

Orientation Values for the Assessment of the Recyclability of Printed Paper Products

*(translation from “Orientierungswerte zur Bewertung der Rezyklierbarkeit von
Druckerzeugnissen aus Papier“)*

6 November 2006

Contents

Part 1: General	1-2
Preface.....	1-2
Field of Application.....	1-3
Principle	1-3
Part 2: Deinkability	2-1
Assessment of Deinkability.....	2-1
Relevance of the single results	2-2
Explanatory note to the test results	2-2
Deinkability of Printed Products	2-3
Part 3: Screenability of Adhesive Applications	3-1
Assessment of the screenability	3-1
Orientation Values.....	3-1
Screenability of Adhesive Applications	3-2
Part 4: Annex	4-1
Cited Test Methods and literature references	4-1
Terms and Definitions	4-2
Sampling	4-3
Test Methods	4-3
Test Report.....	4-4

Part 1: General

6 November 2006

Preface

The “Guide to an Optimum Recyclability of Printed Graphic Paper” was adopted in 2002 by the international industry associations CEPE, CEPI, FAEP, FEICA, INGEDE and INTERGRAF. The associations involved in the paper chain declared their willingness to continue activities to improve the recyclability of printed paper products.

The efforts to improve the recyclability of a specific printed graphic paper product can only be executed by a joint work of all parties involved in the design, manufacture and reuse of this product, which includes all suppliers. First the influencing factors on recyclability have to be studied by field and laboratory work. They can not be defined by simple, theoretically determined optimisation. Based on this, a program has to be developed to quantify the influence of the single components. Only after that it will be possible to determine precise measures to improve the recyclability without affecting the product quality, the technical performance or the cost situation.

In this relation INGEDE funded and supervised studies to evaluate the current state of the recyclability of commercial printed paper products.

This paper was prepared by a working group within the Technical Committee Deinking. The Technical Committee Deinking is an informal committee of the members of the paper chain in Germany, consisting of the associations:

- Bundesverband Druck e.V.
- Industrieverband Klebstoffe e.V.
- International Organisation Promoting the Self Adhesive Labelling Industry (FINAT)
- Internationale Forschungsgemeinschaft Deinking-Technik e.V. (INGEDE)
- Verband Deutscher Papierfabriken e.V.
- Verband Deutscher Zeitschriftenverleger e.V.
- Verband der Druckfarbenindustrie

Field of Application

This paper describes orientation values for the recyclability of printed graphic paper products intended for publication.

These orientation values are applicable for individual printed graphic paper products only – as a whole or sections of it. They are not designated to be used for the entry inspection of recovered paper or the test of deinked pulp (DIP).

Principle

Printed graphic paper samples are treated in laboratory scale according to standardised testing procedures. The results of these laboratory procedures show a good correlation with the quality of the pulp after the deinking process.

Recyclability is mainly depending on the performance of two processes: The removal of printing inks and the removal of adhesive applications. In this paper orientation values for the behaviour of printed paper products during reprocessing are defined in order to evaluate their recyclability. These orientation values describe the desired characteristics of the deinked pulp in order to ensure its use for the production of printing and writing paper, hygiene paper and other paper and board grades for which runnability and optical parameters are important.

The second part of this document refers to the removal of printing inks which influence the optical properties of the deinked pulp.

The third part deals with the fragmentation of adhesive applications and their removal by a laboratory screening process. It serves as an evaluation for potential sticky problems at the paper machine.

A printed graphic paper product whose test values match or exceed the orientation values defined in this paper sufficiently fulfils the requirements of the deinking paper industry.

The testing procedures to be used are described in detail in the quoted INGEDE Methods. These INGEDE Methods usually utilise standardised test methods specified by DIN, EN, ISO and combinations thereof.

Part 2: Deinkability

6 November 2006

Assessment of Deinkability

The results of the research work show that the average deinkability of printed products – newspapers, magazines, catalogues ... – is sufficient to meet the paper industry's needs. In order to classify the results reasonably five product groups were defined:

- Newspapers (independent of the printing process)
- Offset Magazines & Flyers, uncoated
- Offset Magazines & Flyers, coated
- Rotogravure Magazines, uncoated
- Rotogravure Magazines, coated

The deinkability is assessed according to five parameters:

Targets	Evaluation parameters
high reflexion	Luminosity Y deinked pulp
no change of colour	a*-value of deinked pulp
high optical cleanliness	Dirt particle area A deinked pulp
high ink elimination	Ink Elimination IE ₇₀₀
no discolouration of process water	Filtrate Darkening ?Y

The parameters Luminosity, a*-value and Dirt particle area supply a statement on the quality of the deinked pulp and the parameters Ink Elimination and Filtrate Darkening allow to estimate the effect of the deinking process.

The evaluation of the deinkability is carried out according to INGEDE Method 11, a laboratory procedure simulating the conditions of a typical deinking plant for recovered paper for deinking and similar grades of recovered paper.

Thus the lower limit of the confidence interval (statistical reliability 95%) around the corresponding average value obtained from the data base can be regarded as "orientation value" for a sufficient deinkability. Information about the statistical analysis is given in bibliographical reference 6 (see annex)

In the version at hand the rigorous appearing numeric orientation values have been replaced by a colour scheme (overleaf) where the grade of deinkability is displayed by the traffic light colours red, yellow and green. At this the red colour shows a critical deinkability, the yellow colour an improvable deinkability and the green colour a good deinkability. The colour scales are shown in the following pages.

Additional requirement for the Dirt particle area:

The deinked pulp should be free of large visible specks.

Relevance of the single results

However, one test result meeting the orientation value for a printed graphic product may not be sufficient for the grading of the product. Tests have shown that comparable products printed at different locations and prints produced at the same location on consecutive days can vary significantly in their deinking behaviour, partly showing insufficient results. These facts show that the search for influencing factors to the deinking behaviour of printed products has to be continued. Paper characteristics, printing ink characteristics, printing conditions, printing area coverage, age and previous history of the printing object have to be mentioned as important parameters

Even printed products who don't achieve the actual figures could be used for production when adjusting the recycling process. However such adjustment could impair the deinking behaviour of other printed products.

Explanatory note to the test results

The orientation values are derived from a database of deinkability results assembled and evaluated by a number of relevant INGEDE projects.

The laboratory flotation should be adjusted to a yield of at least 80 % for uncoated papers and at least 70 % for coated papers.

Several aspects of the INGEDE Method 11 have been revised within the scope of the INGEDE Project 85 02. The parameters luminosity and colour shade have not been affected thereby. For the filtrate darkening now the deinked pulp sample is used instead of the undeinked sample. However this has no significant bearing on the results. The sample preparation and the evaluation of the Ink Elimination have been modified. For measuring the dirt particle area today modern image analysis systems are used. However, the orientation values are based so far on the results achieved by using the common Dot-Counter. In order to achieve similar results the image analysis systems have to be adjusted which still raises questions. For that reason the results are furthermore based on the Dot-Counter values.

Round robin tests displayed that for reproducibility of the test method the variation coefficients are 4% for luminosity and 8 % for IE₇₀₀.

Deinkability of Printed Products

Newspapers

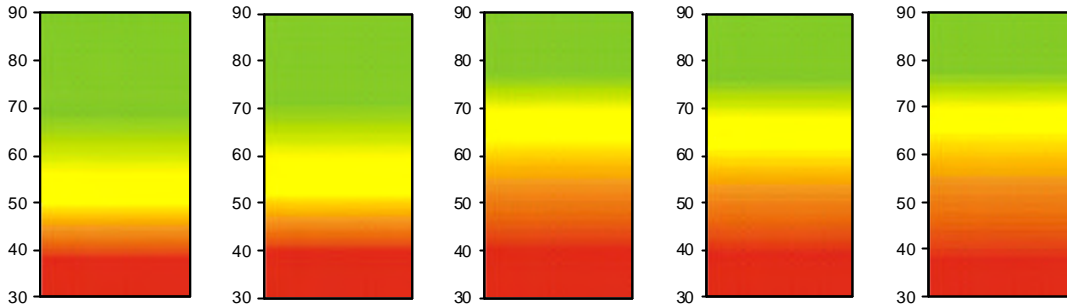
Offset-Magazines
& Flyers/Catalogues
uncoated

Offset-Magazines
& Flyers/Catalogues
coated

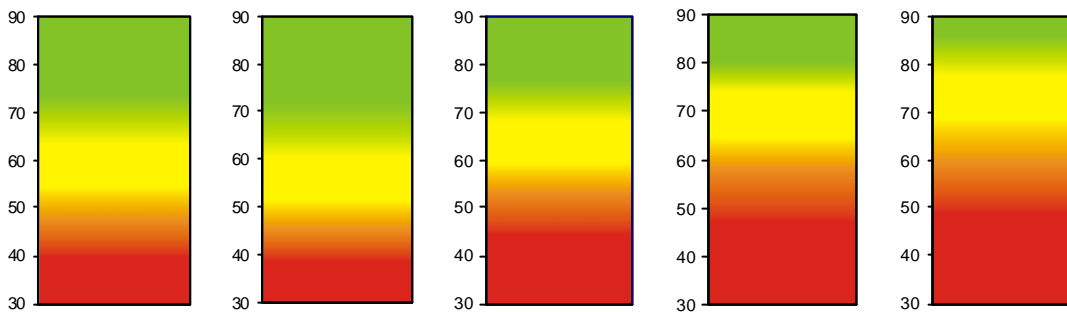
Rotogravure
Magazines
uncoated

Rotogravure
Magazines &
Catalogues coated

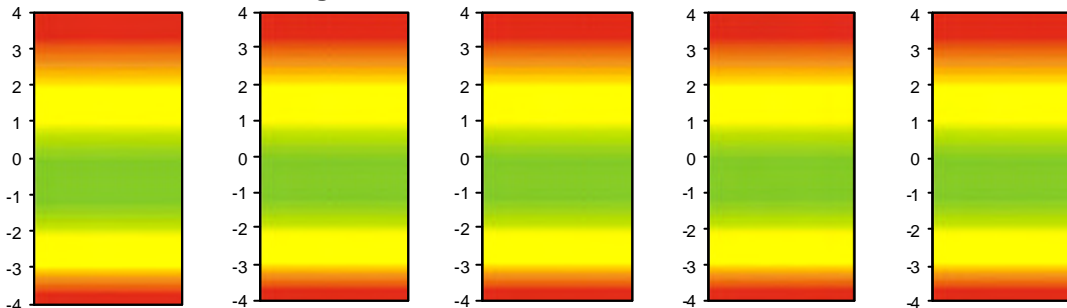
Luminosity Y after Deinking, -



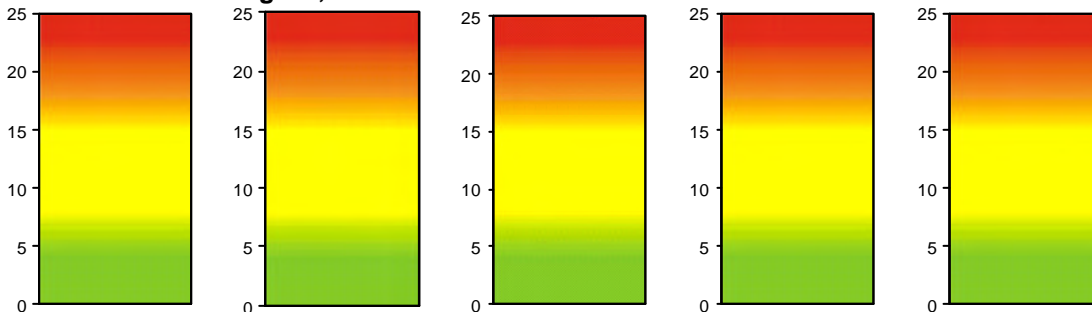
Ink Elimination IE_{700} , %



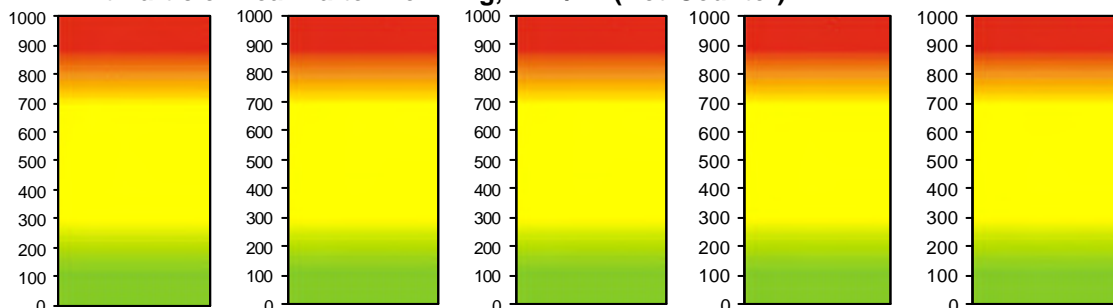
a*-Value after deinking, -



Filtrate Darkening ?Y, -



Dirt Particle Area A after Deinking, mm^2/m^2 (Dot-Counter)



Part 3: Screenability of Adhesive Applications

6 November 2006

Assessment of the screenability

The sufficient removal of adhesive applications is one of the challenges for the paper manufacturers using DIP. Although the paper industry and their equipment suppliers made great progress, a high removal efficiency can only be achieved when adhesive applications disintegrate into particles of large size. Small sized particles or particles of redispersible adhesives accumulate in the process loops and will lead to major problems in paper production and/or converting processes. This knowledge led to the definition that in order to be “good recyclable”

- adhesive applications have to be detectable as macrostickies,
- the share of small adhesive particles (below 2,000 μm equivalent circle diameter) has to be limited and
- the total area of small adhesive particles (below a threshold value of 2,000 μm equivalent circle diameter) has to be limited.

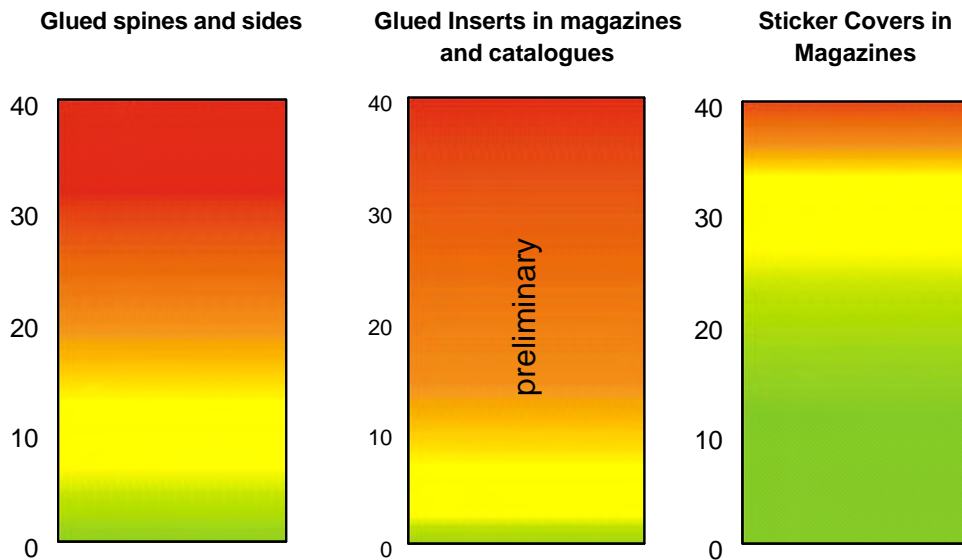
Orientation Values

Precondition:

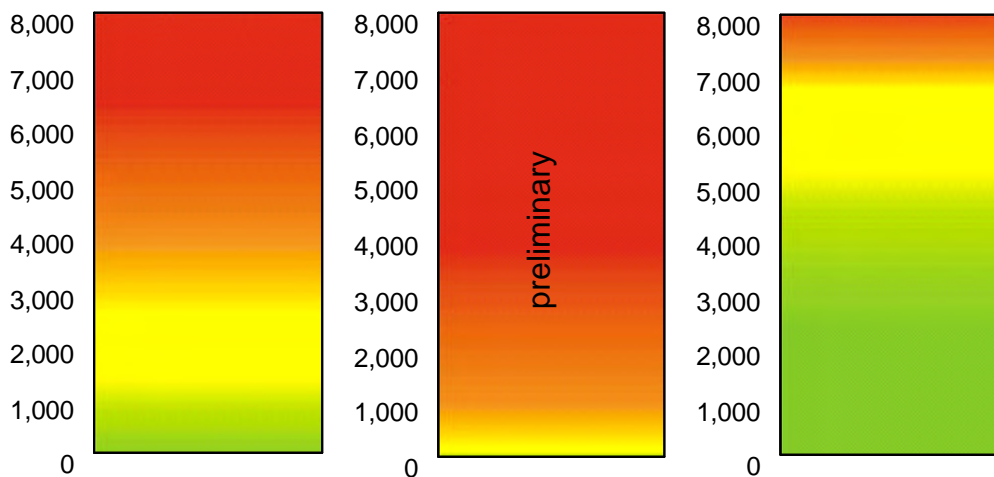
If a printed paper product contains one or more adhesive applications, these have to be detectable as macrostickies. If this not the case, it means that the adhesive application only forms microstickies respectively potential secondary stickies. Here an adequate removability of adhesive applications is not given in any case.

Screenability of Adhesive Applications

Share of Macrosticky Area < 2,000 µm [%]



Total Area of Macrostickies < 2,000 µm [mm²/kg b. d. printed product]



Remarks:

Glued spines:

The orientation values are based on tests with hotmelt adhesives and PUR. In these cases recyclability is mostly not problematic.

Glued inserts:

The definition of the orientation values is based on few results for the moment. Here further examinations are necessary.

**Orientation Values for the Assessment of the
Recyclability of Printed Paper Products
Part 3 – Screenability of Adhesive Applications**

Label covers:

This is about so called sticker-campaigns which are more and more performed by popular magazines on special occasions. These campaigns can cause major breakdowns and quality defects at the paper mills using recovered paper as raw material. The orientation values defined in this paper are only achieved by a small part of the adhesive applications used nowadays. The major part exceeds the orientation values significantly; therefore every kind of improvement is helpful for the paper industry using recovered paper.

Part 4: Annex

6 November 2006

Cited Test Methods and literature references

INGEDE Method 4: Macrostickiness Evaluation 1999-12

INGEDE Method 10: Quantitative Evaluation of the Ink Elimination during Deinking (Ink Elimination IE) – 2005-06 (Draft)

INGEDE Method 11: Assessing the Recyclability of Printed Products – Deinkability Test – 2006-06 (Draft)

INGEDE Method 12: Assessing the Recyclability of Printed Products – Testing of Fragmentation Behaviour of Adhesive Applications – 2001-11 (Draft)

ISO 4046-2:2002: Paper, board, pulps and related terms – Vocabulary – Part 2: Pulp-
ing terminology

ISO 4046-3:2002: Paper, board, pulps and related terms – Vocabulary – Part 3: Pa-
per-making terminology

ISO 4046-4:2002: Paper, board, pulps and related terms – Vocabulary – Part 4: Pa-
per and board grades and converted products

ISO 15360-2:2001: Recycled pulps – Estimation of Stickies and Plastics – Part 2:
Image analysis method

All INGEDE Methods can be downloaded from www.ingede.org.

The results used for the orientation values originate from the following research pro-
jects:

1. Ackermann, C., Götsching, L.: Criteria for Recycling-Oriented Print Products; INGEDE Project 66 99 IfP
2. Ackermann, C., Götsching, L.: Adhesive Fragmentation; INGEDE Project 68 00 IfP
3. Ackermann, C., Götsching, L.: Deinkability of Printed Products; INGEDE Project 74 01 IfP
4. Putz, H.-J., Schabel, S.: Recyclability 2003; INGEDE Project 94 03 IfP
5. INGEDE Project 85 02 CTP/IfP/PTS: European Deinkability Test Method
6. Ackermann, C., Putz, H.-J., Götsching, L.: Printed Products on the Test Bench – Process Simulated Characterisation of the Recyclability ipw/Das Papier (2001) Nr. 3, S. T50-T55

Terms and Definitions

- Recyclability:** Property of a printed product to be recycled without significant negative effect on the deinking or paper production process and any converting processes as well as on the quality of DIP or the paper produced. There a similar quality level like the one of the paper used for the printed product should be achieved.
- Deinkability:** Extensive removal of printing colour or toner from a printed product by means of the deinking process. This shall rebuild the optical character of the unprinted paper as far as possible without affecting the deinking process itself.
- Dirt Particle Area:** Visible dirt specks on laboratory sheets or paper. Particles with a diameter of at least 50 µm are regarded visible.
- DIP (deinked pulp):** Pulp made from recovered paper by a process whose relevant steps are deinking and screening. Definitions of pulp, deinking and screening according to ISO 4046-2
- Coated Paper:** Paper improved by a pigment coating process on one or both sides which can be mat or glossy. (see ISO 4046-4)
- Uncoated Paper:** A paper which has not undergone the coating process. Definition of the coating process see ISO 4046-3.

Sampling

It is recommended to test complete graphic paper products. If only parts of a product can be tested it has to be ensured that the portion for the test is representative for the whole product with respect to its content of printing inks and adhesive applications.

Note:

If a product contains paper of different types of printing processes and/or adhesive applications, it might be of interest to test only one specific type of printed paper. In that case the sample should consist of portions containing only this type of print respective adhesive.

Test Methods

Luminosity

Determination of luminosity according to INGEDE Method 11. The value Y is measured at both sides on the filter pad of the deinked sample.

a* Value

Determination of a* value according to INGEDE Method 11. The value a* is measured at both sides on the filter pad of the deinked sample.

Ink Elimination

Determination of ink elimination according to INGEDE Method 10.

Filtrate Darkening

Determination of filtrate darkening ΔY according to INGEDE Method 11.

Dirt Particle Area

Determination of the dirt particle area of the deinked pulp according to INGEDE Method 11.

Flotation Yield

Determination of the flotation yield according to INGEDE Method 11.

Total Area of Macrostickies retained on slots > 100 μm

Determination of the total area of macrostickies according to INGEDE Method 4.

Share of Macrosticky Area < 2 000 μm

Determination of the share of macrostickies below the size of 2 000 μm (equivalent circle diameter) according to INGEDE Method 12. The heat treatment described in chapter 5.1 is omitted. In combination with the paragraphs 5.2 and 5.3 of INGEDE Method 12 the definitions for sampling in this paper have to be considered.

The method to determine the macrostickies content is also described in ISO 15360-2 A Haindl fractionator or a Somerville fractionator with a slotted plate of 100 µm slot width has to be used and the stickies have to be marked by corundum powder.

Total Area of Macrostickies < 2 000 µm

Determination of the total area of macrostickies below the size of 2 000 µm (equivalent circle diameter) according to INGEDE Method 12. The heat treatment described in chapter 5.1 is omitted. In combination with the paragraphs 5.2 and 5.3 of INGEDE Method 12 the definitions for sampling in this paper have to be considered.

The method to determine the macrostickies content is also described in ISO 15360-2 A Haindl fractionator or a Somerville fractionator with a slotted plate of 100 µm slot width has to be used and the stickies have to be marked by metallic powder.

Test Report

The following items must be recorded in the test report:

- Identification of print product by name, publishing company, date of issue, product category, print process and paper quality, testing of the complete object or parts of it
- Mass-related proportion of supplements and non-paper material in %
- Number and type of adhesive applications
- Luminosity value Y of deinked pulp
- a* -value of deinked pulp
- Ink elimination IE in %
- Filtrate darkening ΔY of the undeinked filtrate sample
- Dirt Particle Area of deinked pulp in mm^2/m^2
- Flotation yield in %
- Share of macrostickies area smaller than the equivalent circle diameter of 2 000 µm (%)
- Total area of macrostickies smaller than the equivalent circle diameter of 2 000 µm (mm^2/kg)
- All deviations from the conditions specified by test methods used, if applicable (e. g. specification of the laboratory flotation cell, conditions of flotation).

Any observation of further optical characteristics of the undeinked or deinked pulp as well as the respective filtrate quality should also be recorded in the test report.

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