

TAMPERE POLYTECHNIC-
UNIVERSITY OF APPLIED SCIENCES
International Pulp and Paper Technology

Final Thesis

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**DEVELOPMENT OF LABORATORY DEVICE FOR LINTING AND DUSTING
MEASUREMENTS IN POLYTEST PROJECT**

Supervisor of the work
Tampere 2007

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Linting, dusting, polytest

ABSTRACT

In this work the main goal was to investigate the linting phenomenon and to evolve a device capable of measuring the paper linting in laboratory conditions. This device would later in the project lead into an on-line version which could be located on the dry end of the paper machine.

The rest is considered as confidential material

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Paperin pölyävyyttä mittaavan laitteen kehitys
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TIIVISTELMÄ

Tämän työn tavoitteena oli tutkia paperin lintingiä ja kehittää laitetta, mikä voisi mitata paperin pölyävyyttä laboratorio-olosuhteissa. Tästä laitteesta kehitettäisiin projektin myöhemmässä vaiheessa on-line versio, mikä olisi sijoitettavissa paperikoneen kuivaan päähän.

Loppu on luokiteltu luottamukselliseksi

FOREWORDS

This project took place in Tampere Polytechnic from September 2006 to May 2007. From the early moments of getting familiar with the word “linting”, to the latest phases of the measurements, I was working with several competent co-workers that I’d like to thank. Pasi Arvela, Jarmo Lilja and Arto Nikkilä as the supervisors showed their dedication to the project by guiding my work through the nine months. I’d also like to point greetings for Antero Haapaniemi and Janne Heinilä as co-students, for working with the project. And finally special thanks to laboratorian, Juhani Pitkänen, who made all the constructional works possible by participating in the development phases.

Tampere,

May 7th, 2007

Teemu Aittamaa

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TERMS & ABBREVIATIONS

A4

Paper sheet with dimensions of 210 mm × 297 mm

AGRYLIC GLASS

Transparent plastic. Chemical formula $(C_5O_2H_8)_n$

ARTI

ARTI HHPC-6 Airborne particle counter. The device measures the amount of particles in air for six categories according particles size. Categories from smallest to largest: 0,5-0,7 μ m; 0,7-1,0 μ m; 1,0-2,0 μ m; 2,0-5,0 μ m; 5,0-10,0 μ m; >10,0 μ m.

AUDACITY

Computer software which was used to create and edit sounds.

DUSTING

Loosening of weakly bonded fillers or coating pigments in printing nip.

ELPI

Electrical low pressure impactor. It is capable of measuring the particle size distribution in real time. Size distribution range: 30 nm -10 μ m.

LINTING

Loosening of weakly bonded fibrous material in printing nip

MASS CONCENTRATION, C_m

A mass concentration is a value which indicates the weight of released paper dust in one cubic meter. [mg/m^3] (Measuring quantities are represented more accurately in Janne Heinlä's final thesis) /3/

NUMBER CONCENTRATION, C_n

Number concentration is a value which indicates the amount of released dust particles in specific volume. [$1/\text{dm}^3$] (Measuring quantities are represented more accurately in Janne Heinlä's final thesis) /3/

PM 10 PUMP

Effective pump to clean the dust chamber in PMM V1

PMM

Particle measurement method

PMM A1...A4

Acoustical particle measuring methods 1-4

POLYTEST

A project in Tampere Polytechnic which is investigating the paper linting phenomenon

PAPER SAMPLES USED IN THE PROJECT:

A-SAMPLE

Telephone directory paper, it is produced in UPM Kaipola mill. It has a basis weight of 36 g/m²

C-PAPER

C-paper is classified as a newsprint paper and it is known to have high linting tendency. It is manufactured in Middle Europe.

SHOTTON

Shotton is a newsprint paper manufactured in the UK. It contains a high share of recycled fibers in its furnish.

1 INTRODUCTION

Paper linting is a common problem especially in printing houses. The paper linting causes extra costs as the loosened material from papers surface is attached to cylinders surface with sticky ink and the printing machines have to be washed. Because of this the printing houses, customers of paper mills, prefer paper grades which have lower linting tendency. At the moment there are some devices which are capable of measuring the level of paper linting, but none of these devices are widely used. Most of them are complicated measuring standards which take a lot of time to operate and some of them include doubtful measuring methods. In POLYTEST project the goal is develop a device which can offer fast and reliable results of paper linting. If this device would be converted into an on-line version the paper mills would see the linting tendency of produced paper in real time. If they could know the linting tendency of their paper, the information would be valuable if they wanted to produce a low-linting paper by changing the parameters of the paper machine. In the markets the printing houses could easily compare the linting levels of different papers from several suppliers.

2 PAPER LINTING

2.1 Background of paper linting

Paper linting means the loosening of weakly bonded fibrous material from the paper surface in converting processes. The strongest impact of this phenomenon occurs in offset printing of newsprint papers. In offset printing the detached material will accumulate on the blanket cylinders surface. When these attached materials are mixed with sticky ink they will cause undesired markings on the papers or even tear the papers surface. Part of the detached material is also carried via the cylinders to the inking unit and ink fountain, causing problems in ink transfers. /1,7,10,11/

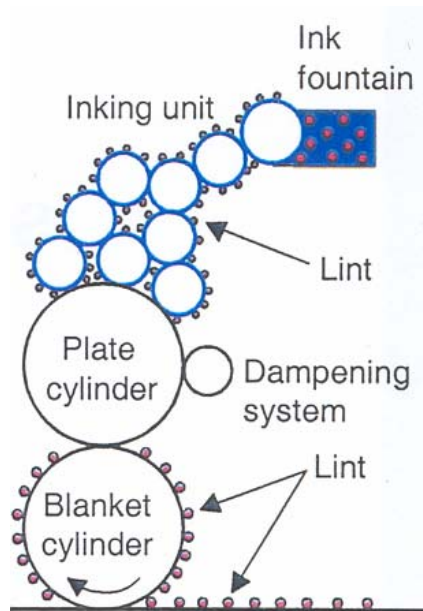


Figure 1 Linting in offset printing /7/

Linting is always a bigger problem with the paper grades which are composed out of mechanical pulps, like newsprint. This is due to the low specific surface area of the fibers in mechanical pulps. /11/

Newsprint paper grades are composed from pulps and fillers. Pulps are fibrous materials which are classified in mechanical, chemical and recycled pulps. In newsprint papers the share of chemical pulp has to be kept as low as possible (<10%) due to its high price. The only function, if it is used at all, is to improve the strength properties of the paper. Share of mechanical pulps can be more than 90 %, it is cheaper than chemical pulp and is the basic element of newsprint papers recipe. Recycled pulp is the cheapest pulp grade available and therefore it is widely used. Nowadays the share of recycled fibers in newspapers can be as high as 100%. Mechanical pulps and recycled pulps have lower bonding ability than chemical pulp, due to the lower amount of long fibers, and that is why the paper grades which are made from these pulp grades have higher tendency of linting. /11/

From the total composition of newsprint paper about 85 % comes from the different pulps and the rest 15 % are fillers. Fillers are minerals which are used in paper making to improve the printability properties of the paper. For an example kaolin has a plate kind of form which makes the surface smoother improving printability. Fillers are much cheaper than fiber raw materials and that's why their share in newspapers recipe should be as high as possible. Reducing element for high filler share in paper recipe is the poor bonding ability. As it is a mineral, a stone, it doesn't form any hydrogen bonds in the dryer section like fibers do. The higher share of fillers the lower strength properties of the paper. Nevertheless the share of fillers is usually set to the peak so that the runnability of the paper machine does not suffer. /11/

2.2 Linting and dusting

Particles tendency to lint is related closely to its low specific surface area. Factors in mechanical pulp which have high tendency to lint are fiber fragments, shives and ray cells. Of these three elements ray cells can be named as the main linting source, because of their unsubstantial bonding ability.

/1,11/

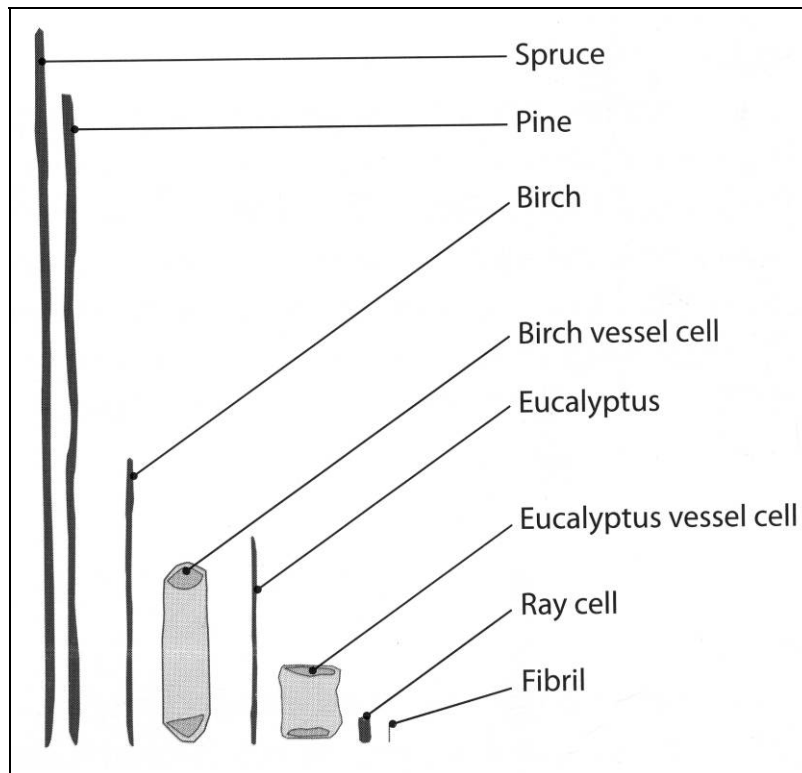


Figure 2 Dimensions of fibrous material /5/

Ray cells can be seen in the figure 2. The length of ray cell is about 100 μm . The length of the softwood (spruce and pine) fibers is near 3 mm whereas the length of the birch fiber is 1,1-1,2 mm. /5,11/

Dusting is considered to be same kind of a problem than linting but it is caused by smaller particles. Main reasons for linting are the ray cells which have the length of 100 μm , but the factors behind dusting are much smaller. Dusting materials are the stone-based coating pigments or fillers which have the length of 0,1 - 5,0 μm . Dusting as term means the loosening of weakly bonded coating pigments which are removed from the papers surface in the printing nip. These loosened particles are causing problems in print quality and as well in the runnability of the printing machine. Linting and dusting are closely related with each others and their difference is still quite vacillating. In generally, dusting considers smaller particles and linting fibrous material. /2,4,6,8,10/