Firewood energy utilization in different dryers used in Tea processing

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Introduction

Tea industry is one of the most key important drives in Sri Lankan economy. Sri Lanka Sustainable Energy Authority is one of the important government institutions for energy management and enhancing awareness and creating technical capacity on energy conservation in Sri Lanka. Tea industry utilizes both electrical and thermal energy for its processing. The tea factories predominantly use fuel wood to meet their thermal energy needs, in the drying process, which is the major transformation process in the tea industry. The lack of researchers on the energy utilization of different dryers used in Sri Lankan tea industry and different types of dryers are used depending on the production capacity of the tea factory.

The objectives of the research are to find out firewood energy utilization of different dryers and performance of different dryers in Sri Lanka.

Materials and methodology

The research was carried out to Sustainable Energy Authority during the period from April to August 2014. Specific thermal energy utilization (MJ/kg) was used to measure the level of firewood consumption for dryers and it was tested for different dryers, location and combustion technology. Two factor factorial design was implemented as the experimental design where dryer type and combustion technology were taken in to consideration .There are three types of dryer commonly used in tea drying such as, conventional endless chain pressure type dryer (ECP), Fluidized bed drier (FBD), and combination drier which works on a combination of ECP and FBD principles .There are two types of combustion technologies used for tea drying such as, Boilers and furnace. Primary data were collected from factory officers by providing the structural questionnaires. Secondary data were also collected from the annual reports of Sri Lanka Sustainable Energy Authority and factory reports of different tea factories. Collected sample was surveyed based on the factory records during 2012 to 2013 to gather necessary information. Factory observations were also was carried out to confirm the accuracy of data that were collected by the interviews of factory officers and Factory managers.

Minitab 16 Statistical Software was used for both descriptive and interferential statistics. ANOVA General linear model was used to analyze the variance of dryer output in relation to dryer types and combustion technology. Collected data were analyzed using descriptive statistical methods. Descriptive statistics were graphical explained with using of Microsoft Excel and Minitab software. Pearson correlation was used to determine the association of consumption of firewood and total production. The relationship of firewood consumption and total production were analyzed by using simple regression technique.

Results and Discussion

According to descriptive statistics, firewood Energy Source was highly used in tea processing. The result revealed that, 19% firewood and saw dust, 8% firewood and furnace oil, only 3% of firewood

and coconut shell was also used. Jungle wood was highly used in tea processing. The results showed that 36% rubber firewood and only 19% rubber and jungle wood were also reported.

The low country and mid country tea factories use only firewood and saw dust. But up country tea factories use different types of energy sources. Up country tea factories mainly use Fluidized Bed dryers and mid country and low country highly use Endless Chain Pressure dryers. Low country and up country mainly trended in small scale production and mid country highly trended in large scale production. In mid country, it is available large, medium and low price firewood. But in up country and low country, it is available only large and medium price fire wood.

The Endless Chain Pressure dryer was the highly used dryer type.it was revealed that, 28% of Fluidized Bed dryers and only 25% of combination dryers were also used in tea processing. Endless Chain Pressure dryers had the dryer capacity of 180-280 kg/hr, Fluidized Bed dryers had 280-500 kg/hr and Combination dryers had 250-450 kg/hr capacity. Endless Chain pressure Dryers are easy to be maintained than others. Endless Chain Pressure dryers were mainly used in small scale production, Fluidized Bed dryer and Combination dryers were highly used in large scale production in tea factories.

The furnace combustion technology was highly used in tea processing. 61% furnace and only 39 % of boilers were reported. Majority of tea factories in small scale production use furnace and tea factories in large scale production use boilers. Majority of low country and mid country tea factories use furnaces and up country tea factories use boilers and prominently Endless Chain Pressure dryers utilize the energy of furnace and Fluidized Bed dryers use the energy of boilers.

When consider the Regression output, P value 0.000 of the model suggests that at 5% significant level, firewood consumption is significant in relation to the dryer made tea production. R – Square was recorded as 49.3 % and it implies that 49.3% of the firewood consumption is explained by the made tea while the 50.7% is explained by unexplained variables.

Table1: Firewood Energy Utilization of Different Dryers and Combustion Technology.

Dependent Variables	Independent Variables	P Value
Firewood Energy Utilization	Dryer types	0.078
	Combustion Technology	0.398
	Dryer types*Combustion technology	0.209

According to ANOVA Analysis, P value > 0.05, there is no significant different of dryers firewood energy utilization mean. So there is no effect of dryer types and combustion technology for dryer firewood dryer firewood energy utilization.

Conclusion

The outcome of the study revealed that, about 70% of firewood and 44.4% jungle wood are mainly used for the dryers used in the thermal energy. Majority of the studied tea factories use Endless Chain Pressure dryers (47%) and the furnace combustion technology (61%).

Endless Chain Pressure dryers are mainly used in small scale production and Fluidized Bed dryer and the Combination dryers are highly used in large scale production. The low country and up country factories function towards a small scale production and while the mid country factories towards a large scale production. Majority of small scale production tea factories use furnace and large scale production tea factories use boilers.

The types of the dryers and the combustion technology do not affect significantly for the firewood energy utilization.

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