TAMPERE UNIVERSITY OF APPLIED SCIENCES
Paper Technology
International Pulp and Paper Technology Confidential

FINAL THESIS

Samuli Tuhkala

COLLECTING AND ANALYSING OF PAPER DUST BY ACOUSTIC AIRFLOW MEASURING DEVICE IN THE POLYTEST-PROJECT

Supervisors of the work: Pasi Arvela, MSc; Riitta Mäkelä, LicEng; Arto Nikkilä, MSc
Commissioner of the work: TAMK, POLYTEST-project; Jarmo Lilja, PhD
Tampere 2008

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ABSTRACT

Paper dusting is a common problem in the printing houses, especially when the offset printing method is used. In the printing, the dust particles attach to the surface of the printing cylinder, and impair the quality of the printed images. Due to dusting, the printing machines have to be washed for sustaining a good printing result which causes unnecessary costs for the printing houses. Problems at the paper machine caused by dusting are not as great as at the printing machine but still significant.

Tampere University of Applied Sciences launched the POLYTEST-project in 2006 to study and measure paper dusting. The target was to develop fast and reliable measurement method for paper dusting which could be used both in the laboratory and online measurement circumstances at the paper mills and the printing houses. The aim of the spring 2008 POLYTEST-project was to adapt the existing online measuring device into a laboratory device. This final thesis focuses on the measurement methods used during the development work, and the results got from the measurements.

The operational principle of the laboratory device was based on the acoustic method where the amount of the dust particles was measured with an optical debris tester. In the measurements, clear differences in the dusting amounts between the different paper samples were observed.

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TIIVISTELMÄ

Paperin pölyäminen on yleinen ongelma painotaloissa ja erityisesti käytettäessä offset-painatusta. Painatuksessa löysästi kiinni olevat pölypartikkelit irtoavat ja tarttuvat painatustelan pintaan huonontaen painettavien kuvien laatua. Pölyämisen vuoksi painatuskoneet on pestävä säännöllisin väliajoin hyvän painojäljen takaamiseksi, mikä aiheuttaa turhia seisokkeja ja kustannuksia painotaloille. Pölyämisen aiheuttamat ongelmat paperikoneella eivät ole yhtä suuria kuin painokoneella, mutta silti merkittäviä.

Tampereen ammattikorkeakoulu aloitti vuonna 2006 POLYTEST-hankkeen tutkiakseen ja mitatakseen paperin pölyävyyttä. Hankkeen tarkoituksena oli kehittää nopea ja luotettava mittauskäytäntö paperin pölyävyyden mittaamiseen, joka olisi sovellettavissa sekä laboratorio- että online-käyttöön paperitehtaissa ja painotaloissa. Kevään 2008 POLYTEST-hankkeen tarkoitus oli soveltaa jo aiemmin kehitetty online-prototyyppi laboratoriokäyttöön. Tässä opinnäytetyössä keskitytään käytettyjen mittausmenetelmien esittelemiseen ja mittauksista saatujen tulosten käsittelemiseen.

Laboratoriolaitteen toimintaperiaate perustui akustiseen menetelmään, missä pölypartikkelien määrää mitattiin optisella hiukkasmittalaitteella. Mittauksissa havaittiin selviä eroja pölymäärissä eri paperinäytteiden välillä.

Luottamuksellinen

FOREWORD

During the project I worked with several people who I would like to thank. First, I would like to thank teachers Pasi Arvela, Jarmo Lilja, Riitta Mäkelä and Arto Nikkilä for their professional guidance and advices throughout the project. I would also like to thank laboratory technician Juhani Pitkänen for his assistance with the construction work of the measurement devices, and Taru Owston for the great help with the English language. Special thanks to Jani Kurra who I made all the trials and measurements with. Finally, I would like to thank all the co-partners and the students who have participated in the POLYTEST-project.

Tampere

June 9, 2008

Samuli Tuhkala

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TERMS & ABBREVIATIONS

bs = bottom side of the paper

TAMK = Tampere University of Applied Sciences

ts = topside of the paper

The rest of the terms & abbreviations are confidential.

1 INTRODUCTION

The aim of the spring 2008 POLYTEST-project was to adapt the existing online device into the laboratory device, and to create a fast and reliable measurement method for paper dusting. This thesis focuses on the measurement methods used during the development work, and presents the results got from the measurements.

Paper dusting is a common problem in the printing houses, especially when the offset printing method is used. The weakly-bonded particles will detach from the paper surface in the printing nip, and cause accumulations on the surface of the blanket cylinder which impairs the quality of the printed images. Due to dusting, the printing machines have to be washed for sustaining a good printing result which causes unnecessary shutdowns and costs for the printing houses.

Paper dusting is a problem that has not been concentrated on so much compared with the other problems occurring in the paper making process. It is known how to affect dusting but there are still a lot of unsolved questions like, for example, how to measure it. At the moment there are few devices which are capable of measuring the level of paper dusting but none of these devices is widely used. Also the results got from these devices can not be compared with one another because their operational principles are so different. Most of them are complicated measuring standards which take a lot of time to operate and some of them also include doubtful measuring methods.

Successful development work of the online device would help the paper mills to produce a low-dusting paper in real time. In the paper markets, printing houses could easily compare with the laboratory device the dusting levels of various papers from several suppliers.

2 PAPER DUSTING IN GENERAL

Paper dusting causes problems at the paper machine but especially at the printing machine. Paper dusting means weakly-bonded fillers, pigment particles and fines which are detached from the paper surface during the printing phenomenon. It is considered to be the same kind of problem as linting in which the detached material consists of fibrous material. However, dusting is caused by much smaller particles. Dusting material consists mainly of fines but also of stone-based fillers and coating pigment particles which are only 0.1-30 µm long (figure 1). Linting material consists mainly of ray cells which are about 100 µm long. Dusting problems occur especially with the newsprint and uncoated paper grades where the content of the recycled fiber and fillers is high. More detailed information about the dusting and linting materials is presented in Teemu Aittamaa's /3/ and Janne Heinilä's /5/ final thesis. /1, 2, 3, 5, 8, 11/

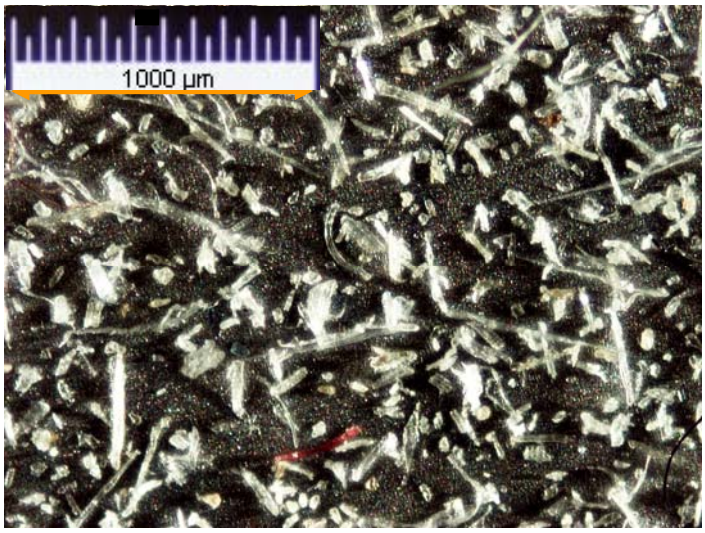

Figure 1 Microscope image of dusting material

2.1 Problems caused by dusting at a paper machine

Problems at the paper machine caused by dusting are not as great as at the printing machine but still significant. At the paper machine dusting causes wearing of machinery, impairs stability of the measurement systems, causes unnecessary web breaks due to impurities, increases risk of fires, and impairs the coating quality. Wearing of the machinery occurs especially at the drying section and the after-

treatment where the stone-based particles settled between the moving parts wear among others blades, cylinders, drying wires and open bearings. The malfunctions of the measuring devices and web break control systems are also daily problems at the paper machines. The descending dust attaches everywhere by covering also the measurement sensors and the electric eyes of the control system. This makes the controlling system of the paper machine unreliable. Dusting causes extra cleaning work and breaks bringing unnecessary costs. Dusting also increases the risk of fires, especially near the infrared dryers. Small fibrous particles can catch fire easily due to high temperature used in infrared dryers. Dust in the coating color causes uneven surface or streaks on the web surface when using blade coating.
/6, 8, 11/

2.2 Problems caused by dusting at a printing machine

Dusting problems occur especially in the offset printing while running the newsprint and uncoated paper grades where the content of recycled fiber and fillers is high. In the offset printing, the weakly-bonded particles will detach from the paper surface in the printing nip, and cause accumulations on the surface of blanket cylinder. Ink used in the offset printing is tacky, and it practically pulls off weakly-bonded material from the paper surface. Thus formed accumulations will cause markings on the images, and part of the detached material is also carried via the cylinders to the inking unit and ink fountain where it causes problems in ink transfer. This phenomenon is presented in figure 2. /3, 5, 8, 11/

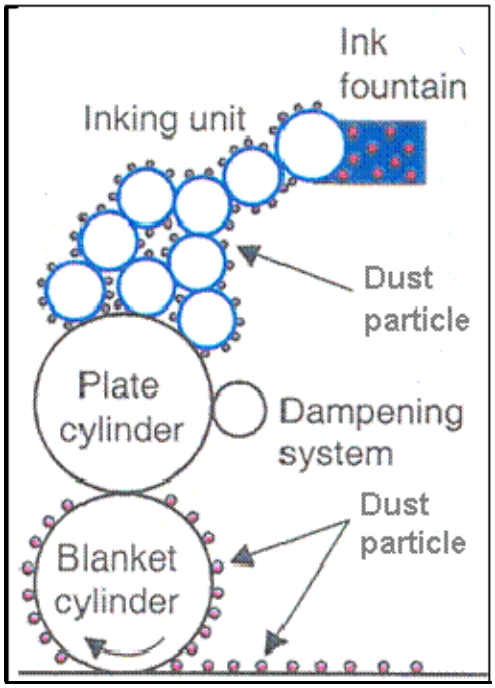

Figure 2 Phenomenon at the printing machine caused by dusting /11/

Paper dusting is a cumulative problem which starts to cause more interference in the longer printing runs. The accumulations lower ink adhesion into the blanket and disturb ink transfer onto the paper. Disturbed ink transfer, for one, causes lower print contrast and image quality. Fine stone-based particles may also glaze the blanket which generates ghost images on the printed product. Due to dusting, blankets have to be washed from time to time which causes unnecessary shutdowns and more expenses. Especially the fine filler and pigment particles are difficult to wash off. The difference in the blanket before and after the washing can be seen in figure 3. The fillers, pigment particles and fibers attached to the blanket make it whiter. /3, 5, 8, 11/

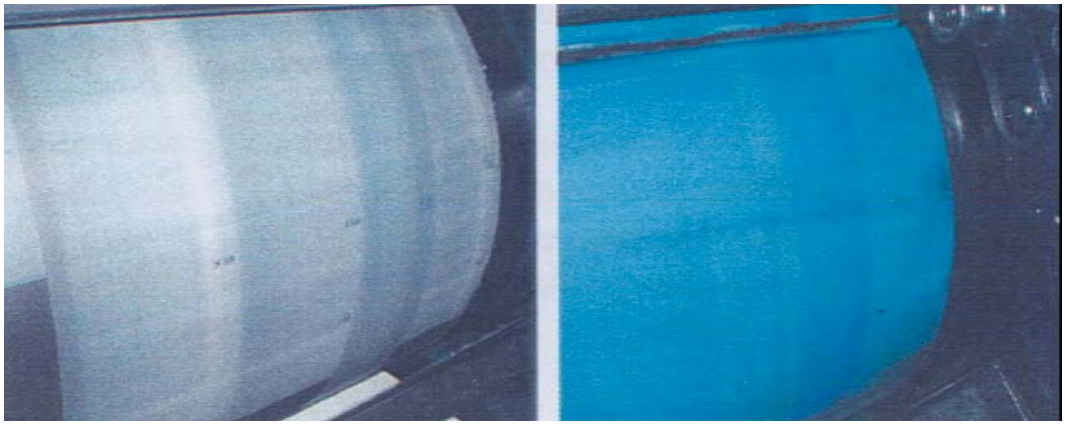

Figure 3 On the left a blanket after 30,000 copies and on the right the same blanket after washing /11/

The rest of the thesis is confidential.

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