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EVALUATION OF THE KILOWATTS (KW) EENERGY CONSUMPTION FOR A MINI PALM OIL FACTORY OPERATION.

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ABSTRACT.
This paper presents the analysis of the electric energy consumption in a complete process of palm oil processing machine. The amount of energy used up at each stage was computed and the value of energy used was summed up for all the stages and this gives an indication of how much energy was used up for the effective running of a palm oil factory mill having electric energy operated palm oil processing machine. A 50 tons capacity palm oil mill located in Amendokhian community Esan North LGA was used as a case study. The result of this study showed that the total electricity consumption for production process at the study 50 tons capacity palm oil mill is 594.7 kW out of a generated amount of 600KW at the factory site using a gas thermal generator. This means that the factory needs about 85% of the total generated energy at the factory site.

Keywords: Boiler, Sterilizer, Thresher, Palm oil, efficiency, turbine, thermal energy, Slip

INTRODUCTION

Energy is the livewire of agricultural production and industries, the transportation of agricultural produce, processing, packaging, and storage/preservation of agricultural produce are all energy based [Bamgboye and Jekayifa, 2006]. Electric energy generation is brought about by conversion of chemical energy locked up diesel/gas (fuel) by use of diesel engine or gas turbine for thermal energy generation.

In Nigeria, the rising fuel cost and limitations in supply is affecting virtually every sector of the economy including the agricultural sector leading to rising cost foodstuffs and other agricultural products [Olawepo and Balogun, 2004]. There is a need to

estimate/evaluate the amount of energy consumed in the production process in order to optimize the available energy and reduce the cost of production.

To maintain economically sustainable level of palm oil production, the energy needed for factory operation of machinery must be cheap and readily available [Odigboh, 2009]. This can be achieved by employing a mini gas thermal generator close to the factory site. One way to determine energy planning policy to achieve energy optimization is energy analysis and evaluation. In this work, the analysis is based on computed energy value used in machine operation of factory equipment as a whole and this gives an indication of the extent to which the energy was used up per kg of output [Obetta, 2003].

MATERIAL AND METHODS

The following are the material components of the electromechanical device to produce electric energy for use in the palm oil mill.

Gas Turbine

Gas Turbine Electric Generator is a power plant which produces electric energy by thermal means. The fuel chemical energy is converted into electric energy by the turbine which is used to drive the palm oil mill. The gas turbine generator is preferred in the palm oil mill operation because it provides cheap energy for use by the palm oil mill. [Mijinyawa and Omoikhoje].

THE BOILER

The boiler is a sealed vessel which can contain large volume of water, heats them up at high pressure and temperature converting the water into a high pressure, high temperature superheated steam which steam can turn a steam turbine an action necessary to generate electric energy. The steam turbine function to convert the heat energy in the steam into mechanical energy and that turns the shaft which is coupled to the shaft of a synchronous generator shaft thereby spinning the generator. It is this generator that does the conversion of the mechanical energy of the rotating turbine shaft into electric energy at its output terminal.

Electric load such as an electric motor can now be connected to the generator output terminal through which the generated energy can be used to do work such as the operation of the palm oil processing mill.

The electric motor usually used is the induction motor which is an alternating current (ac) electric motor whose rotation of the rotor is not the same as the rotation of the rotating field on the stator, in other words, the rotation of the rotor with the rotation of the field on the stator is the difference in rotation called slip [Theraja and theraja, 2001]. The slip is commonly expressed as the percent of synchronous speed (%slip).

$$Slip = \frac{N_S - N_r}{N_S} \times 100\% \qquad \text{i}$$

Operation of induction motor is such that, power passing through the air gap is equal to the power input to the rotor. The total power introduced into the stator coil (Pin).

$$Slip = 3V_1 I_i cos\Phi \quad \text{ii}$$

Where, V=Voltage (Volt) , I = Current (Ampere), Cos Φ = .Power factor.
The efficiency of an induction motor in the form of electrical energy is the ratio of the output energy in watts to the input energy in watts.

$$\eta = \frac{P_{out}}{P_{in}} = \frac{P_{in} - P_{loss}}{P_{in} + P_{loss}} \quad \text{iii}$$

ANALYSIS OF THE ENERGY CONSUMPTION AT THE PALM OIL FACTORY

The thermal power plant generates 600 kW of electricity on site (i.e a location close to the palm oil mill station) which serves input to the palm oil processing mill. The observations on the control panel show the value of the current of 1200 A, the voltage 415 V, cosΦ 0.8, the supply frequency of 50 Hz. Upon computation of the electrical energy requirement for the considered oil palm factory, the total demand for electrical energy in all processing stations can be obtained.

Table 1: Energy consumed in kilowatts in the different stages of the factory operation.

S/N	**Processing stages/sections**	**Electrical energy consumed in (KW)**
1.	Sterilizer Stage	42.6
2.	Thresher Stage	51.4
3.	Pressing Stage	82.5
4.	Clarification Stage	88.2
5.	Seed and Pulp Stage	215.7
6.	Boiler Stage	114.3
	Total	594.7

The total electrical energy usage for the production process is 594.7 kW. When compared with power generated by the side of 700 kW then the total level of electrical energy needs reached 85% of the total electrical energy generated. Power/energy failure which affects the operation of the factory can be caused by many factors including overloaded machine, poor maintenance culture, damage to machinery and equipment, etc. There are other uses of the generated electrical energy in the factory such as street lighting, office electricity, maintenance workshop and lighting inside the factory itself. This also accounts for the total energy consumption in the factory.

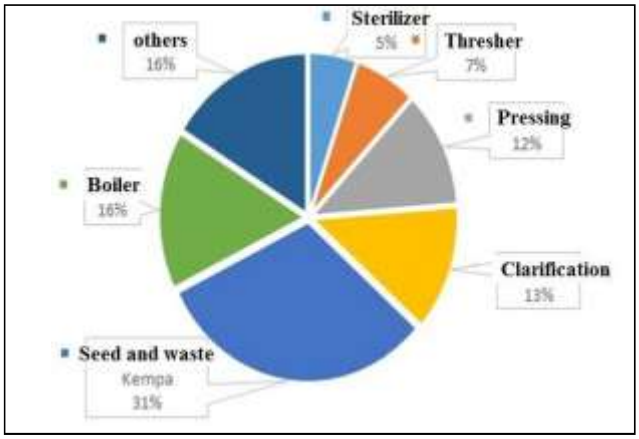

Figure 1: The percentage share of the total electric energy consumption in the different stages of the factory operation.

CONCLUSION

The overall use of electrical energy in the process of producing palm oil reached 594.7 kW. When compared to the power generated by the side of the plant that is equal to 700 kW, the factory needs about 85 % of the generated energy for the factory to run effectively and continuously.

The efficiency of the electric energy use in the production process in the factory for crude palm oil production is improved by considering the workload of the motor so that the motor works in accordance with its production capacity. The highest power consumption stage is found in seeding and pulp stage while the lowest power consumption stage is found in the sterilizer stage.

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