New Deinkable Water based Inkjet Inks

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Abstract

Water based inkjet ink is a major challenge for the deinking process. This process is the key step in paper recycling. It has been designed to separate hydrophobic ink particles from hydrophilic cellulose fibers. In this process, soluble dyes cannot be removed; they stay and accumulate in the circulation water. Thus additional bleaching steps have been suggested to make up for the loss in brightness. However, bleach is not an option for the majority of paper mills producing newsprint and other graphic papers from the household mix. It is neither economical nor ecological as this would require to add equipment and to increase the use of chemicals as well as the chemical load of the effluent.

Therefore, other solutions look more sustainable: Inkjet inks that help to produce prints which perform as good as offset or dry toner prints in a standard deinking paper mill. Resin based inks seem to be a way to achieve this goal.

Introduction

In 2001, for the first time problems with water soluble inkjet inks in the paper recycling process were predicted from lab experiments [1]. Until drupa 2008, only few printer manufacturers were aware of this issue. In 2008, the paper industry in Europe intensified the communication about this issue: The deinking process, the key step in recycling paper for new graphic paper as newsprint and office papers, cannot remove water soluble inks. Especially dyes create problems as they stain the cellulose fibers already in a comparably small fraction of the raw material. Today, paper mills already observe complications (and reject material) e. g. from misprinted mailings and other overprint from inkjet printers. The impact of an increasing amount of distributed water based inkjet prints in the household paper has become more obvious in the last years.

Finally, at drupa 2012 sustainability became a key marketing argument though not every claim presented reveals sufficient substantial background.

Testing Deinkability

The process of deinkability testing has been described earlier e. g. at this conference [2, 3]. Basically, the key steps taking place in an industrial deinking plant are applied in a lab test – the detachment of the ink from the fibers and the removal of the ink from the system. For this assessment, deinkability tests carried out according to INGEDE Method 11 [4] serve as the basis for comparing deinkability of prints. This method had been published as draft for the first time in August 1999 in German language. In March 2009 the European Recovered Paper Council (ERPC) adopted the latest version of "Deinkability Scores" as assessment scheme. The ERPC is the committee of the signatories and supporters of the European Declaration on Paper Recycling. For this scheme, five parameters are determined and converted to a score system [5]. This allows expressing the deinkability assessment in one figure by weighing the parameters according to their importance. Within the last years, INGEDE has collected data from several hundred printed products.

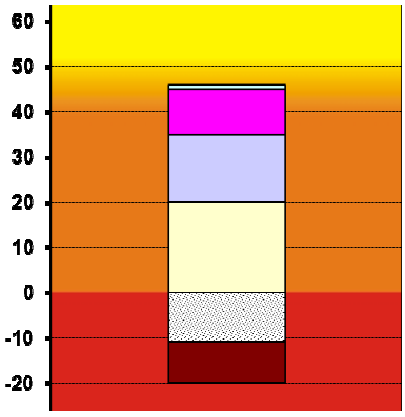

***Figure 1**. Deinkability Scores: Results for a typical pigmented inkjet ink used to print a digital newspaper. From Top to bottom: Scores for (here low) ink elimination IE, dirt speck area A250 and A50, color shift a*; negative are luminosity and filtrate darkening.*

Improving the Deinkability of Inkjet Inks

At least for pigmented inkjet inks, there are options to improve the deinkability. For this, they should either not be water based at all or coagulate after jetting to form larger, hydrophobic particles on the paper surface. Promising approaches by Fujifilm, KAO, and Xerox have been tested whether their solutions – originally intended to improve image quality – also help to match state-of-the-art deinking technology. The most promising approach is to create a precipitation of the inkjet ink on the paper surface. This improves the image quality and in most cases also the deinkability.

A new inkjet ink has been developed in close cooperation between a manufacturer, INGEDE and the PTS research institute. Here the goal was in the first place to develop a deinkable inkjet ink based on the current knowledge of the requirements.

Resin based inks have originally been developed by the Austrian ink manufacturer Sepiax to be used in the wide format sector to print on hydrophobic non-paper and non-absorbent surfaces like plastic film, also on leather or ceramic tiles.

These inks typically consist of a polymer resin, ink particles, dispersant and water. All three compounds can be varied in order to achieve a desired performance.

Initial tests were performed with a standard resin ink without further modification. Standard uncoated newsprint (45 g/m²) was chosen as a matrix, the image printed taken from a daily newspaper.

First Deinking Tests with Resin Inks

The deinkability of different samples was tested by Papiertechnische Stiftung (PTS) according to INGEDE Method 11. As for other uncured water based inks, the dirt speck area is no issue, here the full score is achieved. The final brightness is also sufficient. Though the necessary deinkability target can be met, for filtrate darkening and ink elimination, less than half of the achievable points are scored. This means not all the primary pigments are agglomerated forming larger, removable particles. Still a noticeable fraction can be re-dispersed in the circulation water.

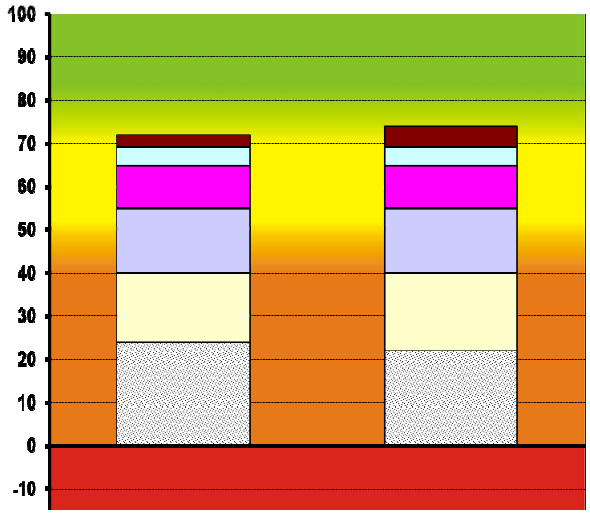

***Figure 2**. Deinkability Scores: Results from two samples of resin ink prints*

Outlook

For inkjet inks, there seems to be a variety of promising ways to make the prints better compatible to integrate into the existing paper loops in the near future. At drupa 2012, interesting approaches have also been presented by HP or Océ Printing Systems. Test results will be presented at the conference.

For the resin based inks, new improved ink formulations are under development that take the described test results into consideration.

References

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[3] A. Fischer, Advances in Deinking and Deinkability of Inkjet Inks, IS&T NIP26 Conference Proceedings (2010)

[4] Assessment of print product recyclability – Deinkability Test –, INGEDE Method 11p, December 2009, www.ingede.org/ingindxe/methods/meth-e.html

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Author Biography

Axel Fischer studied chemistry at Munich Technical University. He worked as a Science Writer for TV, print media and Germany's major news agency. Now he works as communications consultant for the chemical industry and the paper industry. Since 1994, he is responsible for the public relations of INGEDE, the International Association of the Deinking Industry. He chairs the "Digital Round Table", a forum initiated by INGEDE to improve the Deinkability of Digital Prints.

Dr. Elisabeth Hanecker studied chemistry at Munich Ludwig-Maximilians University and completed her doctoral thesis there. Since 1986 she works for Papiertechnische Stiftung (PTS) in Munich. Currently as a project leader she is responsible for all deinking activities at PTS.