

Application of Cleaner Production Techniques in Tea Processing

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Introduction

Tea is the world's most popular beverage (Anonymous, 1993). Sri Lanka is a world famous tea producer, well known for its inherited taste and aroma and it is the world's fourth largest producer of tea and the industry is one of the country's main sources of earning foreign exchange with tea accounting for 1.5% of the GDP, generating roughly \$700 million annually (Dissanayake, 2008). However, during last few decades, the sustainable growth of Sri Lankan tea industry had to face challenges (Jayakodi and Athauda, 2009). In today's dynamic and turbulent environment, industry survival and growth depends on appropriate technology integration and changing management practices. It was identified that the Sri Lankan tea industry with a history of over a century is facing global challenges requiring certain changes to the technology, work practices, work norms and attitudes to overcome problems faced at present (Senarathne *et al.*, 2004). Sri Lanka's COP has been recording steady increases and is now around US\$ 1.75 per kg, which is well above that of Bangladesh, India, Kenya and Vietnam. Possible ways of enhancing profitability are to fetch attractive prices for their produce, increase their productivity level and to reduce the COP (Yogaratnam, 2007). To address these issues, reduction of wastage and increasing resource efficiency using cleaner production techniques will be possible. Cleaner production is the continuous application of an integrated preventive strategy to processes, products and services, to increase eco-efficiency and to reduce risks to humans and the environment. Cleaner production concept was first introduced by United Nations Environmental Program (UNEP) in 1989 as a new innovative approach to resource conservation and environment management (Jayakodi and Athauda, 2009). Cleaner production techniques are important in reducing wastage. Therefore this preliminary study is focused on cleaner Production audit in tea processing giving special reference to Telbedde Estate.

Methodology

Initially walk through study was done. The first phase was to attain the top management commitment. Cleaner production team was developed with 7 members from the organization. During initial gatherings the concept of cleaner production was delivered and their responsibilities for this assessment were demonstrated. Pre-assessment was done to establish a focus. The production process was observed and analyzed in detail. Process flow diagram was drawn describing all the material waste streams at the originating point. Data collection was done for forty – two days of sample period of time. During this period, data were collected on the quantities of consumed resources and generated material wastes for each processing step. The quantities of input resources, output products and material wastes for each major process were daily measured. Material balance was done to quantify previously unknown losses, and to provide an indication of their sources and causes. Quantified data were then analyzed using Minitab Software and the data was interpreted. Causes of these waste streams were identified and possible CP options were generated. The quantified material waste streams were converted in to their monetary values to estimate the

money loss due to these waste streams. Two types of monetary losses for each waste stream were calculated. They were the amount of money spent to deliver these wastes through the process and amount of money lost, account for the gain from the made tea from these wastes. The monetary losses of each waste stream were expressed in terms of monthly and annual losses.

The monetary losses of each process were calculated using equation 01.

Equation 1: Monetary Loss of one waste stream during sampling period

$$MW = \sum_{i=1}^{42} \left[\sum_{j=1}^n x_j a_j + x_n b_n \right]$$

Where;

Total monetary loss for one waste stream during the sampling period is *MW*, the quantity of waste in *nth* step is *x_n*, the cost of production of *jth* step is *a_j*, and the amount of made tea that can be produced by processing *x_j* kilograms of tea in the *jth* processing step is *b_n*.

The significance of monetary losses of each waste stream was evaluated using Pareto analysis. Then the future trends of monetary losses of each waste stream were forecasted by ARIMA model using SAS software.

Results and Discussion

During the walk through analysis several material waste streams were identified using process flow diagram. Identified waste streams and their calculated monetary values are shown in table 01. This calculation has ignored the unavoidable wastes and unknown wastes.

Table 1: Identified waste streams and their monetary value

Processing step	Waste stream	Monetary loss on Monthly	Monitory loss on Annual	Average Wastage %
Transportation	Field Loss	321509.30	3858111.0	9.11
Withering	Spills	79979.29	959751.4	2.26
Rolling	Spills	39301.31	471615.7	1.11
Fermentation	Spills	21545.56	258546.7	0.61
Drying	Blow out	794406.00	9532872.0	22.51
	Spills	636835.30	7642023.0	18.05
Sifting	Spills	147493.10	1769917.0	4.18
	Refuse	1334547.00	16014565.0	37.82
Packaging	Spills	152427.40	1829129.0	4.32

The Pareto analysis resulted that the Refuse tea, Dryer Blowout and Drying spills significantly contributed the monetary losses (Figure 01).

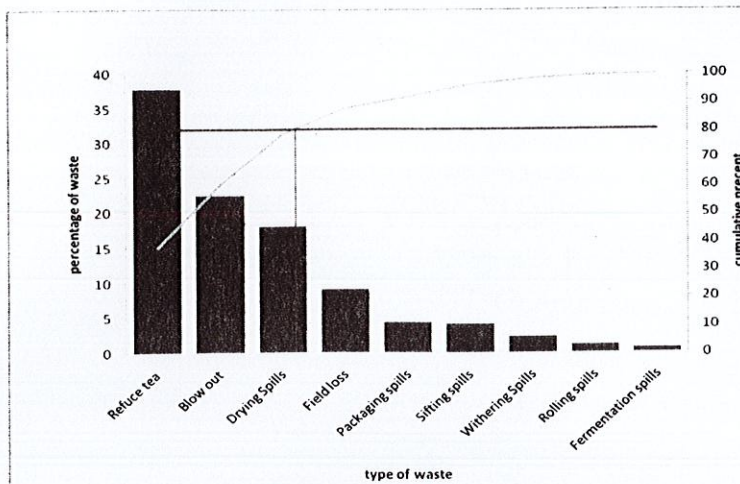


Figure 1: The Pareto diagram for monetary values of waste streams

According to the forecast done using ARIMA model, the future trends of material wastages are either decreasing or remain in constant. The Rolling Spills, Fermentation Spills and Packaging Spills were forecasted to be constant in future. In addition, all the other material waste streams were predicted to be decreased in the future.

Conclusion

The study has shown that the annual money loss from avoidable wastes is Rs. 42,336,530.70 (excluding material loss due to evaporation). The highest waste stream is refuse tea (37.82%) and drier blowout and drier spills have relatively higher losses (22.51%, 18.05%). According to the forecast done the Rolling Spills, Fermentation Spills and Packaging Spills were forecasted to be constant and all the other material waste streams were predicted to be decreased in the future.

Forecast demonstrated a decreasing pattern which proves that making aware of people regarding wastes itself will reduce the wastage. Organizations run with low profits or losses, as in the case of Telbedde estate where losses were obtained in both July and August, implementation of Cleaner Production will increase the profit by reducing the material and energy cost of wasting.

References

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