

## Poplar wood as a raw material for the paper industry in the twenty-first century

KAZIMIERZ PRZYBYSZ, PIOTR PRZYBYSZ

Institute of Papermaking and Printing, Technical University of Lodz

**Abstract:** *Poplar wood as a raw material for the paper industry in the twenty-first century.* Production of paper industry has been growing steadily since the beginning of twenty-first century. Worldwide, it reaches almost 400 million tons while in Poland, it is close to 5 million tons. Currently, the biggest obstacle for further development and increase in production, is to ensure continuous and stable supply of wood. In view of great difficulties in acquisition of wood, pulp and paper industry has taken steps to establish fast-growing tree plantations located in proximity to paper mills. In Poland, the largest poplar plantation was established, which according to the company that runs this project, is to be used both for energy and in the long term perspective for papermaking reasons. This article presents the characteristics of pulp obtained from poplar wood and examines the possibility of using this pulp as an additive in production of graphic and packaging papers.

*Keywords:* poplar, pulp, plantation, paper consumption,

### INTRODUCTION

Production of paper industry has been growing steadily since the beginning of the twenty first century. Worldwide, it reaches almost 400 million tons while in Poland, it is close to 5 million tons.

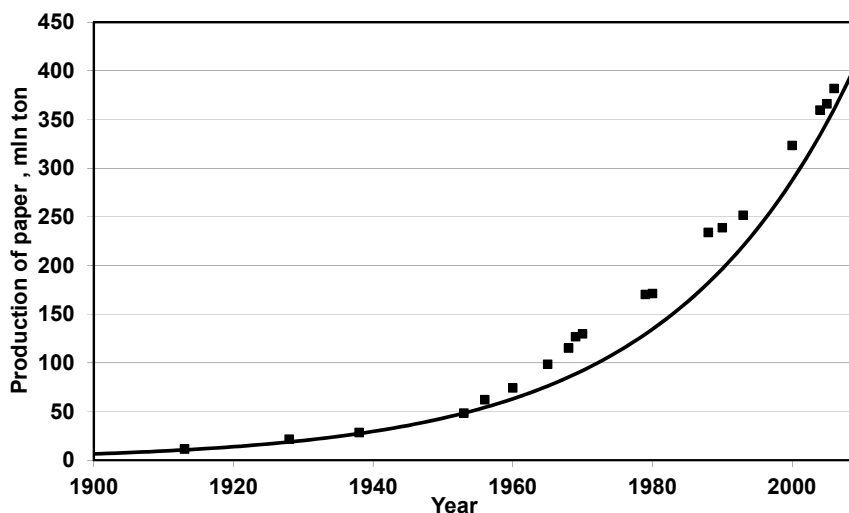


Figure 1. Development of production of paper in 20<sup>th</sup> and 21<sup>st</sup> century

Extremely high, and constantly growing global demand for raw materials and energy has caused decrease in available supply of these goods and has resulted in increase of its prices.

Since the nineteenth century wood has been a basic raw material for paper production. Globally, papermaking industry uses about 15% of total wood procurement. Dynamic increase in demand for paper products causes constantly growing requests for this raw material. The limited resources and growing deficit in availability of wood can be an important factor limiting development of paper industry.

In recent years, the global consumption of virgin pulps produced from wood stands at 180÷190 million tons, while in Poland it is about 1.1 million tons.

#### PLANTATION OF FAST-GROWING TREES

Papermaking sector, like other industrial sectors, according to current formal and legal standards follows sustainable development rules. These rules encourage and force the industry to diminish their influence on the environment. This concept of actions demands that the industry should economize use of primary raw materials and use of fossil fuels. The industry should also limit pollutants emissions into water and air as well as to minimization of the amount of solid waste should also take place.

Apart from factors unrelated to paper industry, the industry, together with forestry, in accordance with the principles of sustainable development is taking steps to expand its resource base. One of the directions of these activities is establishment of fast-growing tree plantations.

Particularly effective were tree plantations established in tropical countries based on the respective varieties of acacia and eucalyptus. The favorable climatic conditions and soil has enabled growth of eucalyptus in tropical countries that exceeds 25 m<sup>3</sup> per hectare annually, while growth of trees in temperate climate zone is only 7 ÷ 8 m<sup>3</sup>.

Possibility of obtaining such large quantities of plant material, resulted in construction of pulp plant next to plantations. Production capacity of these plants exceeds 300 thousand tons of pulp annually. Increase of mass of timber in plantation allows for continuous operation of collaborating pulp plant, as appropriate yield of raw material is wood is balanced with growth of timber.

It is estimated that about 30% of the total amount of primary paper pulp is produced from raw fibrous material from plantations.

Currently, plantations of fast-growing trees used for paper purposes are also established in temperate climate zone. In these plantations are mainly used appropriately selected varieties of poplars.

#### SITUATION IN POLAND

In Poland, at the turn of the sixties and seventies of the twentieth century it was a wide-range action of setting up poplar plantation for paper industry. As a result of mismatched variations of tree lines, these plantations were not resistant to pests and diseases in our climate zone. The whole action was a complete failure and for many years it has discouraged paper industry from use of poplar wood.

In recent years, taking as an example experience of other countries that have successfully established and operated suitable varieties of poplar plantations, attempts have been taken also in our country in this direction.

A pioneer in the development of new varieties of poplar for both papermaking and energy purposes is prof. Stanislaw Karpinski from the Warsaw University of Life Sciences.

On the initiative of prof. Karpinski scientific consortium WOODTECH has been founded. The consortium consists of Faculty of Horticulture Biotechnology and Landscape Architecture, Faculty of Wood Technology, both from Warsaw University of Life Sciences and Institute of Papermaking and Printing at Technical University of Lodz.

Nowadays, studies are under way to investigate possibility of using wood from new lines of poplar as a raw material for paper industry and for energy purposes.

At this stage of studies, determination of papermaking potential of poplar pulp is determined. Usefulness of wood material for paper industry was investigated by cooking wood chips in previously optimized conditions, and then performing an analysis of papermaking potential. This was done by refining pulp in a standard equipment - PFI mill.

Results for pulp and paper formed on Rapid-Koethen device according to PN-EN ISO 5269-2:2007 are presented in Table 1

**Tab. 1** Papermaking potential of pulp produced from poplar wood

<b>Refining time</b>	<b>Density, g/cm<sup>3</sup></b>	<b>Breaking length, m</b>	<b>Extensibility, %</b>	<b>Burst, kPa</b>	<b>Tear, mN</b>
0	0,517	750	1,64	35	220
0,5	0,695	4950	1,94	228	350
1	0,782	6900	2,56	357	300
1,5	0,824	7200	3,25	461	250
2	0,913	7800	4,03	466	220
2,5	0,979	9100	4,37	583	200
3	0,992	9700	3,51	565	180

Results concerning unpredictably high density and breaking length exceeding 8000m are of special interest. Unfortunately, due to the low fiber length, this paper has a very low tear resistance. These results indicate that the use of this pulp as a sole component of paper is limited.

However, these poplar pulp may be appropriate as binding component for other long fiber pulps and can be substitute of secondary pulps. The most promising application of these pulps is fluting - the primary component in corrugated cardboard.

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**Streszczenie:** *Topola jako surowiec drzewny dla przemysłu papierniczego w XXI wieku.* Produkcja przemysłu papierniczego rośnie nieprzerwanie od początku XXI wieku. W skali świata wynosi ona prawie 400 mln ton natomiast w Polsce zbliża się do 5 mln ton. Obecnie największą barierą dla rozwoju i dalszego zwiększania produkcji jest zapewnienie nieprzerwanych i stabilnych dostaw surowca drzewnego. W związku z dużymi trudnościami w pozysku drewna, przemysł papierniczy rozpoczął działania mające na celu stworzenie przykładowych plantacji drzew szybkorosnących. W Polsce powstała już największa w Europie plantacja topoli, która według zapowiedzi firmy, którą ją założyła, ma być przeznaczona zarówno na cele energetyczne jak i w dalszej perspektywie na cele papiernicze. W artykule tym przedstawiono charakterystykę masy celulozowej otrzymanej z drewna topoli oraz przeanalizowano możliwość wykorzystania tej masy jako dodatku do produkcji papierów graficznych bądź pakowych.

Corresponding author:

Kazimierz Przybysz  
ul. Wólczańska 223,  
90-924 Lodz, Poland  
e-mail: kazimierz.przybysz@p.lodz.pl