Assessment of Print Product Recyclability – Deinkability Score –

1 Purpose and scope of application

This ERPC document provides an assessment of the deinkability of a printed product by evaluating results of a laboratory deinking test procedure. It is applicable to all kinds of printed products on white paper.

The deinkability of a print product as a whole can be assessed by only looking at its Deinkability Score, which can range from -100 to +100. For individual products this is done by using the rating of the results given in this specification or by comparing the Deinkability Scores of several print products.

If a more thorough technical / scientific evaluation has to be made, the individual scores or the measured values of the deinkability parameters can be used.

2 Principle

Results of deinkability tests achieved by means of INGEDE Method 11 are converted into deinkability scores. For each of the five parameters – luminosity, colour, cleanliness, ink elimination and filtrate darkening – threshold and target values are defined. The target values are depending on the category of the print product; thresholds are the same for all categories. If the result meets the target value or is better, it scores the maximum points allocated to this parameter. The maximum points achievable for each parameter are different thus indicating the importance of each individual parameter. A score below 0 in one or more parameters leads to the overall assessment "not suitable for deinking".

3 Determination of the Deinkability Score

In this chapter, particularly in the tables, abbreviations for the assessment parameters are used:

Y:	Luminosity
a*:	Colour a* (green – red) of the CIELAB system
A:	Dirt particle area
IE:	Ink elimination
ΔY:	Filtrate darkening

Rounding of the parameters: Y, IE and ΔY to whole numbers, a* to one decimal and A to one decade. The individual scores of each parameter are rounded to whole numbers as well. Method: financial rounding.

3.1 Source of the deinkability results

The results of deinkability tests have to be obtained according to INGEDE Method 11. The yield of the laboratory flotation should be at least 80 % in case of uncoated papers and 70% in case of coated papers. For the determination of IE the parameter R_{700} has to be used with the term $\left(\dfrac{(1 - R_{\infty,unpr})^2}{R_{\infty,unpr}} \right)$ set to 0. For the image analysis, DOMAS or Simpatic are allowed.

3.2 Weighting of the parameters

The assessment of deinkability consists of five parameters. Three of those – luminosity, colour and cleanliness – refer to the quality of the deinked pulp, the other two – ink elimination and filtrate darkening – are process parameters. The quality parameters have a higher maximum score than the process parameters, which serve as a kind of backup for the assessment.

Parameter	Y	a*	A	IE	∆Y	Total
Maximum Score	35	20	25	10	10	100

Table 1: Maximum score for each parameter

3.3 Threshold values

For a good deinkability, the values for Y and IE have to be high, the values for A and ∆Y have to be low. The parameters with a desired high value have a lower threshold, the parameters with a desired low value an upper threshold. The a*-value has both thresholds because the result should be within a target corridor. Falling below a lower threshold, exceeding an upper threshold, as well as falling out of a threshold corridor, results in a negative score for this parameter.

Parameter	Y [Points]	a*-Value [-]	A [mm²/m²]	IE [%]	∆Y [Points]
Lower Threshold	47	-3.0		40	
Upper Threshold		2.0	2.000		18

Table 2: Threshold values

Note:

The deinked pulp has to be free of large, visible specks.

3.4 Target values

Each parameter has a target value depending on the product category.

Category of print product	Y [Points]	a* [-]	A [mm²/m²]	IE [%]	ΔY [Points]
Newspapers	≥ 60			≥ 70	
Offset magazines & flyers, uncoated	≥ 65			≥ 70	
Offset magazines & flyers, coated	≥ 75			≥ 75	
Rotogravure magazines & catalogues, uncoated	≥ 70	≥ -2.0 to ≤ +1.0	≤ 600	≥ 80	≤ 6
Rotogravure magazines & catalogues, coated	≥ 75			≥ 85	
Toner prints on woodfree paper	≥ 90			≥ 80	

Table 3: Target values

3.5 Determination of the Deinkability Score

It is recommended to use spreadsheet software to calculate the score. The INGEDE Office can provide the formulae in Microsoft Excel® format.

3.5.1 Calculation of the score per parameter

Results of the individual parameters which meet or exceed the target values receive the maximum scores for these parameters (according to Table 1). "Exceeding the target values" means:

- In case of Y and IE: higher than the target value
- In case of A and ΔY: lower than the target value
- In case of a*:   between higher and lower target value

If this is not the case, the score has to be calculated. For each individual parameter, the ratio of units better than the threshold value, divided by the range between threshold and target values, multiplied by the maximum score for this parameter, gives the Deinkability Score for this parameter. All individual scores are rounded to whole numbers by financial rounding.

Calculation for one individual parameter:

$$DS_P = \frac{(R_P - TH_P)}{(T_P - TH_P)} \cdot MS_P$$

Where

The index letter P stands for one of the five parameters Y, a*-value, A, IE and ΔY

DS_P is the Deinkability Score of the parameter P

R_P is the result of the parameter P

TH_P is the threshold value of the parameter P (according to Table 2)

T_P is the target value of the parameter P (according to Table 3)

MS_P is the maximum score of the parameter P (according to Table 1)

Example: Deinkability Score DS_Y for the luminosity of DP from newspapers

Luminosity Y of DP: 55

Threshold TH_Y: 47

Target T_Y: 60

Maximum score MS_Y: 35

$$DS_Y = \frac{(55 - 47)}{(60 - 47)} \cdot 35 = 22$$

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The DS is limited to the maximum score MS for each individual parameter, even if the calculation gives a higher result. In that case it is not possible to compensate a weak deinkability in one parameter with a very good deinkability in another parameter.

If the result is worse than the threshold, the score is negative for this parameter. In that case the absolute number is limited to the same value as the maximum score for this parameter.

If the value a* is above the higher target value, the upper thresholds and targets have to be used in the formula – and vice versa if it is below the lower target value.

3.5.2   Calculation of the Deinkability Score

For a complete evaluation of the deinkability, the five individual scores are added. If one or more individual scores are negative, the assessment of the print product is "not suitable for deinking". However, the product may be well recyclable for a process without deinking.

Parameter	Y	a*	A (DOMAS)	IE	ΔY	Deinkability Score / Assessment
Threshold	47	-3 / +2	2.000	40	18	
Target	60	-2 / +1	600	70	6	
Maximum score	35	20	25	10	10	
Sample A						
Result	55	-2.5	150	60	8	
Score	**22**	**10**	**25**	**7**	**8**	**72**
Sample B						
Result	45	-2.0	200	32	12	
Score	**-5**	**20**	**25**	**-3**	**5**	**not suitable for deinking**
Sample C						
Result	60	-1.6	150	75	5	
Score	**35**	**20**	**25**	**10**	**10**	**100**

Table 4: Examples (Newspapers)

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4 Rating of the results

In order to give the user an idea of the relevance of the Deinkability Scores, they should be assessed according to the following table:

Score	Evaluation of deinkability
71 to 100 Points	Good
51 to 70 Points	Fair
0 to 50 Points	Poor
negative (failed to meet at least one threshold)	Not suitable for deinking

Table 5: Rating of the Deinkability Scores

Experience has shown that in cases of poor deinkability not all results of the individual parameters are bad. If the most critical parameter is just slightly better than the threshold, the scores of the other parameters usually give already a sum of about 50 points. Therefore a Deinkability Score of up to 50 points is still regarded as "poor".

In charts, coloured backgrounds as in the table above should be used whenever possible. In order to reflect the assessment above, the colours should be set as follows:

- Below 0 points: red
- 0 to 40 points: orange
- 40 to 50 points: transition orange to yellow
- 50 to 70 points: yellow
- 70 to 80 points: transition yellow to green
- 80 to 100 points: green

5 Report

The report should contain detailed data of the print product, the printing process and the deinking test:

- Identification of print product as to name, publishing company, date of issue, product category, print process and paper quality
- Printing parameters and press settings
- Name and exact identification of inks or toner
- Results of the deinking test according to INGEDE Method 11

- The laboratory equipment used for the deinking test and deviations from INGEDE Method 11, if any

- Deinkability Scores for every parameter and total (total only if all five scores are 0 or higher). The results can be provided either numerical or as graphics. For a graphic presentation column stacked charts are recommended. If at least one element of the stacked columns points to the negative side, this product is rated "not suitable for deinking", even if the other elements are positive.

- Assessment of the deinkability according to Table 5

- Optional but desired: Any interpretation of the result which is possible with the help of the technical data

6 References

- INGEDE Method 11 - Assessment of Print Product Recyclability – Deinkability Test –

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