

**Evaluation of printing ink detachment
by hyperwashing
with the Haindl-McNett classifier****1 Purpose and scope of application**

This INGEDE method describes a procedure for analysing how effectively printing ink is removed from deinking material. This method uses hyperwashing to remove printing ink which is no longer bound to fibres from the pulp suspension, and analyses the hyperwashing residues with regard to optical properties (including cleanliness).

2 Equipment and testing tools**2.1 Hyperwashing**

Any device which meets the requirements of ZM V/1.4/86 or TAPPI T 233 cm and enables to use a wire of mesh no. 50 (50 mesh/inch) may be used for hyperwashing. When using a classifier according to ZM V/1.1/66 it is necessary to manage the utilisation of a wire of mesh no. 50 according to ZM V/1.4/86.

2.2 Measuring optical properties

The analysis should be carried out according to INGEDE Methods 2 and 10. For the measurement any device settings may be used which meets the requirements of DIN 53145 Part 1 or 2. The measuring geometry $d/0^\circ$ (diffuse illumination/observation angle perpendicular to the sample area) has to be preferred.

2.3 Dirt particle measurement

An image analysis system comprising a flatbed scanner and a PC with a suitable control and analysis program is used for making the measurements. The flatbed scanner should work according to the reflectance principle and allow measuring a sample area of at least 100 cm² with a minimum resolution of 600×600 dpi. The software must be able to analyse the number and area of the ink particles, irrespective of the brightness of the background (filter pad).

3 Sampling and sample preparation

Representative deinked pulp samples can be taken along the recovered paper process line. Because of the reduced quantity of impurities, it is recommended to take samples after pre-screening and pre-cleaning. The consistency of the sample should be determined as per DIN EN ISO 4119. Part of the sample is used for hyperwashing. Filter pads are made from the samples and the residue after hyperwashing, which in turn are used to determine optical properties and dirt particles.

If the pulp sample of a deinking line was not yet coarse cleaned or coarse screened, the pulp has to be pre-screened in the Brecht-Holl device of the McNett cascade before hyperwashing.

4 Procedure**4.1 Hyperwashing**

Hyperwashing is carried out in difference to the "Simultaneous determination of shives and fibre fractions" procedure according to ZM V/1.4/86, in which McNett fibre fraction is combined with Brecht-Holl shives content determination. The difference to this method results in using mesh no. 50 exclusively for hyperwashing in the McNett cascade. Another difference of the described method to ZM V/1.4/86 exists in the use of 20±0.05 g oven dried pulp. The residue on mesh no. 50 is used for handsheet preparation for which the weight determination of the hyperwashed pulp on the oven dried paper filter is necessary.

20±0.05 g oven dried pulp should be filled up to a suspension volume of two litres. If the consistency of the pulp suspension is below 1 % this volume has to be homogenised by repeated pouring into another vessel and added within 30 seconds into the first screening chamber (fitted

with mesh no. 50) of the McNett cascade. The introduced pulp is washed for 20 minutes with water at 10 l/min.

After finishing hyperwashing the dewatering chamber is opened and the residue on the filter paper is removed with 1 litre of water.

4.2 Handsheet preparation

From the introduced pulp (disintegrated undeinked pulp) as well as from the residues of hyperwashing 2 handsheets of 1.35 ± 0.05 g oven dried pulp (45 g/m^2) will be performed. The handsheet preparation of the unwashed introduced pulp is performed according to INGEDE Method 10. In contrast to INGEDE Method 10, the handsheet preparation of the hyperwashed can be performed without white water circulation because all material establishing a white water circulation are already removed.

4.3 Measuring optical characteristics

The measurement of optical characteristics is performed on handsheets of the introduced pulp and the hyperwashed residue according to the INGEDE Methods 2 and 10.

The calibration and the adjustments of the measurement device are performed according to INGEDE Method 2 (UV content = 0 %).

Two handsheets of each sample have to be used, with two measurements on each side. The handsheets have to be cut in a way that an opaque paper stack is obtained.

4.4 Measurement of dirt particles

An image analysis based measurement of dirt particles has to be performed on handsheets of the introduced pulp and the residue of hyperwashing.

On a measuring area which should be as large as possible the number and the area of dirt particles is determined on top and bottom side of the handsheets. From the results of both sides an arithmetic mean value is calculated.

5 Analysis

5.1 Optical characteristics

The following parameters are recommended for assessing printing ink detachment after hyperwashing:

- specific light absorption coefficient K
- Ink Detachment ID

$$ID = \frac{K_{UP} - K_{HP}}{K_{UP} - K_0} \cdot 100 \text{ [%]}$$

For further analysis the still attached proportion of ink on the fibres (INK_F) can be determined. Nevertheless, it has to be considered that the expense for the evaluation of INK_F [%] increases remarkable:

$$INK_F = 100 \cdot \left[\left(\frac{K_{UP} - K_{DP}}{K_{UP} - K_{HP}} \right) - \left(\frac{K_{UP} - K_{DP}}{K_{UP} - K_0} \right) \right]$$

Here are:

K_{UP} – specific light absorption coefficient K of the undeinked sample

K_{DP} – specific light absorption coefficient K of the deinked sample

K_{HP} – specific light absorption coefficient K of the undeinked hyperwashed sample

K_0 – specific light absorption coefficient K of an ink free pulp sample

5.2 Dirt particles

The results of the measurements have to be related to 1 m^2 sample area and are documented without decimal point. For a better review the results can be classified in classes (K_i) of area equivalent circle diameter. The distribution of the classes should be related to the possibilities of the resolution of the scanner of the image analysis system.

6 Test report

The following should be noted in the test report:

- Every deviation from the method description or quoted standards that has occurred during the process.
- The results of the measurement of the optical characteristics. It has to be stated for which light source and observation angle the values are calculated, preferably 2° observation angle and light source C.
- The specific light absorption coefficient K in m^2/kg of the disintegrated undeinked and

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hyperwashed pulp sample as well as the calculated ID in percent.

- The system applied for the measurement of dirt particles and its lower resolution limit (area equivalent circle diameter).
- The total number and total area of dirt particles in all classes or – if determined – detailed according to the separate classes (K_i) of the area equivalent circle diameter.

7 Sources

Reference was made to the following standards in this method:

- Zellcheming-Merkblatt V/1.4/86: Prüfung von Holzstoffen für Papier, Karton und Pappe. Gleichzeitige Bestimmung des Gehalts an Splintern und Faserfraktionen

- TAPPI method T 233 cm: Fibre length of pulp by classification
- Zellcheming-Merkblatt V/1.1/66: Prüfung von Holzstoffen
- INGEDE Method 1: Manufacturing Sample Sheets made from Deinking Material for Measuring Optical Properties
- INGEDE Method 2: Measurement of Optical Characteristics of Deinked Pulp
- INGEDE Method 10: Quantitative Evaluation of the Ink Elimination (IE) during Deinking

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