Factors affecting the level of effectiveness of dryers used in Sri Lankan tea manufacturing

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Introduction

Tea production is basically a drying process of freshly harvested green tea leaves, reducing its moisture content from about 75-83% down to 3%. In black tea manufacturing tea undergoes mainly withering, rolling, fermenting, drying, grading and packaging processing steps. Sri Lanka mainly produces tea by the Orthodox technology. Drying is the most expensive process in the manufacture of tea (http://www.biriz.biz/cay/TeaSector2002). The capital investment on dryers is also the highest among the different processing machines. There are three different types of tea dryers up to now namely ECP (Endless Chain Pressure), FBD (Fluidized Bed Dryer) and combination dryers. ECP dryer has been used in tea industry since 1907 and fluidized bed dryer was first developed for tea in Sri Lanka in 1974 (Temple S.J., 2000). Tea dryers have its defined output as rated output. But normally dryer machines give lower output (actual output) than rated output. There may be several reasons affecting for dryer output deviation from rated output. Ultimately this would lead to poor production and high cost of production to the tea factories.

Main objective is to find out the factors affecting for deviation of actual dryer output from rated dryer output in different types of tea dryers.

Materials and Methodology

Effectiveness of three types of tea dryers was taken as dependent variable. Effectiveness of tea dryers can be measured as the ratio between actual output and rated output. It will be finally taken as a percentage value.

As independent variables four factors have been selected as moisture content of withered leaves (wither percentage %), age of three types of dryers (Years), moisture of firewood used for drying (firewood moisture) and dhool percentage taken after roll breaking process (first, second and third dhool percentage).

The sampling frame was 37 tea dryers representing three manufacturing regions in Sri Lanka (Up country, Mid country and Low country). There were 17 ECP dryers, 15 FBD dryers and 5 combination dryers in the sample. The data were collected for recent three months time period and average values were taken finally. For the analysis descriptive, correlation and simple linear regression was used.

Results and Discussion

According to descriptive statistics mean effectiveness of ECP, FBD and combination dryers were 85.88%, 89.83%, 91.53% respectively.

Table 1: Descriptive statistics Results of Effectiveness of Tea Dryers

Dimension	Dryer Type	Mean	Minimum	Maximum
Effectiveness	ECP	85.88	72.73	93.33
	FBD	89.83	83.64	97.22
	Combination	91.53	83.33	96.15

Table 2: Pearson Correlation Results

Dryer Type	Factors	Correlation Coefficient	Status of Correlation
ECP Dryer	Wither Percentage	-0.957	Strong Negative
	Age of the Dryer	-0.992	Strong Negative
	Firewood Moisture	-0.967	Strong Negative
	Dhool Percentage	0.955	Strong Positive
FBD Dryer	Wither Percentage	-0.862	Strong Negative
	Age of the Dryer	-0.977	Strong Negative
	Firewood Moisture	-0.957	Strong Negative
	Dhool Percentage	0.912	Strong Positive
Combination Dryer	Wither Percentage	-0.946	Strong Negative
	Age of the Dryer	-0.969	Strong Negative
	Firewood Moisture	-0.971	Strong Negative
	Dhool Percentage	0.960	Strong Positive

Correlation results showed that wither percentage, Age of the dryer and Firewood moisture has strong negative relationship while dhool percentage has strong positive relationship for the level of effectiveness of three different types of dryers. The correlation results further support to run the regression.

Simple Linear Regression Model resulted following results.

Dryer Type	Factors	R-sq value	P-value
ECP Dryer	Wither Percentage	91.6%	0.000**
	Age of the Dryer	98.3%	0.000**
	Firewood Moisture	93.6%	0.000**
	Dhool Percentage	91.3%	0.000**
FBD Dryer	Wither Percentage	74.3%	0.000**
	Age of the Dryer	95.4%	0.000**
	Firewood Moisture	91.6%	0.000**
	Dhool Percentage	83.1%	0.000**
Combination Dryer	Wither Percentage	89.6%	0.015**
	Age of the Dryer	93.8%	0.007**
	Firewood Moisture	94.3%	0.006**
	Dhool Percentage	92.2%	0.009**
**significant at 0.05			

All the four factors has been affected for the level of effectiveness of three dryers because of simple linear regression model significant at 0.05.

Conclusion

Level of effectiveness of three different types of tea dryers were affected by wither percentage of tea leaves used for drying, age of the dryers, firewood moisture and dhool percentage. Effectiveness of dryers were decreased with increasing of wither percentage, age of the dryers and firewood moisture while increased with increasing dhool percentage. Further research could be done by increasing sample size to overall Sri Lanka and finding more factors which will affect for deviation of dryer output than rated output.

References

Temple, S.J. (2000). Control of fluidized bed tea drying, PhD thesis, Wageningen University, Netherland. ., Pp 128-145

http://www.biriz.biz/cay/TeaSector2002.pdf [Accessed on 25 April 2014]