

# Guide to an optimum utilisation of recovered graphic paper

Bundesverband Druck e. V.  
Industrieverband Klebstoffe e. V.  
Internationale Forschungsgemeinschaft Deinking-Technik e. V. (INGEDE)  
Verband Deutscher Papierfabriken e. V. (VDP)  
Verband Deutscher Zeitschriftenverleger e. V. (VDZ)  
Verband der Druckfarbenindustrie

## Guide to an optimum utilisation of recovered graphic paper

In recent years the recycling of recovered paper in the manufacture of graphic papers has increased considerably.

Today recovered paper is, in terms of quantity, the most important raw material for the German paper industry, and now in particular newsprint consists almost entirely of recovered and subsequently recycled graphic paper. The treatment of recovered paper starts with the separation of non-paper components, and is followed by the removal of the printing ink in the flotation-deinking process. The share of printing ink in average recovered paper mixtures amounts to ca. 2 per cent. However, the yield of deinked pulp (DIP) is only between 80 and 85 per cent, because besides the printing ink also fragments of paper fibre and parts of the mineral fillers and coating pigments are removed.

The outcome of the recovered paper treatment depends on many factors (e.g. quality of the paper, type of printing process, properties of the printing ink, etc.). Moreover the ageing process and climatic conditions during the life cycle of the print products influence the result.

It has recently become increasingly difficult in deinking pulp mills to maintain the customary standards of yield and brightness of DIP. The reasons for this are manifold:

- Because of high collecting rates throughout the country and the collection in systems being unsuitable for the recovery of graphic paper for the purpose of deinking, requirements to recovered paper quality are not met; e.g. due to higher shares of board or aged products.
- The increase in the recycling rate of recovered paper leads to lower shares of virgin fibres in recovered paper.
- The trend in newspaper printing to apply growing quantities of ink onto ever thinner paper leads to an unfavourable quantitative ratio of ink : paper.

To make up for these unfavourable developments, the equipment used in deinking plants is constantly extended. However, to maintain the achieved standard, it is also necessary that everyone involved in the paper chain – including parties placing the order and designers of print products – considers also the requirements of recycling.

Various process steps must be evaluated in the technical process of recovered paper treatment.

### 1. Separation of non-paper components

As a matter of principle, operators of deinking plants see non-paper components in an unfavourable light, because they increase waste quantities. However, quite often such components cannot be avoided. To impair the deinking process as little as possible, the following requirements are made: Non-paper components should be dimensioned and mechanically stable in such a way that they survive as large particles, without being comminuted, in the conditions of pulping and allow mechanical separation by means of punched screens, slot screens and centrifugal purifiers. Relevant examples are cover foils, staples, thick adhesive layers, various product samples. Materials applied in very small dimensions or disintegrating into very small parts are unfavourable, because they cannot be removed using today's conventional sorting methods.

## 2. Removal of the printing ink film

The next step is to remove the printing ink film from the paper fibres. In the case of print on coated paper there is, of course, no contact between printing ink and paper fibres. Here no problems arise, because the paper coating disintegrates as the recovered paper is pulped and fragments of the ink film are released. On uncoated paper the adhesion of printing ink to paper depends, firstly, on paper properties such as surface structure, fibre type, ash content, etc. and, secondly, the drying mechanism of the chosen printing process. Printing inks which form firmly sticking, tenacious printing ink films are more difficult to remove from the fibre. Examples of inks forming sticking, tenacious ink films are radiation curing systems (UV inks) and offset inks containing large shares of oxidatively drying oils such as linseed oil or soy oil (sheet fed offset inks, some newsprint offset inks).

## 3. Soluble and redispersable components

Recovered paper components which dissolve in the process under standard conditions of deinking (pH 8-10) and reach the process water pose a risk of unintended spreading to all parts of the paper machine. Problems occur when sticky residues – stickies – form in redrying. Stickies can be removed only in tedious manual work from the switched-off paper machine. A well-known way in which stickies form is the agglomeration of dispersed or dissolved auxiliary materials, e.g. water-soluble or redispersable adhesives, paper coating binders, coatings, varnishes and printing ink constituents. A similar – albeit very rare – problem arises when dyes from paper or printing ink dissolve initially in water and later on move onto clean paper fibres.

This results in the requirement that recovered paper should contain as few components as possible which dissolve or disperse in a weakly alkaline medium and form sticky residues or cause discoloration.

## 4. Flotation

Flotation is the essential step to remove printing inks. Supported by surface active substances, printing ink particles gather on the surface of air bubbles. This process works at an optimum with printing ink particles sized between about 20-100  $\mu\text{m}$ . The thus loaded air bubbles stream upwards through the paper pulp. On the surface of the flotation cell a dark foam segregates which contains printing ink, fragments of paper fibre, fillers and coating pigments. Particles smaller or bigger than the optimum particle size are floated with less efficiency.

In rare cases water-based printing inks are used for flexo-newsprint or publication gravure printing. These inks contain binders soluble in the alkaline range. Consequently, in deinking such inks do not break up into fragments of printing ink film but into pigment-primary particles sized smaller than 1  $\mu\text{m}$  and not enveloped by the binder. These particles are much too small for flotation.

Printing ink particles too large for the flotation process occur in cases of tenacious, cross-linked ink films in thick layers on coated paper. This problem can arise in connection with coated papers and UV inks or conventional sheet-fed offset inks coated with UV varnishes. When such coarse printing ink particles are obtained, the paper factory still has the option of comminuting them in a disperser and float them once again.

## **Recyclability assessment**

Development and design of print products are dynamic. Materials and processes, too, are subject to technical innovations. Therefore it is necessary that all parties involved evaluate their products as to good recyclability if major changes are made to materials and processes.

Solutions are available to the various problems highlighted in this **guide**. These solutions must be examined in each individual case. In this examination additional criteria, e.g. production quality, economic efficiency, environmental protection, occupational safety, etc must be included in the assessment.

The *Institut für Papierfabrikation* (Institute for Paper Technology) at the Darmstadt Technical University and the *Papiertechnische Stiftung* (Paper Technology Foundation) in Munich developed a series of test methods. With the help of these methods it can be assessed whether print products meet the criteria of recyclability (annex).

When assessing whether the criteria of recyclability have been fulfilled, the relevance of the quantity of the examined print product must be taken into account with regard to its effect on the composition of recovered graphic paper.

## **Reuse of residues from the deinking process**

The paper industry is eager to reuse residues generated in recovered paper treatment or to find external possibilities of reuse. Technical and economically feasible options are available. Here it is important that the reuse of residues is not impaired by individual constituents.

Statements made in this guide will be reviewed annually and revised if necessary.

Annex**Methods for Testing the Recyclability of Printed Products****PTS-RH 021/97**

“Testing of raw materials, pulp and additives of paper manufacture.”

**DIN 54606**

“Testing of papers, identification of the flotation deinkability of printed recovered paper.

Part 1: Flotation deinking method.”

**INGEDE – test methods**

01/1997: Test sheet preparation from deinked pulp for measurement of optical characteristics.

02/1997: Measurement of optical characteristics of deinked pulp.

03/1997: Optical evaluation of deinking filtrates.

04/1997: Evaluation of macro-stickies in deinked pulp.

05/1997: Evaluation of printing ink detachment by hyperwashing with the Haindl-McNett classifier.

06/1997: Precipitation of anionic substances.

07/1998: Entry inspection of unbaled recovered paper for deinking (D 39).

08/1998: Entry inspection of baled recovered paper for deinking (D 39).

09/1998: Test of adhesives on their potential to create stickies in paper machine dryer sections.

10/1999: Quantitative evaluation of the ink elimination during deinking.

Note: The methods for testing the recyclability of graphic paper products will be reviewed in an INGEDE project and revised to meet actual requirements.

## **Addresses**

Bundesverband Druck e. V.  
Biebricher Allee 79  
D-65187 Wiesbaden

Industrieverband Klebstoffe e. V.  
Ivo-Beucker-Straße 43  
D-40237 Düsseldorf

Internationale Forschungsgemeinschaft Deinking-Technik e. V. (INGEDE)  
c/o Verband Bayer. Papierfabriken e. V.  
Widenmayerstraße 39  
D-80538 München

Verband Deutscher Papierfabriken e. V.  
Adenauerallee 55  
D-53113 Bonn

Verband Deutscher Zeitschriftenverleger e. V.  
Winterstraße 50  
D-53177 Bonn

Verband der Druckfarbenindustrie  
im Verband der Mineralfarbenindustrie e. V.  
Karlstraße 21  
D-60329 Frankfurt am Main