Annals of Warsaw University of Life Sciences - SGGW
Forestry and Wood Technology № 92, 2015: 92-95
(Ann. WULS - SGGW, For. and Wood Technol. 92, 2015)

Effect of refiner load on Bendtsen air permeability

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Abstract: *Effect of refiner load on Bendtsen air permeability*. The main aim of this paper is to compare the impact of refiner load, on Bendtsen air permeability of paper sheets. This article assesses changes of air permeability of paper sheets obtained from pulp refined at different intensity. Results show that refiner load plays an important role in refining process, since it affects both the energy consumption of this process and improve various properties of paper. All of results allowed to present significant impact of refining process to develop papermaking ability of refined pulp.

Keywords: refining, Bendtsen, air permeability, energy consumption, refiner load

INTRODUCTION

Refining of cellulosic pulps has a significant impact on almost all properties of paper. The omission of this important process during the production of paper, would make it virtually impossible to obtain paper, which is characterized by functional properties at acceptable level[1].

This is caused by the characteristics of the cellulose fibers used to produce pulp. Unrefined fibers are rigid and excessively long. The use of fibers which are characterized by such properties would result in obtain a paper which has loose structure, uneven transparency, and insufficient strength properties[2].

To enhance the usefulness of fibrous material for production of paper, which has satisfying functional properties, it must undergo suitable processing. Therefore pulps are subjected to the refining process. During the refining process fibrous material is mechanically treated in aqueous medium[2].

During the ongoing refining process structure of fibers is changed. Fibers after refining process become more flexible and pliable, they undergo shortening and they become source of fines[3].

As a result of obtained changes in refined pulp, the changes also occur in paper properties. Paper obtained from refined pulp is characterized by improved static strength properties, more compact and homogenous structure, and also more even transparency.

Therefore the main purpose of refining process is create optimal conditions for forming strong bonds between the fibers in the paper structure, and correspondingly different dimensioning of fibrous material[2].

Strength of bonds between fibers in the paper is affected by both specific energy of these bonds and contact area between fibers. Refining process does not lead to a significant increase in specific energy of bonds. After mechanical treatment of pulp in water, contact area between fibers increases, as a result of increased flexibility of fibers and growing fine content in pulp[3].

Development of specific energy of bonds between fibers in the paper structure depends on changes in the fibers structure. They result primarily from the processes involved in refining of fibrous material. After mechanical treatment of pulp in aqueous medium, fibrous material undergo the following changes: external fibrillation, internal fibrillation and fibers shortening process[4].

The industrial refining process is influenced among others by properties of fibrous material, refiner load, pulp flow through the refiner, pulp concentration and pulp temperature.

In the industrial operating conditions, when the other aforementioned conditions are stable, refiner load is a measure of the intensity of refining process[2].

Changing the intensity of refining process has an impact on energy consumption of this process. Low intensity refining causes a slow increase of refining effects and low energy consumption. Such conditions are conductive to fibrillation of cellulose fibers and reduce the fibers shortening process. Paper obtained from such treated pulp is characterized by low volumetric mass and high strength properties. High intensity refining causes a rapid increase of refining effects and high energy consumption. The above refining conditions favor the fibers shortening process. Paper obtained from high intensity refined pulp is characterized by high volumetric mass, low porosity and low strength properties[3].

In order to obtain good printing papers, which are characterized by appropriate transparency, smoothness and softness, it is necessary to obtain not very fibrillated fibers, but correspondingly shortened fibers.

MATERIALS

The research is based on model tests. During research on the effect of refiner load on Bendtsen air permeability kraft pulp in form of sheets has been used bleached. Pulp used for research does not contain any non-fibrous additives.

The refining process was conducted in Valley beater (ISO 5264/1). During the refining process only refiner load was changed. Type of fibrous material, pulp flow through the refiner, pulp concentration and pulp temperature were constant. Before refining pulp was soaked in water for 24 hours. After the refining process pulp was stirred at mixer.

The next step was a process of forming paper sheets on Rapid - Koethen apparatus. The formation was performed in accordance with ISO 5269-2:2001. Each laboratory produced paper sheets characterized by basis weight 75 g / m². Prior to submission of paper samples tested their property, air-conditioned them in a constant temperature and humidity room, under conditions of temperature of 23°C and humidity of 50% RH, according to ISO 187:1990. Paper samples subjected to the process of conditioning, were used for testing properties such as breaking length, breaking load, volume, roughness, air permeability, etc.

Air permeability of paper is associated with porosity of paper. Ability to air permeance of paper sheet depends on compactness of paper structure[5].

Examination of air permeability was prepared on Bendtsen Roughness and Air Permeance Tester. This tester is an advanced microprocessor-controlled instrument for measuring the roughness and air permeance of paper and board using the Bendtsen method. The range is of 0-5000 ml per minute. The measurement of air permeance of paper sheets was performed in accordance with ISO 5636-3:2013.

RESULTS

The following figure presents results obtained during the measurements.

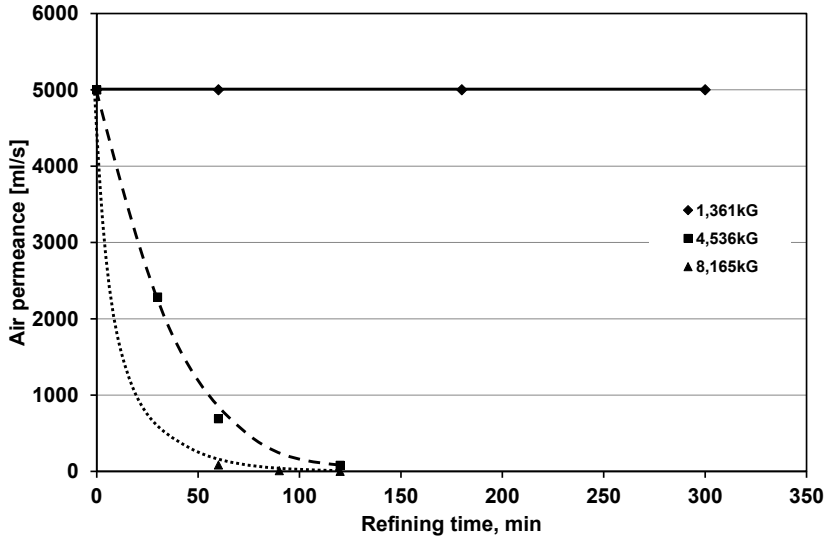

Figure 1. Influence of refiner load on air permeance of paper

CONLUSIONS

Refiner loading in pulp processing has a significant impact on paper structure. Paper sheets obtained from low intensity refined pulp has loose and porous structure. This is evidenced by the high value of air permeance of paper sheets obtained from pulp, which are refined with a 1,361 load.

With increasing of refiner load, value of air permeance decreases. This is due to the increasing compactness of paper structure, which is the result of shortening the fibers.

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Streszczenie: *Wpływ obciążenia młyna na przepuszczalność powietrza papieru mierzoną metodą Bendsena.* Głównym celem pracy było porównanie wpływu obciążenia urządzenia mielącego na przepuszczalność powietrza papieru mierzoną metodą Bendsena . W tym artykule oceniono zmiany przepuszczalności powietrza arkuszy papieru otrzymanych z mas włóknistych poddanych mieleniu z różną intensywnością. Otrzymane wyniki pokazują, że obciążenie urządzenia mielącego odgrywa ważną rolę w procesie mielenia, ponieważ wpływa zarówno na zużycie energii, jak i na zmianę różnych właściwości papieru. Wszystkie wyniki pozwalają pokazać znaczny wpływ procesu mielenia na rozwój zdolności papierotwórczej mielonej masy.

The authors gratefully acknowledge that this work was financially supported by the project LIDER/407/042/L-4/2013 founded by National Centre for Research and Development, Poland (NCBiR).

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