| **Recyclability Test for Packaging Products (2nd Draft)** | **Leaflet** |
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| | **Issued** |

## 1 Introduction

To minimize the problems occurring during recovered paper processing it is essential that paper products are manufactured considering a good recyclability. In favour of this the paper products have to be for the most part from fibres and must provide the possibility of easy disintegration, to minimize overloading of coarse and fine screening steps of the stock preparation. Alike, adhesive applications used for the paper products have to be shear resistant to withstand shear forces during stock preparation processes and fragment only to adequate particle sizes, which can be removed successfully during the process.

The following described laboratory method defines a procedure to assess the processing of packaging material. Thereby the content of non-paper components, content of difficult to disintegrate material, the flake content and macro sticky-potential after a disintegration step is investigated. The determined data can be used for the assessment of packaging product recyclability. A general assessment scheme is not available yet.

## 2 Purpose and Application

The methods application is the simulation of the behaviour of packaging material during the stock preparation of a paper mill. During the investigation the packaging material is probed considering the content of non-paper components, content of difficult to disintegrate material, the flake content and macro sticky-potential.

The content of non-paper components as well as the content of difficult to disintegrate material and the flake content allow the evaluation of disintegration behaviour of the packaging material. The non-paper components and the content of difficult to disintegrate material form coarse impurities, which could stress the coarse screening process in a paper mill. The flake content detects impurities like small plastic parts and primarily fibre bundles, which have to be removed in fine screening steps of a paper mill. The flake content therefore gives information about the load of the industrial fine screening process.

The macro sticky potential is analysed by measuring the macro sticky area. The macro sticky area allows data about the load of the industrial stock preparation with adhesive impurities.

## 3 Definitions

*Non-paper components*
Packaging materials are designed for different functions and for this reason they are manufactured using a combination of different materials and paper, like plastics or metals. These non-paper components can disturb, hamper or avoid the material recyclability.

*Content of difficult to disintegrate material*
As several packaging products show a certain water resistance and are more robust during disintegration in water, it is not possible to suspend certain fibre materials in single fibres instead fibre bundles maintain. Such water resistant packaging materials disturb or hamper the preparation process and the material recyclability.

*Disintegration behaviour*
The disintegration behaviour describes the possibility to suspend the packaging material into single fibres. The disintegration behaviour is analysed by considering the content of non-paper components, the content of difficult to disintegrate materials and the flake content.

*Macro sticky potential*
The macro sticky potential describes the macro sticky area after disintegration of the packaging material.

## 4 Principle

This leaflet describes the preparation and investigation with the main steps sample preparation, disintegration, coarse screening, flake content evaluation and sticky potential evaluation. For this, a defined amount of the packaging material has to be prepared and afterwards disintegrated at low consistency. The generated suspension has to be screened using a hole screen. The reject on the screen has to be evaluated gravimetrically. The screening accept has to be analysed for flake content using Zellcheming Leaflet ZM V/18/62 [1] or alternatively by and adapted Method suitable for the Haindl-Classifier. For the macro sticky area the determination follows a macro sticky method based on INGEDE-Method 4 [2].

The flow chart of the procedure is given by **Figure 1**.

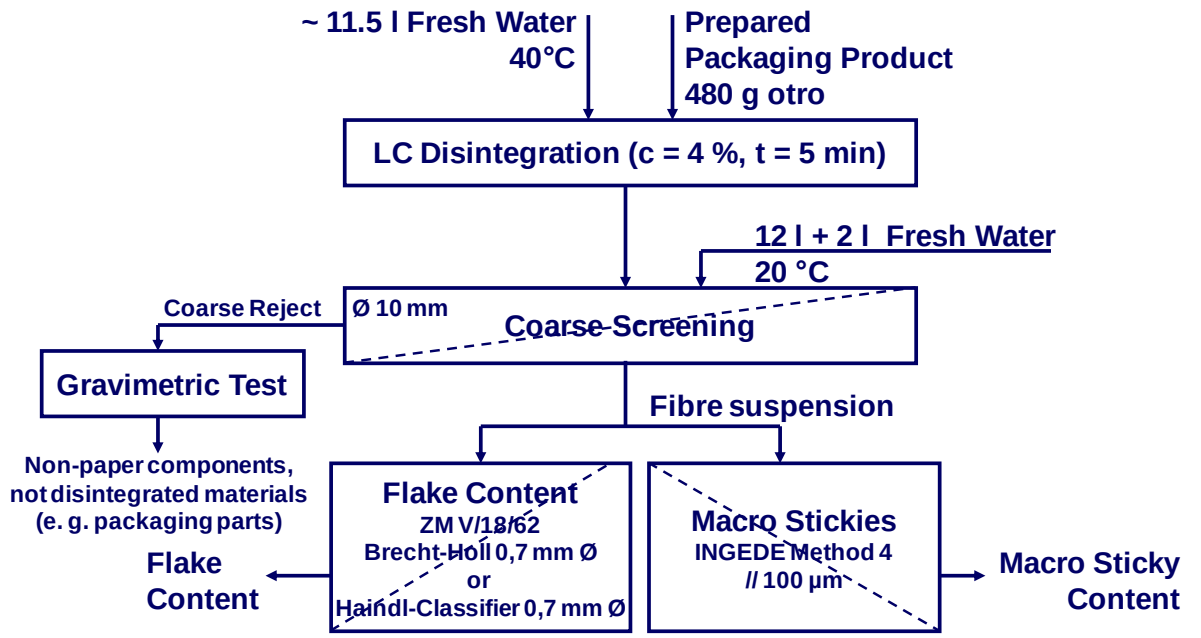


**Figure 1: Flow chart of the procedure for the assessment of packaging material recyclability**

## 5 Equipment and Tools

### 5.1 Disintegration equipment

As disintegration equipment a low consistency laboratory pulper has to be used, that can handle a suspension volume of 12 l with a stock consistency of 4 %.

### 5.2 Coarse screening equipment

For the coarse screening a screening device with a 10 mm hole screening plate at the bottom and a volume of min. 12 l is to be used. The accept stream of the screen has to be interruptible by an outlet valve. The screening holes have to be kept free during the screening process by using a stirrer. The stirrer blade have to be positioned 10 - 20 mm above the screen plate and to be operated with a agitator speed of 200 rpm. As the stirrer has to overcome high resistance forces if excessive coarse rejects are accumulated, the driving motor has to transmit high moment of torque to the stirrer. For this application the driving motor of a pillar drilling machine seems to be suitable.

### 5.3 Screening equipment for macro-sticky test

For the macro sticky test screening equipment as mentioned in INGEDE Methode 4 [2] has to be used. A screening plate with 100 µm sloths width is necessary. Using of a Haindl screen device acc. to ZELLCHEMING Leaflet V/1.4/86 [3] is recommended.

### 5.4 Screening equipment for flake content test

For flake content measurement a Brecht-Holl screen device has to be used. The device is described in [4]. Alternatively a Haindl-Classifier could be used.

5.5 Other Tools

- Distributor for suspension homogenisation
- Garden pump sprayer, e.g. “Gardena”
- Analytical balance
- Drying cabinet
- Laboratory sheet former “Rapid-Köthen”
- Buchner funnel 150 mm diameter
- Filter paper 150 mm diameter (e.g. Munktell Grade 12/N)
- Filter paper 240 mm diameter (e.g. Macherey-Nagel MN 617≡Nr.4)
- Black ink
- Alumina powder

## 6 Sampling and Sample Preparation

6.1 Determination of the adherend proportion

Before disintegration in the laboratory pulper the dry content of the packaging sample has to be determined as well as the proportion of the adherend. To determine the mass ration of the adherend, the mass of the air-dry packaging sample has to be measured. Afterwards the entire adherend are cut out tight with all adhesive material and weighed. The ratio between the mass of adherend (plus adhesive) and the mass of the total sample is defined as adherend ratio.

$$X_{\mathrm{Adherend}} = \frac{m_{Adherend}}{m_{PackagingSample}} * 100\,[\%]$$

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| $X_{Adherend}$: | Adherend ratio in % |
| $m_{Adherend}$: | Adherend mass (adhesive and glued packaging paper) in g |
| $m_{PackagingSample}$: | Packaging sample mass in g |

6.2 Sample preparation

480 g oven-dry material is needed for one investigation. By using the dry content of the samples, the respective amount of packaging products is determined. If a packaging product has to be divided to reach sufficient amount of material, the correct ratio between adherend and non-adherend material has to maintained. Therefore parts of the adherend and non-adherend material should be added following the adherend ratio.

Afterwards the complete sample material has to be cut to palm size.

## 7 Realisation

7.1 Disintegration of the sample material

The palm size cut material has to be filled completely in the pulper adding water of 40 °C temperature. The water amount has to be calculated in order to reach disintegration stock consistency of 4 %. The disintegration time is 5 min. After

disintegration, the complete sample is removed from the pulper. The sample with a volume of approx. 12 l will be processed further using the coarse screening device.

## 7.2 Coarse screening

The coarse screening is used to separate large and difficult to disintegrate paper parts as well as large non-paper components. The device consists of a 10 mm hole screen and is defined in Chap. 5.2.

Before starting the process a container with a capacity of min. 30 l is placed below the screening device, for collecting the accept of screening. The outlet valve below the screen is closed. The stirrer is started with 200 rpm. The stirrer has to be operated during the complete screening process. The suspension with the volume of 12 l is filled in the screening device completely and agitated for 3 s. Afterwards the outlet is opened, to start the screening process.

When the suspension is drained completely the outlet valve is closed and 12 l tap water are filled in the device. After agitating 3 s the outlet is opened and the device is drained again. Afterwards free fibres still attached to the screening plate or the surface of the device are drained through the screen using approx. 2 l tap water, sprayed using the garden pump sprayer. The water-jet is arranged like spray. Then the stirrer is stopped and the reject on the screening plate is transferred to a weighted and heat resistant case to dry the reject until constant weight. The temperature during the drying should be 105 °C. Afterwards the reject is determined gravimetrically.

The screening accept is used for the determination of the flake content and macro sticky area.

## 7.3. Homogenisation of screening accept

In order to ensure a homogenous sampling of the screening accept for flake content or sticky determination the sample should directly be filled in a distributor. A sufficient amount of material for all trails should be used. For this a minimum of 70 g b. d. should be filled in the distributor and diluted to a stock consistency of app. 1 %. After a gentle mixing of several minutes, samples for the respective trials could be taken.

## 7.4 Determination of flake content

The accept of the coarse screening has to be tested for flake content acc. to ZELLCHEMING Leaflet V/18/62 [1]. Alternatively to the Brecht-Holl screen device a Haindl-Classifier could be used. Deviating the method, non-paper components like small plastic parts are not removed from the reject on the screening plate but examined as part of the flake content. As screening plate a metal plate with a hole diameter of 0,7 mm should be used, complying with the requirements of the method.
If a Haindl-Classifier is used a water volume flow from 3,33 l/min or 0,2 m³/h have to be applied. 2 g b. d. sample material have to be classified for 5 min using 100 double pass per minute.

## 7.5 Determination of macro sticky area

The macro sticky area of the accept of the coarse screening step is evaluated following the INGEDE Method 4 and determined as macro sticky area per kg packaging material [2]. Therefore four suspension samples of 10 g oven-dry material are screened over a 100 µm slotted plate. The screen period per sample is 5 min. The screening should be performed using a Haindl device with 480 double-pass per min. Prior to the screening, the suspension samples have to diluted to a stock consistency of max. 1 %. At the beginning of the screening, the complete sample is filled in the Haindl device. The reject on the screening plate is transferred to a paper filter following INGEDE Method 4, stained and visualised. After that the filters have to be finished and evaluated using image analysis, as described in INGEDE Method 4.

## 8 Report

The results for the rejects of the coarse screening step, the flake content test and macro sticky area test are summarised in a report. The report must consist of the single results as well as the arithmetical means. All results have to be scaled as value per kg packaging material. Additionally the mass of the packaging material and the adherend ratio report has to be mentioned in the report. If derivations of the above mentioned procedure are conducted, reasons and type have to be noted.

## 9 References


1. **N.N.**: ZELLCHEMING Merkblatt V/18/62. - (Fachausschuss für Physikalische Halbstoff- und Papierprüfung). - Prüfung von Holzstoffen für Papier, Karton und Pappe - Gravimetrische Bestimmung des Stippengehaltes von Stoffsuspensionen. p. 3
2. **N.N.**: INGEDE Method 4. - (INGEDE e.V.). - Analysis of Macro Stickies in Deinked Pulp (DIP). p. 5
3. **N.N.**: ZELLCHEMING Merkblatt V/1.4/86. - (Fachausschuss für Physikalische Halbstoff- und Papierprüfung). - Prüfung von Holzstoffen für Papier, Karton und Pappe - Gleichzeitige Bestimmung des Gehaltes an Splittern und Faserfraktionen. p. 9
4. **Brecht, W. ; Holl, M.**: Stippengehaltsbestimmung und Faserfraktionierung in einem Gerät. - In: Das Papier. - 2(1948)5-6. - p. 885-891