Digitally printed newspapers – unrecyclable trash or still a sustainable resource?

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Abstract

Digitally printed newspapers – news on demand – gain importance. INGEDE has initiated investigations on the recyclability of digitally printed newspapers. For the first time, inkjet printed samples have been tested.

The presentation will outline remarkable differences between new digital printing processes. It will also deal with high speed printing processes used for direct mail, with dye and pigment based inkjet, liquid and dry toners and UV curable technologies. New results obtained with improved toners will be presented. More companies have joined INGEDE's deinkability survey that has been presented at NIP22 for the first time [1]. More – and more reliable – results have been achieved. The consequences for the printing industry will be discussed.

Introduction: Paper recycling

Paper recycling is still a cost effective and sustainable source of fibers for graphic papers (and hygiene papers). More and more paper is recovered all over the world. In Europe, newsprint is made of 100 per cent recovered fibers already. Even more paper has to be recovered, as the demand is still high. The paper industry faces several challenges from different sides, every single one increasing the cost of the recycling process: Coming from the US, there is a tendency towards "co-mingled" collection of paper together with other recyclables as all kinds of packaging like plastic, cans, board and even glass. This leads to more impurities in the recovered paper, more contaminants to be removed and to be disposed of, more expensive equipment to be installed, increased landfill costs and more wear and tear of pipes and pumps e. g. due to abrasive glass particles. As a consequence, paper mills have to shut down their operation, the sorted but still highly contaminated recovered paper is exported to China where it is used to produce packaging material.

New inks challenge the recycling process

Another challenge for the recycling process is the increasing diversification of printing processes. The flotation process used to recycle recovered paper for new graphic paper has been designed to remove offset and gravure ink, together still the majority in the paper being collected. Offset and gravure inks usually consist of a hydrophobic mixture of binder and pigment that is separated from the hydrophilic fibers in the paper mill.

Digital printing processes are not one like the other: There are solid and liquid toners, different resin system used for dry toners, dye based and pigment based inkjet inks, UV curable and wax-like systems, and every year new processes are invented. If the paper used for a newspaper would change from cellulose fibers to polyethylene film it would be obvious that this cannot be recycled together with paper made from wood. With new inks having about as much in common with their offset and gravure ancestors as paper and plastic, it is far more difficult to communicate how they create problems in the recycling process.

On the other hand, at least in Europe there is a clear political demand to use the resource "urban forest" also for higher paper qualities – as only these have the potential to increase recycling rates in Europe. But this would also require a better quality of the raw material. Nevertheless, some paper mills are still capable to produce copy paper, fine paper and coated offset paper from 100 per cent deinked pulp.

Deinking: How does it work?

Contaminants can be removed by size differences (screens), density differences (cyclones) or their surface properties (flotation). Deinking is the removal of the printing ink from the recovered paper. Flotation is the key process for the removal of printing ink in Europe, washing is more prevalent in the US, but even here more and more replaced by flotation (due to the disadvantage of washing: low yield).

Flotation

A suspension of re-pulped paper fibers with water, caustic soda, peroxide, silicate and soap is mixed to support the ink detachment. Air bubbles blown through carry the ink particles to the surface where the resulting foam is skimmed off. The flotation can also remove some varnishes and adhesives.

To be removable by this process, the ink has to be hydrophobic. How the particles are removed depends also on their size:

- particles > 150 µm = screenable
  (as long as they are stiff!)
- 30 µm < particles < 300 µm = cleanable
- 10 µm < particles < 100 µm = flotable

If particles are smaller than 10 µm, they are not removable by these processes. Problems occur with water based inks, especially with pigmented inkjet inks and almost all of the currently available flexo inks.

Dispersing and bleaching

In many deinking plants, the flotation is followed by a disperger which reduces the size of residual contaminants like hot melt adhesives, varnishes or toners to become less visible or to become removable by a secondary flotation. A bleaching step uses peroxide or FAS.

Deinking of digital prints

In the near future, many digitally printed products will end up in the recovered paper collection from households and offices, becoming part of the raw material to be recycled by papermakers. Consumers assume that anything printed on paper is alike because the differences between the chemical and physical properties of the inks used are not obvious (cf. "Regulatory consequences").

The poor deinkability of some digital prints could turn out to be a threat to today's paper recycling systems: Although some of these prints deink quite easily, others lead to severe problems, which may endanger the entire deinking process. A series of initial tests performed by scientists of the French Centre Technique du Papier (CTP) in Grenoble has also shown that all water based inks lead to severe deinking difficulties. Differences between processes currently on the market turned out to be surprisingly high.

European Round Table – Deinkability survey

In January 2006, on invitation of INGEDE a European Round Table on the Deinkability of Digital Prints met for the first time. Representatives of paper mills and printer manufacturers as well as research institutes and authorities discussed issues of recyclability.

In order to make deinkability testing better comparable, a test form was developed. This standard test form is available on INGEDE's website www.ingede.com. With this test form, prints have been made by several printer manufacturers and sent to INGEDE. From there, they were given as unnamed samples to different research institutes to test the deinkability and also to monitor the reproducibility of deinkability testing. At the same time, a set of data is collected to allow comparing printing parameters once the deinkability data are available.

Until early 2007, HP Indigo, Kodak NexPress, Océ, Ricoh, Xeikon and Xerox (in alphabetical order) joined the round table discussion and/or provided standardized samples that allow comparing the deinkability. The results are discussed with the participants but not published to keep them confidential. Still, if the results are within a range that has been defined to fulfill the deinkability requirements, this will be confirmed by INGEDE. A respective certificate is under discussion.

Inkjet inks are hard to remove

None of the inkjet printer manufacturers joined the survey or the round table discussion. Though HP Indigo was involved, HP's inkjet division did not answer invitations. Kodak Versamark, offering a continuous inkjet technology for printing newspapers, refused any cooperation. Kodak Versamark claims to have "the fastest digital printing speed available today duplex, full-process-color newspapers at the rate of over 1,000 40-pagebroad sheets per hour, and over 40,000 16-page weekly tabloids per eight-hour shift". So field samples of four different newspapers printed on a Kodak Versamark VX5000 were tested by a German research institute. The deinkability of these samples was disastrous, failing to meet the requirements in any category (luminosity, yield, ink elimination, filtrate darkening).

IBM and Screen also start offering production-class machines competing with dry toner processes. IBM did not answer attempts to discuss deinkability issues yet. RISO, offering a fast printer using drop-on-demand print heads, has not been contacted yet.

Most black inks today contain finely distributed pigments that can neither be deinked (they are too small to be removed by flotation) nor discolored (as intended to increase light fastness, they are not susceptible to bleach). As little as 10 per cent of print products with these inks mixed with other recovered paper is enough to spoil the deinkability of the whole mixture.

There are no estimates yet about the contribution of SOHO printers to inkjet prints in the paper recovered from households. Direct mail seems a more serious issue: To make mass mailings more attractive by personalization, increasing volumes of direct mail, bills, statements and manuals are printed at a speed of more than 2,000 pages/minute with inkjet printers. It can be assumed that many of these mailings reach the paper mills as peak loads rather than evenly distributed over a period of time. This leads to problems that by far outnumber the fraction of inkjet prints currently in the recovered paper.

Liquid toner still create problems for paper recycling

Poor results were still observed with liquid toner processes such as the one used by Indigo, which claims market leadership in digital color printing systems. The particles resulting from the thin and flexible ink film can neither be removed by the usual screens nor through flotation. The result is a high number of clearly visible dirt specks in the recycled paper. Not only that Indigo prints still are not suitable for paper recycling, even small amounts of them can create problems if they enter the process mixed with other recovered paper.

Washing is no solution

Ultrasound application [2] which is also discussed during this conference looks promising at the first glance but the conditions actually present in a paper mill are different. The authors find good removal for experiments "simply with disintegration and washing". Except at some older mills in the U.S., world wide the washing process is not used in industrial scale for the production of graphic paper due to high losses of fibers and water (*see introduction*).

Also the suggested ultrasound treatment looks impractical and too expensive for industrial application to a varying mixture of paper. Only if Indigo prints are collected separately from other paper and treated separately in a recycling plant especially designed for this purpose, this process will work, though the costs might be far from an economical solution.

Dry toners do it better

Dry polyester toners, as they are applied for digital four color printing processes from NexPress, Ricoh, Xeikon, Xerox and others, create fewer problems. The resulting brightness and residual ink are sufficient to lead to good deinkability.

A future trend in dry toners is to lower the melting temperature. This could lead to problems in paper recycling as the particles might form elastic aggregates under the conditions of the deinking process. These aggregates are very difficult to remove. Deinkability tests should accompany these developments to avoid the creation of new problems by trying to save energy.

UV inks: Most of them leave too many specks

UV inks are developing quickly into different applications, leaving the packaging sector and offering ways to glossy finishing as well as to water based, fast drying inkjet inks. But UV ink particles can pass the flotation process as well as screens to end up as visible specks in the paper. Still, curing inks with UV might one day be an option to turn small pigments into screenable pieces.

Regulatory consequences

In Europe, an eco-label for printed products is under discussion. One of the criteria for this label will be recyclability and

especially deinkability. Many digital printing processes deliver products that will fail to fulfill these requirements.

In Austria, there is already an eco-label for production printers requiring deinkability.

As soon as significant problems in the paper mills will be observed, in some countries a label "non-recyclable" to be applied by the printer might become mandatory in order to inform the consumer who cannot tell one print process from another. This will especially be necessary for inkjet printed newspapers to keep them away from the paper recycling cycle as long as they are unrecyclable. INGEDE will increase the communication of recycling problems associated with inkjet printed newspapers towards authorities, publishers and consumers as this technology means a serious problem for the current utilization of recovered paper.

Automated detection systems that will be able to remove flexo ink printed papers and inkjet printed papers are currently under development.

Many printer manufacturers beyond the participants of the first round table have agreed to provide samples for the deinkability survey.

Who is INGEDE?

INGEDE is an international research organization of paper mills that recycle paper to produce graphic and hygiene paper. INGEDE already spent more than 5 million € for research in deinking technology, deinkability of printed products, standardizing test methods and related research topics.

References

[1] Axel Fischer, What Makes a Digital Print Recyclable? Results of a European Survey. Paper presented at NIP22, Denver, USA, September 17–22, 2006

[2] A. Fricker, A. Manning and Robert Thompson, Deinking of Indigo prints using high-intensity ultrasound, Surface Coatings International Part B: Coatings Transactions, Volume 89, Number 2, June 2006, pp. 145-155(11)

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. Since 1994, he is responsible for the public relations of INGEDE, the International Association of the Deinking Industry. Besides dealing with international media, he also represents the association at international events and working groups dealing with recyclability, with flexo inks and digital printing technologies and the consequences of recycling printed materials. He chairs the European Round Table on the Deinkability of Digital Prints.