SIMULATION OF CHARACTERISTIC HEAT AND
MASS TRANSFER OF PAPER WEB DRYING
AT DRYER SECTION

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ABSTRACT

Paper grade can be used if water content less than 0.1 kg water/kg finished paper. There is no practical method to reduce the water content below the level 1 kg/kg finished paper except by drying process. By drying it is possible to remove all the water from paper web to certain level of moisture content. In drying a paper web at dryer section two basic processes are involved, heat and mass transfer. Heat is transferred from steam inside cylinder dryer to paper web in order to provide the energy required to evaporate water from it surface. The moisture evaporate and is then transferred from the paper web to the surrounding atmosphere by mass transfer process.

In this study a model for paper web drying at dryer section of paper machine was developed based on heat and mass balances around drying cycles. Temperature increase in paper web is modeled with heat transfer. Based on the temperature change of paper web, the evaporated residual water of paper web can be computed via mass transfer analysis. In this simulation, dryer section consists of 53 heated cylinders and 2 uno-rolls divided into 5 group in pre-dryer and after-dryer. The kind of paper web is copy paper with bone-dry weight 60, 70, and 80 gsm, machine speed is 900, 1000, and 1100 m/min. Relationships for heat transfer coefficients between paper web and the air as well as between dryer cylinder dan paper web were extracted from the closed-loop plant operation data. In this research can be shown that heat transfer coefficient could be represented effectively in terms of water content, basis weight, and machine velocity in one dimensional model. The solution for two dimensional model is computed with numerical methods by finite difference method (FDM).

The result of modelling paper drying at dryer section show that evaporation rate of residual water from the paper web increase with increasingly machine speed and will decrease with increasingly bone-dry weight of paper web and air humidity in the ventilation hood. This simulation describes some physical phenomena simultaneously and gives crucial information of the dryer section, thus helping paper manufacturers optimize dryer section configurations.

Key words: paper web, heat and mass transfer, heat transfer coefficient, bone-dry weight, dryer section