PROPER FLOW CONTROL STRATEGY FOR TEA WITHERING PROCESS

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Department of Chemical Engineering

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DECLARATION

I hereby declare this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

In this research project the tea withering process, which accounts for the bulk of electricity consumption in tea manufacturing was investigated. The main objective of the project was to develop a proper flow control strategy for the withering process to conserve energy. The other objective was to devise a method to select a suitable axial flow fan to optimize energy utilization. With the present design of withering troughs, process parameters such as temperature and relative humidity could not be precisely controlled. Due to this, empirical approach involving multiple tests was used to derive the relationship between the drying rate and other major parameters. Air flow rate, temperature and relative humidity of inlet air, pressure inside the trough, and energy consumption of the fans were the measured parameters. Several fans with different make and different operating conditions were studied during the experimental testing.

The results of the study reveal that during the first few hours (around 4 hours) the drying rate was dependent upon both the flow rate and the wet and dry bulb temperature difference. But in the latter hours, drying rate is mainly dependant on wet and dry bulb temperature difference. Therefore, it was concluded that best flow schedule is that the fan runs at full speed at the first 4-5 hours and then the speed is lowered in such a way that the pressure inside the trough does not go below 75 Pa, the recommended minimum pressure. When this flow schedule was coupled with other factors, such as the quality of tea deteriorating due to long withers, uneven withering, and variation of crop, it was revealed that conventional fans, which are usually over-designed with higher pressure and flow rate capacities, when operated with variable speed drives with the developed flow schedule, can be more effective than the fans recently introduced to the industry. Further research work on thick bed drying is needed to confirm the results. It is recommended to construct a test rig which can regulate the parameters such as flow rate, humidity and temperature and can record the test parameters real time, and hence derive an accurate drying rate equation for tea withering process.

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LIST OF ABBREVIATIONS

Abbreviation	Description
SLSEA	Sri Lanka Sustainable Energy Authority
TOE	Tons of Oil Equivalents
TRI	Tea Research Institute
VSD	Variable Speed Drive

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