



TEA RESEARCH INSTITUTE OF SRI LANKA

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GUIDELINES TOWARDS SAVING ELECTRICAL ENERGY IN WITHERING

Electrical energy is required for withering, rolling, roll breaking and drying in black tea processing. Electricity consumption in fermenting, sorting and packing operations is rather low. The bulk of electricity consumption is thus seen to take place in the unit operation of withering.

The energy consumption in typical up/mid and low-country factories derived by analysis of historical data and by actual measurements during energy audits is given in Table 1.

Table 1: Energy Consumption in Factories at Different Elevation Zones

	Up/Mid Country		Low-Country	
	kWh/kg of made tea	%	kWh/kg of Made tea	%
Withering	0.46	48.9	0.46	61.3
Rolling	0.20	21.3	0.10	13.3
Drying	0.07	7.4	0.07	9.3
Sorting & Packing	0.09	9.6	0.07	9.3
Ancillaries	0.12	12.8	0.05	6.7
Total	0.94	100	0.75	100

Studies carried out by the Tea Research Institute have indicated that more than 50% of the moisture removal takes place during the first four hours of withering. Results have shown that the airflow rate required for withering process could be regulated according to the rate of moisture removal, without affecting the final quality of tea produced.

Airflow of the withering fan can be controlled by outlet dampers, inlet guide vanes or by adjusting the motor speed. Of these different flow control methods, the most efficient is the method that employs a variable motor speed control system. The power requirement of the fan is proportional to the cube of the speed, whilst the flow reduces linearly and pressure reduces as the square of the speed reduction.

Results also showed that up to 40% of electricity consumption could be saved during withering by proper control of airflow by installing variable speed controllers.

About 0.46 kWh of electricity is used in withering, to produce one kg of made tea. However, when speed controllers are used, about 0.184 kWh/kg made tea ($0.46 \times 40/100$) could be saved. At the present tariff rates of Rs 8.52 per kWh, the saving would be about Rs 1.57 per kg of made tea. Therefore, if all the factories in Sri Lanka use speed controllers in all their troughs, the saving would be in the region of Rs 300 - 450 million.

The cost-benefit analysis of the investment is given below:

Assumptions:

Production : 500,000 kg made tea per year
Green leaf intake : 7500 kg/day¹
Troughs needed : 8, Loading rate 1500 kg green leaf/100' trough
Electricity consumption in withering: 0.46kWh/kg MT
Saving on a kg made tea : $0.46 \times 40/100 = 0.184$ kWh or Rs 1.57 (0.184 x 8.52)
Cost of 8 speed controllers 8 x Rs 1,20,000/= - Rs 960,000/=

The payback period on such investments will be as follows:

The cost quoted below includes the harmonic filters as well.

If the capital investment is Rs 960,000/= - Payback will be in 1 year and 3 months

If the capital investment is Rs 1,200,000/= - Payback will be in 1 year and 7 months

If the capital investment is Rs 1,440,000/= - Payback will be in 2 years.

Since there is a wide fluctuation in the price of speed controllers, the investment may vary from Rs 960,000/= to Rs 1,440,000/=

Caution: The installation of speed controllers could cause harmonics in the power supply and therefore they should be always coupled to harmonic filters. This will protect the machinery and power factor capacitors/capacitor banks installed in local factories.

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¹ In a factory with an annual capacity of 2,250,000 kg green leaf working 300 days per year @ 22.22% of outturn of made tea/green leaf.