

Abstract:

The frequent and instantaneous changes of atmospheric and weather conditions on a typical day, significantly influences ambient air that is heated and used for drying prepared wet tea leaf (dhool) in a dryer. Its frequent and instantaneous variable state affects its drying capacity and the quality of the final tea. The current tea dryers have gaps which require improvement to enable further control of key air parameters important for tea drying. The parameters includes, plenum chamber pressure, dry and wet bulb temperatures and airflow rate among others all of which are affected by changes in the atmospheric and weather conditions. In this project, a pilot batch pulse vibro-fluidized bed tea dryer was designed, fabricated and tested for its capacity to study control of the above selected ambient air variables on the quality of tea. It involved design and fabrication of vibration mechanism, air supply system and selection of specified instruments for automatic control of the said parameters. A. computer aided manufacturing (CA.M) mode was utilized, in which a closed-loop feedback system. Comprising of a computer software in conjunction with a with a programmable logic controller (PLC) , sensors and actuators were used to control and provide desired conditions of the drying air variables. The controlled conditions, simulated typical example of variable weather conditions that exist in tea drying locations. To validate the performance of the dryer, experimental values of k (constant of geometrical coefficient of resistance to airflow through the bedplate) for two bedplates of different % free areas (0) were determined and compared. The results indicated bed plate with % free area of 5.4% had a higher k value of 0.7030 while bedplate with % free area of 5.94% had k value of 0.3968, meaning that bedplate with higher k value is more resistant to air flow than bed plate with lower k value which is theoretically true. Other experiments on drying characteristics of the dryer, incorporated instruments were tested for their capacity to control the air variable conditions. Dhool samples of 5 kg at various moisture contents were dried for ten minutes with the key ambient air parameters controlled to attain the final moisture content of 3%. Experiments on the relationships of dhool moisture content against time, exhaust temperature against time, dhool moisture loss against time and rate of dhool moisture loss against remaining dhool moisture content in dhool were carried out. Graphical analysis of all the relationships gave results that were consistent with theoretical relationships of drying. The dryer was therefore capable of controlling the environmental variables during tea drying to improve its final quality. The assembled dryer whose photographs are herein provided, was used to carry out experiments and study the quality of tea dried at different ambient air parameters in different environmental conditions. Having proved its objective was commissioned for use.