Electric Energy Reduction in Cassava Powder Industry

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ABSTRACT

This paper introduces the electric energy consumption measurement of the cassava powder production process. The result of energy consumption measurement is used to consider for shutting down of some machines. This shutting down is not affected to the production output. By energy cost calculation, the energy cost savings is more than 1.3 million baht per year.

Key words: Electric energy reduction, Cassava powder, Energy consumption measurement.

1. INTRODUCTION

Energy savings and efficiently energy consumption in Thailand are considered to be a law by Thai government. All industries need to use the energy with high efficient. By the way, the energy engineer needs to check the energy consumption in all energy used sections. Then, the energy savings criteria are came out from energy engineer. The implementations of energy engineer suggestions could be benefited to industries sections and also overall of energy used. Cassava powder industry is one important in Thailand. Thus, electric energy reduction becomes important to reduce the investment cost for producing cassava powder.

In cassava powder industry process of Northeast of Thailand (Jirat Pathana Karnkasate), the system is designed for producing powder output 300 tons per day. The electricity is mainly power source in process. Since the raw cassava input is less than to produce 300 tons output, some machine in the process should be shut down for reducing the energy consumption. The practical powder output is around 200 tons per day. Thus, some machine should be concerned to shut down while the powder output is remaining at 200 tons per day.

In this paper, the basically concept for reducing the energy consumption is proposed. Some machines in the process are considered to shut down. However, the production output is still satisfied. Energy consumption is measured to relevant for considering the shutting down of some machines.

2. MACHINERY IN CASSAVA POWDER PROCESS

The machinery of 300 tons output of cassava powder includes raspers, horizontal turbo sections and compressed residue turbo sections as in Figures 1-3.

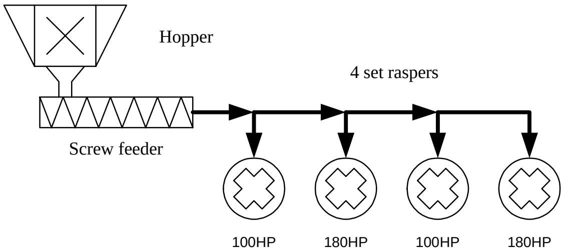

Figure 1. Raspers

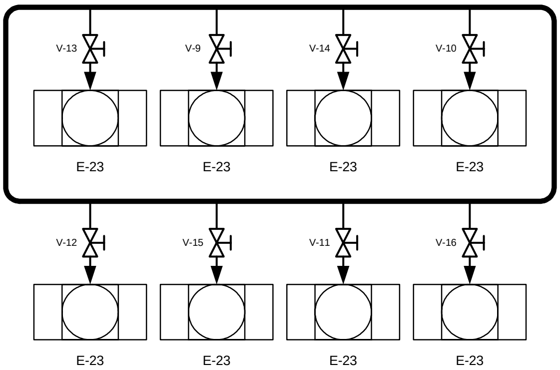

Figure 2. Horizontal turbo sections

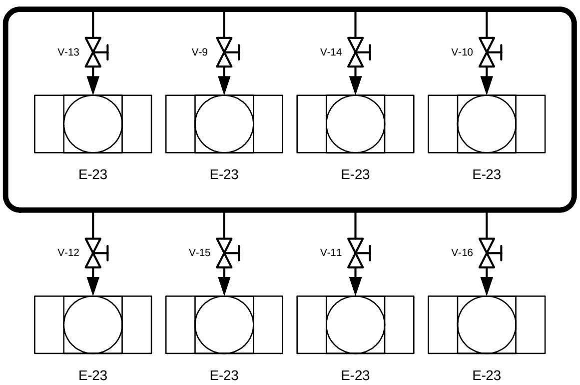

Figure 3. Compressed residue turbo sections

In Figure 1, raspers machines include two 100 HP and two 180 HP induction motors. Raw cassava is fed into the rasper via screw feeder. Then, the milled cassava output is processed in the horizontal turbo and compressed residue turbo sections respectively as Figures 2 and 3. All machines are operated by electric energy source. The physical installation of those three machines sections are shown as Figure 4.



Figure 4. Three machine sections

3. METHODOLOGY

The rational behind of energy reduction is the operation of process could be skipped in some machine since that is not operated at full load. However, which machine should be shut down that is not affected to the output will be concerned. Percentage of electric motor operation might be one criterion for this consideration.

Electric power energized to all machines will be measured. Then, the operation criterion is considered to compromise with output process. The high energy consumption is in rasper section. Measured power consumption and estimated full load consumption are shown in table 1.

Table 1. Miller power consumption

Miller Motor	Estimated input power	Measured input power	Percentage of operation
100 HP	87.76 kW	52.50 kW	59.82%
180 HP	157.98 kW	118.30 kW	74.88%
100 HP	87.76 kW	51.32 kW	58.48%
180 HP	157.98 kW	113.54 kW	71.87%
Total 560 HP	491.48 kW	335.66 kW	68.39%

In Table 1, the input power of miller motor is estimated at 85% efficiency. Total power consumption is only 68.39% of designed miller motors. Thus, the 155.82 kW (491.48 – 335.66 kW) is higher than the real operation point. Then, the third (100 HP) motor is considered for shutting down with is not affected to the output. However, both 100 HP motors can alternative shut down.

For horizontal turbo section, the power consumptions are also measured as following lists.

$$W_{Turbo} = \left[W_{T1} + W_{T2} + W_{T3} + W_{T4} + W_{T5} + W_{T6} + W_{T7} + W_{T8}\right]$$
$$W_{Turbo} = \left[12.36 + 15.4 + 14.3 + 12.67 + 8.3 + 4.43 + 7.02 + 8.85\right]$$
$$W_{Turbo} = 83.33 \text{ kW}$$

In the last section, the compressed residue turbo consumes the power as following lists.

$$W_{TurboC} = \left[W_{TC1} + W_{TC2} + W_{TC3} + W_{TC4}\right]$$
$$W_{TurboC} = \left[10.32 + 11.33 + 13.25 + 11.44\right]$$
$$W_{TurboC} = 46.34 \text{ kW}$$

From all three sections, the total power is consumed at:

$$W_1 = W_{Rasper} + W_{Turbo} + W_{TurboC} = 465.33$$

By experiment and percentage of operation criterion, overall process machines are considered to shut down in some machines as Figures 5-7.

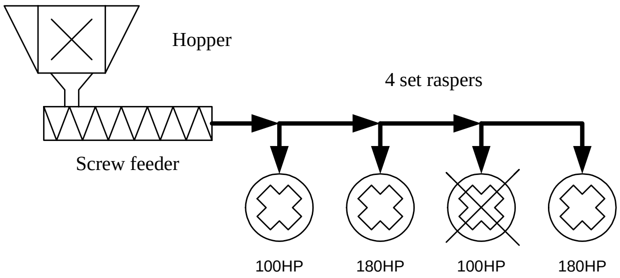

Figure 5. Shutting down for miller machines

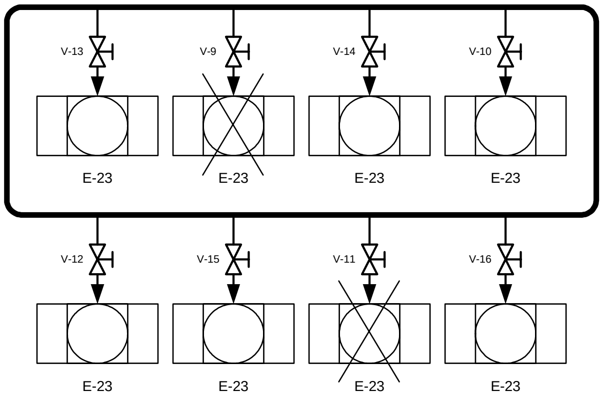

Figure 6. Shutting down for horizontal turbo section

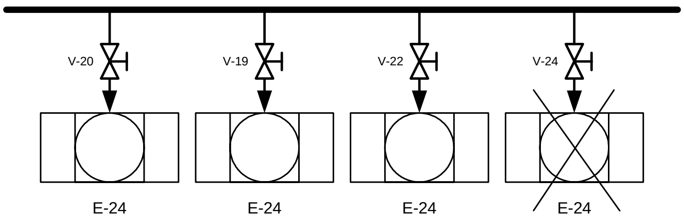

Figure 7. Shutting down for compressed residue turbo section

After machines shutting down, the process of cassava powder production is still efficiently satisfied by operator as in Figure 8. Then, the total power consumed in all three machine sections are measured as:

$$W_2 = W_{Rasper} + W_{Turbo} + W_{TurboC} = 382.05\ \text{kW}$$

Therefore, the power savings is as:

$$W_{Save} = W_1 - W_2 = 465.33\text{-}382.05 = 83.28\ \text{kW}$$

At 80% load factor (LF), the energy savings in one year is as follow:

$$\begin{aligned}\text{kWh} &= W_{Save} \times \text{working hour} \times \text{working day} \times \text{LF}\\ &= 83.28 \times 24 \times 300 \times 0.8\\ &= 479{,}692.80 \text{ kWh/year}\end{aligned}$$

In crude oil function reduction (COR) is as:

$$\begin{aligned}\text{COR} &= 479{,}692.80 \times 85.21 / 1{,}000{,}000{,}000\\ &= 0.040875 \text{ ktoe}\end{aligned}$$

Thus, the energy cost savings (2.84 Baht per kWh) is 1,362,327.55 Baht per year.

Figure 8. Operator satisfactory checking and their checking list.

4. CONCLUSIONS

This paper introduces the simple implementation for energy cost savings in cassava powder industry. Measured power consumption is used for consideration to shut down the unnecessary machines. This implementation is not required the investment cost. The benefit is turned to both industry section and world energy consumed.

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