



Intelligent modeling of printability of liner paper coated with modified soda lignin

Omid Ghaffarzadeh¹ · Maryam Ataefard² · Sahab Hedjazi³ · Ali Abdulkhani⁴ · Mohammad J. Taherzadeh⁵

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Abstract

This research aimed to investigate the production of a sizing agent based on lignin extracted from the soda pulping black liquor. The crude lignin was subjected to chemical modifications, including sulfomethylation and amination, to improve its reactivity and to increase its solubility in water. Unmodified (crude), sulfomethylated, and aminated lignin were combined with starch and then applied on the surface of test liner papers. In this study, surface, mechanical, colorimetric, and printability properties were modeled via an innovative approach called the artificial intelligence method. The effect of ratios of crude lignin, sulfomethylated and aminated lignin, and even starch portion were investigated on the paper properties, i.e., tensile strength and ring crush test (RCT) as well as optical properties, i.e., L^* , a^* , and b^* indices and optical density and roughness of the treated handsheets by surface. The developed code can appropriately learn the non-linear behavior process and make decisions according to the pattern constructed intelligently. The paper treated with unmodified lignin exhibited an increase in the roughness value, according to the results. It was illustrated that applying a layer based on the unmodified lignin solution increased the tensile index. Also, it caused a relative increase in the tensile index of paper when a sizing solution based on sulfomethylated/aminated lignin was implemented. The value of the RCT for the paper treated with unmodified lignin and even the paper treated using the aminated lignin was as high as the treated paper just based on pure starch. There was no discernible variation in the colorimetric indices between papers treated with the black ink. The findings showed that the treatment containing pure starch had the lowest value of optical density, and the control treatment had the closest value to it. The data about alternative treatments showed that a paper treated with pure lignin without starch has the highest optical density.

Keywords Artificial neural network · Printability · Black liquor reuse · Liner test paper · Lignin · Flexography ink

✉ Maryam Ataefard
ataefard-m@icrc.ac.ir

✉ Sahab Hedjazi
shedjazi@gau.ac.ir

¹ Department of Natural Resources, Faculty of Agriculture and Natural Resources, University of Mohaghegh Ardabili, P.O. Box: 56199-13131, Ardabil, Iran

² Department of Printing Science and Technology, Institute for Color Science and Technology, P.O. Box: 16688-36471, Tehran, Iran

³ Department of Paper Science and Engineering, Faculty of Wood and Paper Engineering, Gorgan University of Agricultural Sciences and Natural Resources, P.O. Box: 49138-15739, Gorgan, Iran

⁴ Faculty of Natural Resource, Tehran University, P.O. Box: 31587- 77871, Karaj, Iran

⁵ Bioprocess Technology Department, University of Borås, P.O. Box: S-501 90, Borås, Sweden

1 Introduction

Enhancing the paper's relative resistance to absorbing liquids, such as water, is the main goal of paper sizing. The two types of treatment are internal treatment and surface treatment. In surface sizing, the sizing agent is added to the paper in the size press, but in internal sizing, it is added to the stock at the wet end section of the paper machine [1]. In modern surface sizing technologies, enhancing physical and mechanical properties of surface quality, particularly printability, may take precedence over water repellency in some situations [2]. Starch is the most common ingredient among the surface sizing materials. Not only the raw starch but also its derivatives, i.e., enzymatic, oxidized (anionic), and cationic varieties, are used in paper sizing. Despite starch's inherent sensitivity to water due to its structure, it could be destroyed by some biological agents. Furthermore,