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Deinkability of printed matter

This leaflet is aimed at printers and publishers to give an overview about deinkability of printed graphic paper products and deinking issues.

The industries represented by the printed paper products have invested millions of Euros in new technologies to best service the communication needs of Europeans. In recent years, the environmental challenge has become an increasingly significant factor for the industries when determining the communication strategy of a customer. A considerable number of break-through technologies have been made in this respect and the industries continue to push the boundaries and improve their performance.

One of these areas relates to deinkability of printed materials in the recycling process. This paper – the first in a series on recycling issues, describes the necessity of deinkability and the challenges the recycling industry has to face.

Recovered paper is an essential raw material for the paper industry

The paper industry depends on the proper balance of virgin and recycled fibres. To increase recycling rates above today's levels helps to maintain the sustainability of the paper value chain. Political bodies in Europe are therefore demanding more intense recycling efforts. As part of the „European Declaration on Paper Recycling” [1], the major stakeholders in the paper value chain emphasise their commitment to increase the recycling rate to 66 percent by 2010. The recycling rate is the proportion of recovered paper fed to recycling as a percentage of the total paper consumption.

The European Declaration on Paper Recycling specifies measures that aim to optimize handling of recovered paper throughout the entire value addition chain – from paper manufacture through its processing and printing to the collection, sorting and transport of the recovered paper, carton and cardboard.

The signatories to the Declaration include the European Associations of the paper and printing industry, publishers of newspapers and magazines, as well as manufacturers of printing inks and adhesives.

A good deinkability is of increasing importance

Recovered paper has been used in deinking plants for newsprint papers and similar grades for decades. Its share in the furnish climbed to 100% in many cases. A further increase in the utilisation of recovered paper can only be achieved in higher, more demanding grades. To be able to meet those requirements, improved deinkability of printed paper products has become essential.

More and more paper is now being collected, often at the expense of quality – also more recovered paper that is not suitable for production of graphic paper reaches the paper mills. Hence the mills that produce recycled based high quality graphic paper suffer from a continuously deteriorating raw material

Evaluation of deinkability

Investigation of deinkability according to INGEDE Method 11 is now recognised as an international standard [2]. A deinkability scoring system has been developed based on this method and was approved at the European Recovered Paper Council in March 2008 by the signatories and supporters of the European Declaration on Paper Recycling.

Points for good performance enable comparison

Samples of graphic printed products are analysed in the laboratory under standardised conditions. These tests deliver values for luminosity, colour change, dirt particle area, ink elimination and discoloration of white water.

Ranges have been defined for these points on the basis of random samples. Printed products must lie within these ranges to be considered deinkable.

Points are calculated from the test results. A single value is calculated in which the parameters are weighted according to their importance. This enables comparison of different categories of printed products. The maximum number of points that can be attained is 100.

Upper and lower threshold values or a value range have been laid down for this points system – depending on the parameters. The values measured must satisfy the relevant requirements. These threshold values are independent of the category of the print product and are listed in Table 1. The print products must meet the threshold values for all parameters. If a product fails to meet one of the threshold values then it is to be regarded as “not suitable for deinking”.

Parameter	Y [Points]	a* [-]	A ₅₀ [mm ² /m ²]	A ₂₅₀ [mm ² /m ²]	IE [%]	ΔY [Points]
Lower Threshold	47	-3.0			40	
Upper Threshold		2.0	2.000	600		18

Table 1: Threshold values of deinkability scores
Luminosity (Y), colour shade (a*), dirt particle area (A) in two size classes (A₅₀: larger than 50 μm, A₂₅₀: larger than 250 μm), ink elimination (IE) and discoloration of the filtrate (ΔY)

Evaluation criteria

The first three parameters are quality characteristics of the deinked pulp – brightness, colour and cleanliness (luminosity Y, colour shade a* and dirt particle area A, the latter one in two size classes – one for all visible dirt particles and one for large visible dirt particles). The other two are process parameters (ink elimination IE and discoloration of the filtrate ΔY). They are representative of the effect of the printed matter on the operation of the plant and are to be regarded as supporting parameters.

Target values apply for all print products and parameters (Table 2). The target values for the parameters colour (a*), dirt particle area (A) and filtrate discoloration (ΔY) are the same for each print product category. The target values for the luminosity of the deinked pulp (Y) and the ink elimination (IE) vary from one category to another.

Category of print product	Y [Points]	a* [-]	A ₅₀ [mm ² /m ²]	A ₂₅₀ [mm ² /m ²]	IE [%]	ΔY [Points]
Newspapers	≥ 60	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 70	≤ 6
Magazines, uncoated	≥ 65				≥ 70	
Magazines, coated	≥ 75				≥ 75	
Stationery (Y of base paper ≤ 75)	≥ 70				≥ 70	
Stationery (Y of base paper > 75)	≥ 90				≥ 80	

Table 2: Target values (for abbreviations see table 1)

Maximum of 100 points

Points are awarded and added together for the 5 parameters.

The parameters are weighted differently – the most important parameters (luminosity and dirt area) account for 60 of the maximum of 100 points. The sum enables a simple overall evaluation of the deinkability of print products with a numerical value between 0 and 100 points (Table 3). If a threshold value is not reached then the overall score is 0.

The Challenges

Flexographic printing

Flexographic printing is performing adequately for many packaging and some other printing jobs without generating problems in the end of life phase of the product. Flexography is however also used occasionally in newspaper printing, and so far this application is generally not suitable for deinking. The flexo ink particles cannot be removed from the recycled pulp.

The presence of newspapers printed using flexographic processes, even in small quantities, amongst newspapers and magazines printed using offset and rotogravure processes can render them unusable for deinking.

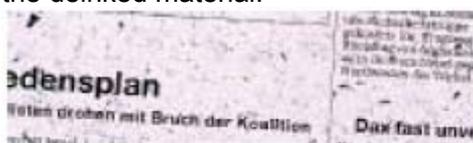
For years research efforts have displayed improvements. Some first printing inks with slightly improved deinkability are presently being tested.

Research is therefore also progressing in the direction of developing new automated sorting methods that recognise and remove flexographic newsprint.

Digital printing

Digital printing processes are about to supplement offset printing in many areas and open up new business opportunities, involving also larger print runs. They enable saving waste paper both during production and via more flexible ordering management.

Different ink systems are used in digital printing, such as dry or liquid toners; some of them are not favourable to de-inking. Inkjet inks contain either soluble dyes or pigment particles that are very small. The presence of either, in low quantities, has an adverse effect on the outcome of deinking as the separation processes developed for offset inks and rotogravure inks do not work for them. This also applies for liquid toners that can severely contaminate the deinked material.



Liquid toners can leave visible residues (dirt specks) in recycled paper.

Dry toners can generally be deinked without difficulty. Inkjet or liquid toner processes should therefore not be used for high print runs such as newspapers, magazines, direct mail or inserts.

UV printing

UV-curing printing inks have rarely satisfied the criteria for good recyclability to date. Some UV inks are deinkable but most cases tested to date show a presence of excess printing ink particles in the recovered paper. These excess particles cannot be satisfactorily removed, (if at all). This also applies for a further variant of UV-curing inks that are used in inkjet printers.

Papers printed with UV-curing inks can adversely affect the deinkability of individual recovered paper batches. Such products therefore have to be collected separately already at the production site and sent for disposal (printers' waste) or – in an ideal case with corresponding labelling – should be pre-treated by the recovered paper dealers (covers of magazine returns).

One possible solution is the development of new printing inks that can be removed under the usual conditions used for processing of recovered paper, i.e., the inks are removed from the fibres in the alkaline environment of paper treatment and can then be separated through flotation.

Deinkability is a global challenge

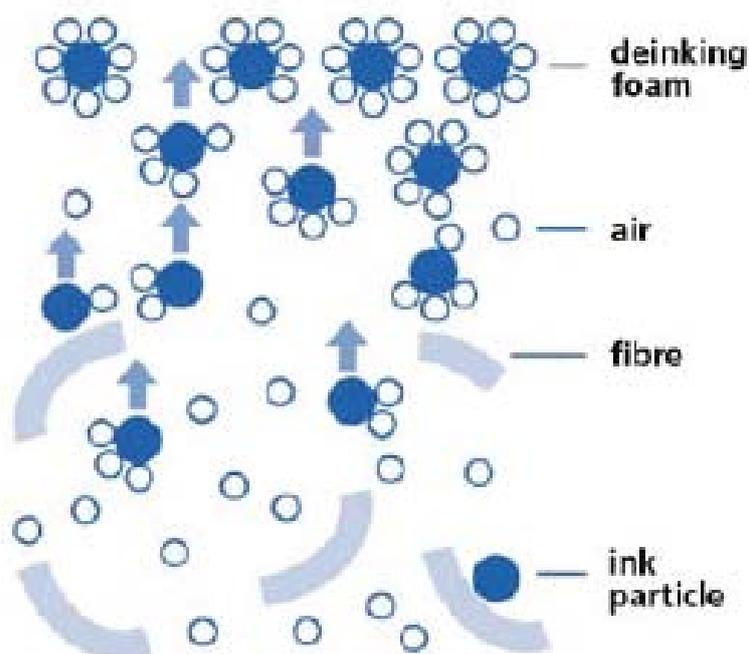
As explained, the deinkability of printing inks varies depending on the ink. Water-based inks present problems since they also dissolve in the recycling process. Cross-linked ink particles cannot be removed either mechanically (through a sieve) or through flotation because of their size, flexibility and surface characteristics.

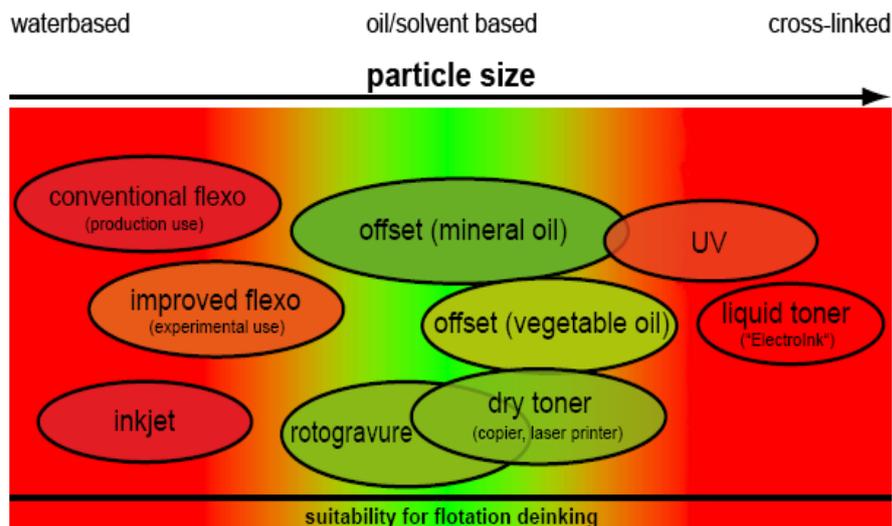
At the same time, the weight of the newspaper paper is falling and there is a tendency towards more 4-color pictures. This means paper mills must remove increasing quantities of printing ink from fewer and fewer fibres.

The paper mills, together with manufacturers of printing inks, their associations and publishers, are continuously investigating the deinkability of current print products.

Efforts are also being made in co-operation with manufacturers of printing inks to replace inks that have a poor deinkability with inks that are better in terms of recycling.

Upon deinking, small air bubbles transport the printing ink removed from the fibres to the surface.





Points	Evaluation of deinkability
71 to 100 points	good deinkability
51 to 70 points	fair deinkability
0 to 50 points	poor deinkability
negative (failed to meet at least one threshold value)	not suitable for deinking (may be recyclable without deinking)

Table 3: Evaluation

What printers and publishers can do?

- For production processes with larger print runs the deinkability performance of the technology should be established before the investment is concluded.
- UV inks that have better deinking characteristics should be chosen, if available. For further information, contact your ink supplier.
- UV overprinted sheets should be isolated and treated separately.

Further information: Recyclability Guide

European Recovered Paper Council (ERPC) issued the “Guide to an Optimum Recyclability of Printed Graphic Paper” in September 2008 [3]. The associations in the ERPC have declared their willingness to continue their activities to improve the recyclability of printed paper products.

Sources

[1, 3]: Further information on the European Declaration, the guidelines and deinkability scores system is provided at www.paperrecovery.eu

[2]: Further information on INGEDE Method 11 can be found at <http://www.ingede.com/ingindx/methods/meth11pe-2007.pdf>