, increase in no load amperage will indicate the need of cleaning. We suggested providing Variable Frequency drive to the feeder of the Huller to increase the efficiency. We suggested removing the foreign materials in the Intake conveyor to improve the efficiency. Huller machine is consuming more power and it is running at 60% of its load only. There is an opportunity to reduce the energy consumption cost by utilizing the Huller Machine and all other machine at its full capacity. Due to the unskilled employees in the paddy processing, the industry consuming more power, it is suggested to conduct training program on employees to create an awareness of energy conservation.

References

1. Komol Singha, “Paddy Processing Mills in India: An Analysis“, Rice Research, Vol. 1 (2), pp. 1-5, 2013.
2. Kali Sankar Chattopadhayam Debajit Roy, “Hulling and Miling Ratio in Major Paddy growing States: west Bengal”, Agro-economic Research Centre, Visva-Bharati, Santiniketan, Study No.65, pp. 23-78, 2011.
3. Kshirod R. Bhatacharya and Y. M. Indudhara swamy, “Conditions of Drying Parboiled Paddy for Optimum Milling Quality”, Central Food Technological Research Institute, Mysore, Paper IV, Vol. 44, pp. 592-600.
4. Ayamdoo J. A. Demuyakor B, Dogbe W, and Owusu R, “Parboling of Paddy Rice, The Science and Perceptions of it as practiced in Northern Ghana”, International Journal of Science and Technology Research, Vol. 2 (4), pp. 13-18, 2013.
5. N. Venkatachalapathy, R. Udhayakumar, “Effects of Continuous Steaming on Milling Characteristics of

two India Rice varieties", Rice Science, Vol. 20 (1), pp-309-312, 2013.

6. Igathinathan, P.K. Chattopadhayay, and L.O. Pordesimo, "Cobination Soaking Procedure for Rough Rice Parboiling", American Society Agricultural Engineers, Vol. 48 (2), 2005.
7. Oludare Olumuyiwa Adekoyeni, Rahman Akinoso and Akintunde Stephen Fagbemi, "Effect of Paddy storage and Processing parameters on quality of ofada Rice in the production of ready to eat flakes", African Journal of Food Science, Vol. 9 (5), pp. 335-341, 2015.
8. Umogbai V.I. ,"Development of a Farm level paddy rice parboiling device", International Journal of Recent Technology and Engineering, Vol. 2 (2), pp. 16-21, 2013.
9. K.G. Gunasekara and D.A.N. Dharmasena, "Effect of Grain Shape and Pre-soaking on cooking time and Cooking Energy," Tropical Agricultural Research, Vol. 22 (2), pp. 194-203, 2011.