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Prediction Method for Winding Parameters in Label Converting Process with Data Mining Tools

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Abstract

This paper describes how developed models of data mining tools can be used for the prediction of initial tension parameters and winding speed for each new design of shrink sleeve labels. The aim of this paper is to choose significant factors and build a model in the learning process using the collected data. The model can be used for prediction of key winding parameters of each new design of a shrink sleeve label. This saves time for experimental selection during the conversion of winding parameters and minimizes the risk of occurrence of defects with incorrect winding parameters.

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1. Shrink sleeve labels

In many references and online resources different definitions of shrink sleeve labels exist, as for example in: [4–8], but for the purposes of implementing this article the following definition was established as below: Shrink sleeve labels are manufactured by printing on the plastic film followed by seaming the printed film into a sleeve, which under the influence of a determined temperature for a given material, shrinks and clings onto the target surface.

Shrink sleeve labels are produced using flexographic printing technology, more specifically it is a rotary printing method that uses a flexible printing form to compensate for the surface irregularities of the substrate. Ink is transferred from the inkpot onto the flexible printing form by anilox roller and from there directly onto the substrate. Labels printed with this technique are used to perform unstable mass production. The group includes, for example shrink sleeve labels [4].

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Shrink sleeve labels are made from many types of macromolecular materials, as listed below:

- PVC
- PET
- PET-G
- OPS
- PLA (polylactic acid)
- And other hybrid materials for specific applications.



Fig. 1. Shrink Sleeve Labels.
Source: [12].

These type of labels are applicable in many specific applications, mainly in FMCG brand – Fast Moving Consumer Goods, where shrink sleeve labels are applied in many of products like: milks, yoghurts, alcohols, juices, tea or coffee, and in house held chemicals [5, 12], (Fig. 1).

2. Introduction to winding quality issue

Main steps in the shrink sleeve label production process are divided into four stages which result in a finished product of a wound roll of shrink sleeves. These stages are: printing, slitting, seaming and inspection. The common feature of the steps mentioned in the production process is the winding from a roll to roll (R2R), which is typical for flexographic printing process [7, 8]. A schematic diagram of a roll to roll production is shown below (Fig. 2).

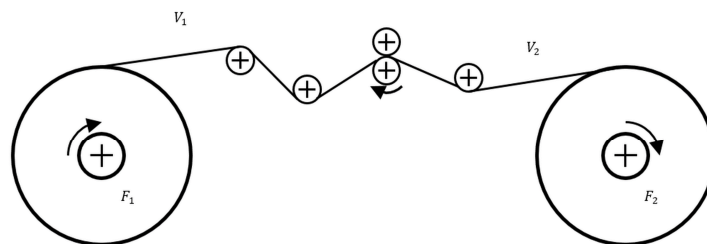


Fig. 2. Schematic diagram of R2R converting process.

The winding and beam quality of the rolls at every stage of the process are essential to achieve the optimal quality of shrink sleeve labels and roll to roll winding process without problems. In reference to quality, it should be noted that significant factors which influence the winding quality are initial tension parameters and winding speed, which

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