TAMPERE POLYTECHNIC -
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CONFIDENTIAL

Final thesis

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DEVELOPMENT AND APPLICATION OF ACOUSTIC AIR FLOW PAPER DUST MEASURING DEVICE IN POLYTEST -PROJECT

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Commissioning company TAMK, POLYTEST -project, Jarmo Lilja PhD
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ABSTRACT

In 2006, Tampere University of Applied Sciences launched POLYTEST – project whose target is to develop real-time measurement method for paper dusting. In the beginning of the project there were many different laboratory prototypes developed, but finally in case of on-line device common dust detaching and collecting method was found. The target of this thesis was to develop and apply those methods for laboratory use. The focus of this thesis is in developing of new prototype and in research work of potential end use places.

Paper dusting has been a problem a long time in printing houses and it has been one of the reasons which have restricted production. Especially in off-set printing weakly bonded fibres and loosened fillers can cause problems when they are attached to blankets and finally transferred to inking system. In worst cases it can cause cumulative linting problems and machine must be washed which leads loses in production. If the realiable real-time measurement could be developed for paper dusting it could be possible to affect on paper dusting when producing paper in machines, now it is more or less impossible.

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TIIVISTELMÄ

Vuonna 2006 Tampereen ammattikorkeakoulussa aloitetun POLYTEST – projektin tarkoituksena on kehittää reaaliaikainen mittausmenetelmä paperipölynmittaamiseen. Projektin alkuvaiheessa rakennettiin useita prototyyppejä laboratoriomittauksiin ennen kuin on-line mittalaitteen kehitystyön myötä löydettiin yhteinen pölynirrotus- ja keräysmenetelmä. Tämän opinnäytetyön tarkoituksena oli kehittää ja soveltaa näitä hyväksi todettuja menetelmiä laboratorio käyttöön. Tässä työssä on keskitytty uuden prototyypin kehittämiseen, sekä tulevaisuuden käyttökohteiden kartoittamiseen.

Lehtipainoissa paperin pölyävyys on ollut jo pitkään ongelmana ja tuotantoaikaa rajoittavana tekijänä. Erityisesti off-set painatuksessa, heikosti sitoutuneet kuidut ja täyteaineet aiheuttavat kumulatiivisen ongelman keräytyessään painotelastoille, sekä kulkeutuessaan musteen syöttö järjestelmään. Pahimmissa tapauksissa painokoneen pesuvälit lyhentyvät monin kerroin paperipölyn ja lintingin johdosta, mikä johtaa tuotanto ajan menetyksiin. Jos reaaliaikainen pölyävyyden mittaus saataisiin kehitettyä, olisi tähän ongelmaan mahdollista vaikuttaa paperin valmistus prosessissa.

LUOTTAMUKSELLINEN

FOREWORD

My time in POLYTEST – project is running into its end and I have learned and faced up lots of new things. Now, it is time to present thanks for every one who has taken a part to help in this project. First of all I would like to thank Samuli Tuhkala with who I made all measurements and tests. And without our withdrawals to sports, like playing badminton this project would not face its end. Then I would like to present thanks to our teachers Arto Nikkilä, Jarmo Lilja and Riitta Mäkelä who were supervising us during project, Juhani Pitkänen who supported technically, Taru Owston who patiently corrected and helped with the language. I would like to give special thanks to Pasi Arvela who was always supporting and helping when he just found some time. Finally I would like to thank also all members and co-operator partners who have taken a part to the project and developed earlier prototypes. It was a great help to get good basics from your thesis before starting my work.

Tampere

May 27, 2008

Jani Kurra

TABLE OF CONTENTS

1 INTRODUCTION

In the modern fast printing machines paper dusting is a very common problem. Paper dusting has been a problem a long time in printing houses and it has been one of the reasons which have restricted production. Especially in off-set printing weakly bonded fibres and loosened fillers can cause problems when they are attached to blankets and finally transferred to the inking system. In worst cases it can cause cumulative linting problems and machine must be washed which leads loses in production.

As yet there are no practical real-time equipments to measure paper dusting. Though dusting has been researched a lot, all the difficulties in measuring it are not solved out. Dusting is still more or less certainty, which just exist and it is enough when you know how influence that. But when you do not have good equipment, from which you can get quickly dusting level information, you can not run your machines in way to affect the aftermaths. The information you need comes from present-day equipments usually far too late.

The target of this thesis work was to develop further already existing dust measuring method, which has been developed in POLYTEST-project.

2 PAPER DUSTING IN GENERAL

In general paper dusting means an incident where loose or weakly bonded small fillers, coating particles or fines are loosened from the paper surface. And when this occurs a great deal, it is called dusting. Dusting takes place mainly in coated grades, but also in uncoated papers if the filler content is high. High filler content of the paper interferes also with the bonding ability of fibres and therefore causes strength losses. In that case dust might have also some fibrous material.

Paper dusting has not been pointed out as much as other problems in the world of paper making. For long time paper makers have known how to affect dusting, but there are still a lot of unsolved questions like, how dusting could be measured reliable in realtime. Until now, there is no practical and realtime equipment developed yet. Because of difficulties in solving problems in measuring, dusting has been more or less a certainty which just exists, and it is enough when you know how to affect it. But at the same time it causes a lot of problems and extra work. /6/

2.1 Dusting problems in paper machine

This chapter deals with dusting problems in a paper machines. Information of the chapter is mainly based on the writer’s experiences in mill site and on conversations with workers and managers in mill.

The dusting problems are not always so massive in the paper machine. Dusting problems can mainly be seen in printing machines. In any case dusting causes problems also on a paper machine and the paper machine is, of course, the place to affect dusting. Problems that can be caused by dusting are wearing of machinery, unreliability of measuring systems, unreasonable breaks because of impurities in the web break control system, it inflicts fire safety problems and the coating quality can be weakened.

The wearing of machinery can be seen mainly in drying section and in after-treatment. Drying wires, cylinders and doctor-plates can wear out in a rarely short time if dust has a possibility to stay between the moving parts. The wearing of cylinders and blades happens when fillers from paper or pigments from coating colour go between the blade and the cylinder. The effect that follows is like grinding with stone paper against cylinder and of course at the same time blades are wearing, too. If there are any open bearings or the sealings do not work as they should, some dust can go to unwanted places and speed up the wearing of bearings. Sometimes also the wearing of wires can be seen in the paper machine. It occurs when there is material on the cylinder; it consumes the plastic wire slowly.

The malfunction of measuring equipment and web break control systems are also daily problems in paper machines. Floating dust attains every place in the machine, thus it covers also measuring heads and the electric eyes of the control system. In that way dust causes a lot of cleaning work and sometimes even really expensive break time, which means, of course, losses in production.

Every now and then dust in paper machine inflicts dangerous situations because it raises the risks of fire. Dust is not wanted, for example, near the IR-dryers. Temperature there is so high that dust can flame, especially in cases when there is already fire because of a web break in IR-dryers.

Dust can also have a harmful effect on coating quality. When we are speaking about blade coating dust particles can accumulate to the blade and made streaks to the web. In film coating the effect can be that it roughens the surface, as it floats to the wet surface. Situation can be compared to a situation when varnishing is made in dusting environment.

2.2 Dusting problems in printing machine

Paper dusting problems are a really big issue in printing machines. The printing cylinders are collecting all dust material and they have to be washed every now and then when they have collected too much particles and the print quality starts to weaken.

Dusting and linting are major issues for all uncoated and coated paper grades, it is often used to describe deposit build-up found on printing blankets or plates. This build-up can force printers to cease operation in order to clean the blankets or plates, which are essential in enabling them to meet their required printing quality./4/

Dusting appears usually in the first print press. There can be white accumulation on non-printed areas and it can cause ghost images in the same or on the following run. When there is lot of dust accumulating on printing blanket or blade it can lead to start of linting (more about linting in chapter 3), and that is a cumulative problem. Aftermath of dusting and linting is really tacky stuff (ink and mineral particles) on blankets and blades and it is really hard to wash out. Because the dust is really hard to wash off from the blankets it is also very time consuming process, and that means again losses in production. /4; 6/

3 PAPER LINTING IN GENERAL

This chapter concentrates on paper linting. Paper dusting and linting are very often connected and mixed together. There is a clear correlation between linting and dusting but still these two are totally different events.

Paper linting problems take place normally in offset printing. Linting is an event in which weakly bonded fibrous material is loosened from the paper surface caused by tacky ink. After loosening lint particles accumulate on the printing blankets from where they can drift in the inking system. In offset printing linting is a cumulative problem, because the more there is lint the tackier ink becomes and tacky ink loosens more and more weakly bonded lint material. In Figure 1 you can see illustration of the linting event.

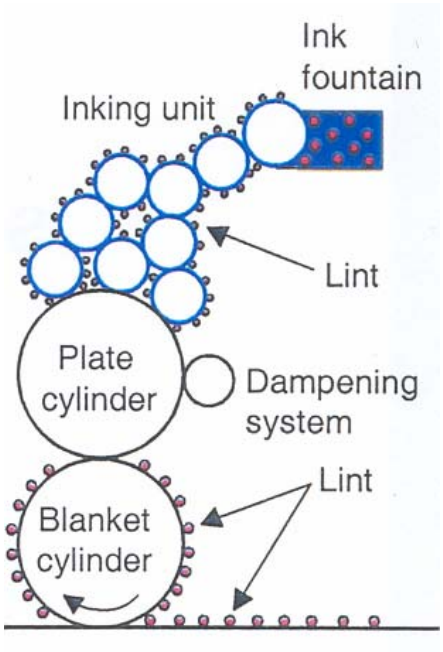

Figure 1. Linting event in offset printing/Päivi/

Linting is a significant problem in longer printing runs, especially in the case of uncoated grades. In the end product, linting can be seen as a variation of printing density and sometimes it can affect even fibre shaped uncoated areas. /3;6/

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