Papermaking potential of poplar pulps reinforced with pine fibers

PIOTR PRZYBYSZ, KUCNER MARTA, DUBOWIK MARCIN, MAŁACHOWSKA EDYTA, BUZAŁA KAMILA
Institute of Papermaking and Printing, Technical University of Lodz, Poland

Abstract: The paper presents tensile properties of paper produced from mixture of poplar and pine cellulosic pulps. Pine cellulosic pulp was delivered by one of domestic paper mills and is mainly used for production of fine graphic paper. Poplar pulp was produced at Institute of Papermaking and Printing. The produced paper was thoroughly investigated and structural, tensile and optical properties were measured. This work presents just the most crucial properties like breaking length and tear resistance.

Keywords: poplar pulp, paper, refining, tensile properties

INTRODUCTION

Paper is a versatile material used in everyday life, industry and economy. Global production and consumption of paper products amount for 400 million metric tons and shows constant growing trend [1,2]. Apart from functionality and relatively low price, paper products belong to environmental friendly materials produced from fibrous crops, mainly wood, and secondary raw materials – recovered paper[3,4]. Recently, there is an emerging trend to apply fast growing plants as raw material for production of paper. One of the most promising are fast-growing poplar trees, which are expected to be used as hardwood feedstock and can be competitive to birch wood. There is many research done concerning this topic. Currently in Institute of Papermaking and Printing there is conducted project PBS1/A8/16/2013 which aim to apply pulps produced from fast-growing trees in paper production. The initial results suggested that due to very short fibers application of poplar pulps as standalone pulp is very difficult. Therefore, an attempt to produced paper from mixture of poplar and pine pulps were performed.

METHODS/ MATERIALS

The research material used in the work was bleached pine sulfate pulp in form of sheets of dryness equal to 93%. This was a commercially available pulp delivered by one of domestic paper mills. Generally, this pulp is used for production of high quality graphic paper. The next pulp was poplar pulps produced from two lines of poplar ie. Populus Maximowiczii and Populus Trichocarpa. Poplar timber from these lines was chopped into woodchips and then digested by sulphate method into pulp. The digestion conditions were as following: digestion temperature: 160°C, digestion time 2h, cooking liquor modulus 4, active alkali 26%. The obtained pulps were screened and undigested elements were removed.

Both of these pulps were then refined in PFI mill until freeness of 30°SR was obtained. For pine pulp refining time was 3 minutes for poplar pulps it was 1 minute. Suspensions of these pulps were prepared in separate mixing chambers and appropriate samples of each pulp were taken and poured into Rapid-Koethen class device so as to form laboratory hand sheets. Proportions of poplar to pine pulp were as following:

- 10:90
- 15:85
- 25:75
- 50:50
- 75:25
As reference paper produced from poplar and pine pulp was used. After performing test sheets, they were conditioned for 24 hours in standard conditions (23 ± 1°C and 50 ± 2% relative humidity). The wide range of paper properties were investigated such as: breaking length, tear resistance, roughness, air permeability, etc. Moreover pulp properties like water retention value, length, fines content, freeness were also made.

RESULTS

The following figures presents changes in breaking length and tear resistance of paper produced from mixtures of poplar and pine pulp.

![Graph](image)

Figure 1. Influence of addition of poplar pulp on breaking length of paper
As reference paper produced from poplar and pine pulp was used. After performing test sheets, they were conditioned for 24 hours in standard conditions (23 ± 1˚C and 50 ± 2% relative humidity). The wide range of paper properties were investigated such as: breaking length, tear resistance, roughness, air permeability, etc. Moreover pulp properties like water retention value, length, fines content, freeness were also made.

**RESULT**

The following figures presents changes in breaking length and tear resistance of paper produced from mixtures of poplar and pine pulp.

**CONCLUSIONS**

According to initial results, poplar pulps cannot be used as standalone stock for production of paper. It shows very high static tensile properties, however, dynamic tensile properties are unacceptably low.

There is no significant chance in breaking length for different additions of poplar pulp. In case of pulp produced from *Populus Maximowiczii*, breaking length of paper is even higher than for paper produced from pine pulp.

As far as tear resistance is concerned, addition of poplar pulp higher than 15% cause significant deterioration of dynamic tensile properties of paper. For both poplar pulps (from *Populus Trichocarpa* and *Populus Maximowiczii*), a great chance in tear resistance can be observed between addition of 15 and 25% of poplar pulp.

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**Streszczenie:** Zdolność papierotwórcza mas celulozowych topolowych z dodatkiem masy celulozowej sosnowej. Praca przedstawia właściwości wytrzymałościowe papieru otrzymanego z mieszanek mas celulozowych topolowej i sosnowej. Masa celulozowa sosnowa została dostarczona przez jeden z krajowych zakładów papierniczych i jest stosowana do produkcji papierów graficznych. Masa topolowa została wytworzona w Instytucie Papiernictwa i
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Corresponding author:

Piotr Przybysz
Wólczańska 223,
90-924, Lodz, Poland
email: piotrprzybysz@interia.pl