QUALITY REQUIREMENTS IN GRAPHIC PAPER RECYCLING

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Paper recycling has a long history. The use of recovered paper in white grades received a boost since the 1970s, with the introduction and spreading of flotation deinking. The paper analyzes two main aspects related to the quality of recovered paper for deinking: one is related to the characteristics of delivery, in terms of contamination, moisture and composition, and the other to the recyclability of the paper products in delivery. The first aspect is in close connection with the collection system, handling and storage of the recovered paper. It is essential for the paper industry that paper and board should be collected separately from other recyclables. The deinking process is designed to remove inks, but not to whiten unbleached fibres. Therefore, the deinking industry favours a separate collection of graphic papers from households, for reducing the contamination with non-deinkable paper and board. The content of brown packaging papers and boards is therefore one of the most important parameters in the entry inspection of recovered paper deliveries. INGEDE, the International Association of the Deinking Industry, has developed methods for entry inspection and runs a database for its members. Deinkability mainly depends on the characteristics of the inks and, therefore, on the printing process. Flotation deinking, the dominant process, developed to remove letterpress and rotogravure inks, works well on mineral-based offset inks and dry toners. Flexographic and inkjet ink particles are too hydrophilic and too small for an efficient flotation. Cured systems and some toners, particularly liquid toners, form agglomerates, which are too big to float. The acknowledged assessment scheme for deinkability, the removal ability of inks, uses INGEDE Method 11 for testing. The results are converted into “deinkability scores”. The second product-related quality aspect is the ability to remove adhesive applications. This depends not only on the chemical characteristics of the adhesive, but also on its type of application. INGEDE’s database on the recyclability behaviour of adhesive applications is considerably smaller than the one on deinkability. The tests focused on glued spines and labels. Glued spines often show sufficient recyclability, if they are made with hot-melt adhesives. Of them, polyurethane glues are generally the best option. Labels are much more critical; one of the reasons is the low film thickness. Not enough is known yet on the way feasible chemical nature can compensate for this disadvantage. In order to find out more about how adhesive applications can improve their recyclability, INGEDE with some co-sponsors launched a survey on the recycling behaviour of about 200 printed products containing adhesive applications.

Keywords: recovered paper, recycling, deinking, deinkability, printed products, flotation, inks, recyclability, adhesive applications, macrostickies

INTRODUCTION

Recovered paper is the most important raw material in the worldwide production of paper and paperboard. A proper balance in the industry’s supply of virgin and recycled fibres involves coping with today’s societal, economical and – last, but not least – environmental requirements. Sufficient recyclability is a prerequisite to meet such requirements.

With the “European Declaration on Paper Recycling”, the paper value chain in Europe launched[1] an important appeal for self-commitment to recycling 66% of the consumed paper and board products by the year 2010. The utilisation of recovered paper in the production of newsprint and corrugated base paper is already at levels exceeding 90%, above which it cannot be raised significantly. There is however room for a larger utilisation in an important paper stream denoted “other graphic papers”. In the countries whose paper industry is member of the European Paper Industry Association – CEPI – Austria, Belgium, Czech Republic, Finland, France, Germany, Hungary, Italy, Norway, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, Switzerland, the Netherlands and the United Kingdom (as of 2008), this stream represents an annual production of nearly 37 million tons of paper. The utilisation of recovered paper rises, however, only slightly above 10%.[1] In these printing and writing paper grades, ink removal from the recycled fibre slurry, by a deinking process, is a prerequisite for their re-use.

INGEDE, the International Association of the Deinking Industry, is dedicated to improving recyclability of recovered graphic papers and recovered paper quality. INGEDE's members are 32 paper mills, mostly European, having utilised more than 10 million tons of recovered paper in 2008. INGEDE has been running a statistical evaluation of recovered paper utilisation and quality in its member mills since 2002.

Sources and uses of recovered paper

In the CEPI countries, the utilisation of recovered paper exceeded 48 million tons in 2008. Households are important sources for mixed and graphic papers, trade and industry – for corrugated and solid boards as well as for other packaging paper and board. The collection in offices can provide medium and high recovered paper grades. Usually, printing and converting operations deliver high grades, the first two sources providing the main amount of material. Definitely, most of the recovered paper collected from households has to go through a dry sorting process, usually provided by the recovered paper merchant. Sorting is also employed for other sources, unless sourcing allows its dispensing. A simplified diagram of the main flows and some figures are given in Figure 1.

While the packaging recovered paper grades and most of the mixed grades find their way to the paper machine without deinking, the deinking process is very common for graphic paper grades, except some high quality grades with little or no ink (Figure 2).

According to EN 643, most of the recovered paper for deinking mills comes[1] from old newspapers (ONP) and magazines (OMG) – mostly "sorted graphic paper for deinking" (grade 1.11) – but also from recovered office papers. The production consists of newsprint, SC, LWC, office papers and hygiene papers. The INGEDE member mills, which use predominantly ONP and OMG, purchase 80% of their recovered paper as 1.11 or similar, 7% as pure ONP, 12% as pure OMG and 1% – higher grades. The overall composition of this mix – rather stable over the years – is the following: about 47% newspapers, 50% magazines and 3% higher qualities.

Quality of recovered paper grades for deinking

Generally, paper and board are easily re-usable after their manufacture. This is daily practice in paper mills by re-using the dry broke from finishing operations and off-quality paper, except when some special characteristics, such as wet-strength, are sought. On their further path through conversion into various products, paper and board undergo different applications with coating colours, inks, varnishes, laminates, adhesives and other substances. For the packaging material, contacts with other materials have also to be considered during its use. Once the paper and board products become available for recycling, further and unintended contacts with non-paper components might occur, through or during the recovery and collection process. These characteristics, applications and contacts might affect the recyclability of paper and board products.

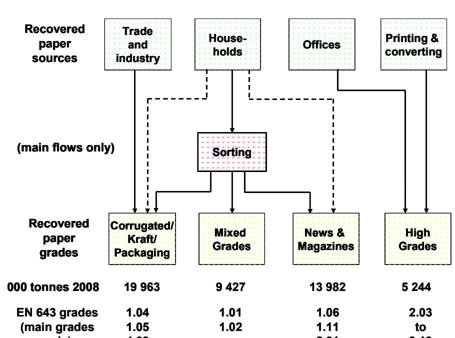

Figure 1: Recovered paper sources and flows

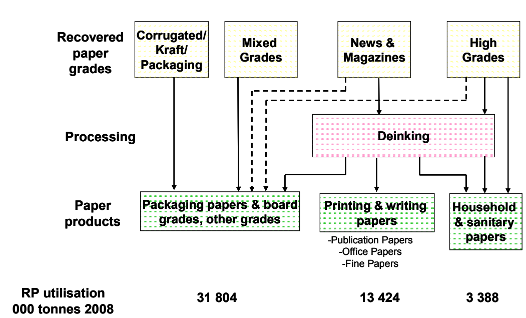

Figure 2: Recovered paper (RP) and paper products

Non-paper components and other unwanted materials in recovered paper

The term "non-paper components" in recovered paper trade and quality control is used for materials other than paper products, which form a part of the bunch of recovered paper, but are not attached to it. Therefore, the content of non-paper components depends on collection and handling. Generally, the non-paper components do not affect recyclability, unless the substances belong to "prohibited materials". This category, under discussion for a future version of EN 643, comprises any materials that represent a hazard for health, safety and environment, such as medical wastes, contaminated products of personal hygiene, hazardous waste, organic wastes (foodstuff included), bitumen, toxic powders and the like. Recovered paper contains several non-fibrous, unwanted substances that are part of the paper and board products, such as laminated covers, staples in magazines or office papers, samples of cosmetics in magazines, print products wrapped in plastic and many others. Recovered paper treatment plants are designed to handle a certain amount of such unwanted components. If the amount gets too high, the treatment process becomes less economical, because of the higher raw material demand, caused by the lower yield and higher costs for disposal and wear-and-tear of the equipment, as well as less ecological, because of the higher reject rates and energy requirements.

A proper sourcing system for collecting paper and board separated from other recyclables or from garbage is the first step to limit the non-paper components. Improved sorting of the collected paper is required before it enters the treatment process.

Strictly speaking, inks and adhesives are also non-paper components, which have to be removed in the recycling process. They are, however, regarded as integral parts of the paper and board products recovered from industry, trade and consumers. Moreover, the treatment processes are designed to remove inks and adhesives to a high extent. Even paper may contain substances unwanted in recycling, such as binders for coating or high filler contents.

EN 643 states that "recovered paper and board should in principle be supplied free of unusable materials", therefore no limit is given in the current version of this document. Most INGEDE members set their individual limits for unwanted material as a whole. Some also split this into two limits for non-paper components and for unusable papers.

The content of the total unwanted material is of about 2.5%, rising from 2.4% in the year 2002 to a peak of 2.8% in 2005. Mills' limits for non-paper components range from 0.2 to 3%. The average content of non-paper components, around 0.5-0.6%, has shown no significant changes in recent years (Figure 3).

The deinking process is designed to remove inks, but not to whiten unbleached fibres. The content of brown packaging papers and boards is therefore in the focus of the entry inspection of recovered paper deliveries. For "non-deinkable papers", meaning brown packaging and other unusable papers, EN 643 states a long-term target of 1.5% maximum content of grade 1.11. Until this target will be fixed, the standard recommends an agreement between supplier and mill, resulting in limits from 1 to 3% among the INGEDE members.

The average content of unusable papers is, however, not yet below the EN 643 long-term target, namely around 2% for brown paper and about 1.6% for board. Also, a peak was recorded in Western and Southern Europe in 2005 – a content of brown paper and board above 2.5%! In terms of total unwanted material, the quality level is generally better in Central Europe. However, a steady increase in the content of total unwanted material can be observed here (Figure 4).

The deinking mills advocate for a separate collection of graphic papers. Such systems are widely in use in some countries, *e.g.* Sweden and Switzerland. In Germany, the European country with the highest amount of recovered paper, the most common collection system is the "blue bin", in which graphic and packaging papers are collected together.

Moisture and age

The moisture limit is defined as 10% in EN 643 for all recovered paper grades, which is also considered as a limit by most of the mills. In spite of some regional differences, most mills record values safely below that limit. The average is between 8.6 and 9.0%, with the lowest value in the year 2004 and slightly rising since then.

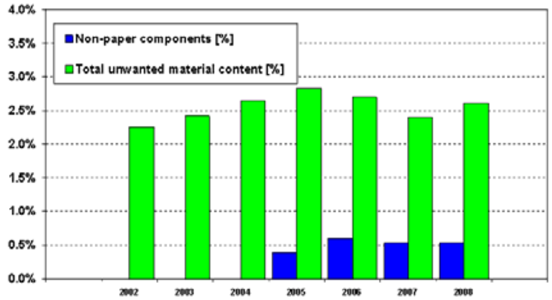

Figure 3: Contaminants in recovered paper for deinking at INGEDE member mills

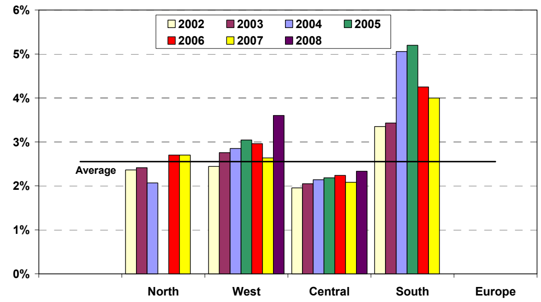

Figure 4: Total unwanted material at INGEDE member mills (2002 to 2008)

The old age of printed products affects their deinkability, mainly in the case of offset prints. Most INGEDE members set the limit for the age of recovered paper at 4 to 12 months; the most common limit is 6 months. Although single deliveries of high age occur, the average is between 1 and 2 months.

If the recovered paper delivery fails to meet these quality limits, the mills react commercially or even refuse the paper. The most important reason for refusals refers to the unwanted material – total unwanted material, unusable paper and/or non-paper components, followed by moisture and bale quality, the latter being often a safety hazard. The composition of the graphic papers depends upon the reading habits in the region where the paper is collected. Since the mills have to adapt their processes to that normal mix, claims occur only if the composition largely deviates from the normal shares of newspapers, magazines or other desired papers. Quite noteworthy, some refusals are due to the high content of newspaper printed with water-based flexographic inks, since deinking of conventional flexo inks is incompatible with the flotation developed for hydrophobic offset and rotogravure inks. Since the targets on the paper age are usually met, no claims refer to this parameter.

Quality inspection of recovered paper

There are many ways to inspect the quality of recovered paper, ranging from "quick look" to thorough gravimetric and sensor-based procedures. For recovered paper delivered in a loose form, INGEDE has developed a method enabling mills to inspect their recovered paper quality visually, yet in a quite detailed way. The advantage lies in the frequency of inspection, which can be much higher – necessary, given the possibility of rapid contamination and the composition of recovered paper – than when using a gravimetric method. INGEDE Method 7 describes[1] the inspection of unbaled deliveries of recovered paper involving visual counting of unwanted materials and subsequent conversion to their content by mass. The portion of accepted paper is visually assessed by estimation. Both conversion and estimation need verification[1] through gravimetric inspection on a regular basis, *e.g.* by INGEDE Method 14. There is also a corresponding method for the entry inspection of recovered paper in bales, but it is currently under revision.

Deinkability and its assessment

The deinking process in brief

Deinking is the process of detaching and removing printing inks from recycled fibres for improving their optical characteristics. The detachment of the printing ink from the fibres of the disintegrated recycled pulp is induced by the shear forces active during pulping, in most cases being supported by detergent-like chemical additives. Particularly, deinking of groundwood-based recovered papers, like ONP and OMG, takes place in an alkaline environment. The removal of the detached ink particles further involves flotation or washing. Deinking is the most important stage in the processing of recovered paper as a raw material for the production of deinked pulp (DIP) primarily used for manufacturing graphic papers, hygienic papers, or white top layers of packaging paper and board.

The term "deinkability", expressing the ability of a printed product to be deinked, is defined as "removal of ink and/or toner from a printed product to a high extent by means of a deinking process. This shall restore, as well as possible, the optical properties of the unprinted product".[1] Figure 5 shows the principal process steps of a deinking process. Figure 6 illustrates the effect of these process steps on recovered paper and pulp.

Deinking through flotation is the predominant technology applied to produce pulp for graphic papers. Washing is and will remain limited to special products, such as hygiene papers. For both processes, detachment of ink from the paper surface is a prerequisite for good deinking results. Cross-linked and vegetable oil-based inks are more difficultly detached than mineral oil-, solvent- or water-based inks. An efficient flotation process needs some additional definite characteristics of the printing inks, such as hydrophobicity and a certain particle size range, in order to be suitable for flotation (Figures 7 and 8). As a rule of the thumb, a suitable particle size ranges[1] from about 10 to 100 microns. In fact, the range is significantly larger, at least from 4 to 180 microns. The exact limits also depend on the hydrophobicity and, possibly, on the rigidity of the ink particles. Further essential prerequisites for the efficiency of flotation deinking are the proper hydro-dynamic conditions.[1] The construction and operating parameters of the flotation equipment should assure them.

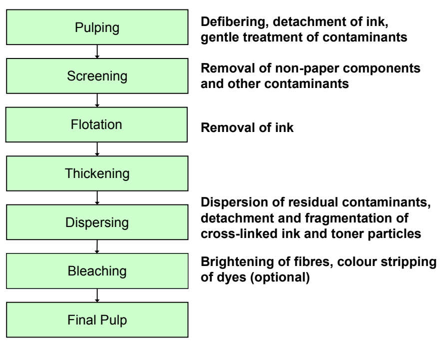

Figure 5: Main process steps of a deinking process and their tasks

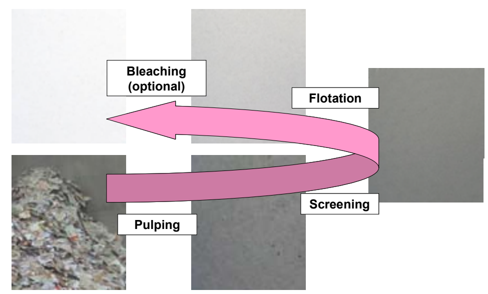

Figure 6: Effect of deinking process steps

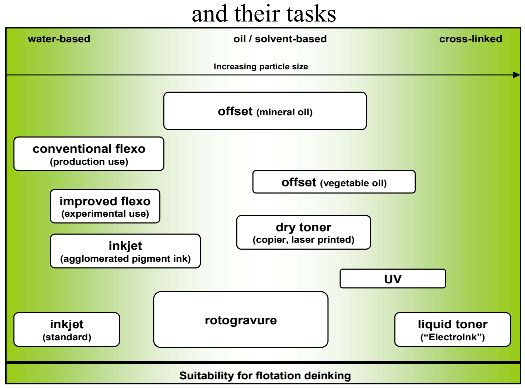

Figure 7: Compatibility of different printing technologies with alkaline flotation deinking (dark area = good deinkability/bright area = poor deinkability)

Figure 8: Handsheets of deinked pulp (left: water-based flexographic newspaper; centre: offset newspaper with mineral oil-based inks; top right: offset newspaper with vegetable oil-based ink; bottom right: digitally printed newspaper based on woodfree paper with UV-cured preprint)

In this respect, washing deinking is easier to perform. Ink particles have to be detached from fibres as well, but they do not require any specific surface chemistry. The important characteristic[2] of deinking through washing is that the process removes everything from the pulp with a particle size below 30 microns, which includes fines and fillers. High quality hygiene papers or mills producing pulp substitutes need deinked pulp with low filler content, as they operate the washing stages, often in addition to flotation. In most deinking installations, fillers should be retained to a high extent. In these cases, the low yield of the washing process is prohibitive for feasible operation.

Procedures to assess deinkability

In recent years, a proper assessment of the deinkability of several printed products has been present in INGEDE's research agenda. To this end, deinkability tests carried out[2] according to INGEDE Method 11 serve as a basis for comparing the deinkability of prints. In March 2009, the European Recovered Paper Council (ERPC) – the committee of signatories and supporters of the European Declaration on Paper Recycling – adopted the latest version of the "Deinkability Scores" as an assessment scheme.

The deinkability test performed according to INGEDE Method 11 simulates, at a laboratory scale, pulping and flotation, the two major process steps for ink removal (Figure 9). Deinking of prints on mechanical pulp-based papers is most efficient in an alkaline process. Since such paper products represent the majority of the deinking material, INGEDE Method 11 uses alkaline conditions, as well. Prior to pulping, the samples undergo a 3 day artificial ageing, which is equivalent to an about 3 month natural ageing. Pulping, storage and flotation are exactly defined by equipment and operating parameters.[2,3] The original concept of INGEDE Method 11 is to work with a fixed dosage rate of deinking chemicals. The reasons include a better comparability of the results and an easier, less time-consuming execution in the laboratory, compared to the definition of a fixed pH. Recent research and testing work, however, showed that certain printed products result in a pH beyond the normal operating range in industrial deinking plants. Consequently, in the recently revised version of INGEDE Method 11, the pH acts as a "sentinel" for adapting the chemical dosage, if necessary. This improves the correlation between industrial and laboratory deinking conditions and results.

INGEDE Method 11 comprises the five parameters listed in Figure 10. The first three are quality parameters characterizing the deinked pulp as to brightness and cleanliness (luminosity Y, dirt particle area A). The dirt particle area is subdivided into two results – the area of particles larger than 50 μm in diameter, which represents all particles visible to the naked eye, and the area of particles above 250 μm in diameter. This is very close to the TAPPI assessment of the dirt specks, which counts all spots above 225 μm. Additionally, the colour shade on the red-green axis of the deinked pulp is determined by the a*-value, due to the fact that red discoloration is more critical than discoloration on the yellow-blue axis (b*). The last two are process parameters (ink elimination, IE; discoloration of filtrate, ΔY), offering information on the possible effects of ink carry-over on deinking and enriching the information provided by the three quality parameters.

The test results are converted into a score system,[4] which allows expressing the deinkability assessment in one figure by weighing the parameters according to their importance. Additionally, the deinkability scores provide the opportunity for cross-comparisons among different product categories. In all product categories, the maximum score is 100 points.

To achieve a common point system, threshold as well as target values are defined. Depending on the type of threshold values, a lower threshold, an upper threshold or a threshold corridor is fixed, which have to be exceeded, undercut or met, respectively. These threshold values, which are independent of the print product categories, are listed in Table 1. For a given print product, the threshold values have to be fulfilled for all parameters. If one or more threshold levels are not reached, a print product is judged as "not suitable for deinking".

According to Table 2, target values are set for each group of print products and for each parameter. The target values of the parameters colour (a*-value; green-red axis), dirt particle area (A_{50} and A_{250}) and filtrate darkening (ΔY) are equal for each print product category. The target values of the luminosity of the deinked pulp (Y) and the ink elimination (IE) have variable levels, depending on the print product category.

If the target value of a parameter is met, the full score is given for this parameter. The maximum scores of the individual parameters, listed in Table 3, have different values, which reflect their importance. The parameter luminosity of the deinked pulp has, with a ratio of 35%, the most significant effect on the total deinkability score, followed by dirt particle areas (25% as total of A_{50} and A_{250}), colour (20%) of the deinked pulp and the two process parameters: ink elimination and filtrate darkening (10% each). Between the threshold and the target value of each parameter, the score is linearly subdivided, resulting in a constant increment per parameter. Finally, the score of all five parameters is added up to provide a single number, corresponding to the total score for a particular print. This allows a simple overall assessment on the deinkability of a print product, with one numerical value between 0 and 100 points, comparable to test results of consumer goods (Figure 11). If one or more threshold values fail, the print product is considered unsuitable for deinking. Anyhow, the product may be well recyclable without deinking – for example, in a board mill. If all thresholds are reached, the product is judged as deinkable with three various gradations: poor, fair and good.

Table 1
Threshold values of deinkability scores

Parameter	Y	a*	A_{50}	A_{250}	IE	ΔY
	[Points]	[-]	[mm²/m²]	[mm²/m²]	[%]	[Points]
Lower threshold	47	-3.0			40	
Upper threshold		2.0	2000	600		18

Y – luminosity of deinked pulp; a* – colour of deinked pulp on green-red axis; A_{50} – dirt particle area of all particles larger than 50 µm; A_{250} – dirt particle area of all particles larger than 250 µm; IE – ink elimination; ΔY – filtrate darkening

Table 2
Target values of deinkability scores

Category of print product	Y	a*	A_{50}	A_{250}	IE	ΔY
	[Points]	[-]	[mm²/m²]	[mm²/m²]	[%]	[Points]
Newspapers	≥ 60	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 70	≤ 6
Magazines, uncoated	≥ 65	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 70	≤ 6
Magazines, coated	≥ 75	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 75	≤ 6
Stationery (Y of base paper ≤ 75)	≥ 70	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 70	≤ 6
Stationery (Y of base paper > 75)	≥ 90	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 80	≤ 6

Table 3
Maximum score per parameter of deinkability score

Parameter	Y	a*	A_{50}	A_{250}	IE	DY	Total
Maximum score	35	20	15	10	10	10	100

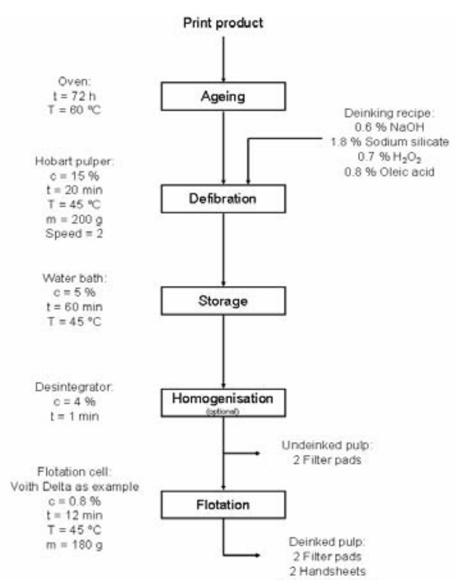

Figure 9: Flow chart of INGEDE Method 11

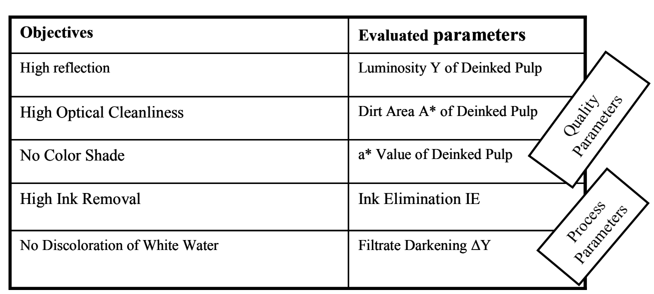

Figure 10: Test criteria for deinkability

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

Figure 11: Evaluation according to deinkability scores

Deinkability test results

Since the scoring system has been developed, the research institutes have performed[5] more than 300 deinkability tests on behalf of INGEDE. One way of displaying the results is according to the product category described in Table 2. Each stacked column in Figure 12 represents the average score of this product category. The columns are subdivided into individual scores for the different assessment parameters. The figures above the columns indicate the number of test results in each category and the share of positive results.

The “Newspapers” category also contains results of flyers, if printed on newsprint paper, and of telephone directories. It mainly consists of offset products. Some of the prints are water-based flexographic prints, the group also containing some inkjet newspapers that have been presented in exhibitions and trade shows. Letterpress is not anymore significant on the European newspaper market. 7% of the tested samples give a positive deinkability result.

The “Magazines” category also embraces flyers on SC and LWC paper, comprising offset and rotogravure products. Titles with a circulation above about 200000 copies are usually printed in rotogravure, the others in offset. In these categories, there are some UV-cured prints and, possibly, some magazines with UV-cured and varnished covers.

“Stationery” is a category that includes a wide variety of printed products usually containing less ink than newspapers and magazines do, such as transactional prints, books, manuals, forms, tickets, computer print-outs and the like. The sub-category with base papers having a luminosity of 75 or lower is not yet well represented in the test results, because most of the prints we have got so far have been made on woodfree or nearly woodfree paper with high luminosity. In these categories, digital prints are well represented.

A scientific evaluation of the influences on deinkability has to consider the printing technology and the printing conditions (Figure 13). Within the scope of this article, only a general overview can be given. For graphic products, offset is the dominant printing process, followed by rotogravure. These two printing technologies represent about two thirds of the results of INGEDE’s surveys and tests. Flexographic printing in graphic products is done for some newspapers in Italy and the United Kingdom. About 25% of the tests refer to digital printing technologies.

81% of the offset prints – mainly newspapers and magazines – achieved a positive assessment of their deinkability. If they fail, it is usually due to luminosity or dirt particle area. The latter often occurs in the case of UV-cured prints. Luminosity deficits are related to a high amount of inks on low-weight paper, *e.g.* tabloid newspapers and promotional flyers. Waterless offset was found to be rather troublefree.[5]

Rotogravure prints are generally well deinkable. The few cases of failure were due to dirt particles. Red discolouration is sometimes visible, in no case leading to negative assessment which, compared to older results, appears as an improvement.

All tests with flexographic prints failed in luminosity, ink elimination and filtrate darkening, due to the hydrophilic nature of the ink particles. Research has shown that the newly-developed inks can perform better in the deinking plants, though not yet established commercially. In a few cases, the deinking process can be tuned a little to cope better with flexo, but usually at the expense of a lower efficiency in the removal of other ink types present in the furnish.

In these conventional printing technologies, variations in deinkability are more pronounced with uncoated papers.

Toner prints are usually well deinkable, if made by a dry toner process. All samples of the liquid toner prints fail a positive judgement, because of a very high content of dirt particles in the deinked pulp. The toner films are very cohesive and flexible; they do not fragment well enough during pulping.

In most cases, inkjet prints fail to achieve a positive deinkability result. Most of the samples investigated were inkjet printed newspapers, which are nowadays promoted for small volumes and remote locations, *e.g.* foreign newspapers at international airports. Similarly to flexographic prints, inkjet fails due to luminosity, ink elimination and activities of INGEDE. Some indicators as to how deinkability can be improved are provided. Agglomeration or precipitation of pigment-based inks at the paper surface appears as a promising solution. This requires a surface preparation of the paper, either on the paper machine or prior to the contact with ink in the printing machine.

Removal of adhesive applications

Another product-related quality aspect is the ability to remove adhesive applications, which form tacky particles in the paper recycling process. These "stickies" are classified according to their sources as primary and secondary ones.[6] The first group of stickies is introduced by the recovered paper. Secondary stickies originate from the physico-chemical effects during recovered paper processing. Depending on their size, stickies are classified into macro-, micro- and disco (dissolved and colloidal) stickies. There is a clear definition to distinguish between macro- and microstickies: their separation behaviour under a standard screening process at a laboratory scale.[6] The recommended criterion is a plate with a slot width of 100 µm. For pulps of recovered paper or for packaging papers, a slot width of 150 µm is possible. Stickies in the reject are macrostickies, while the stickies in the accept are called microstickies. Definitions of disco stickies are not as clear, nor are they generally acknowledged.

Research work proved that mechanical screening is the most efficient tool for sticky separation in the industrial process.[7] This means that stickies have to be as large as possible in order to be screened (Figure 14). A particle size of the macrostickies above 2000 µm, as determined by means of INGEDE Method 4, favours complete removal in the state-of-the-art recycling process.[8]

For an assessment method under laboratory conditions, not only the screening, but also the pulping process has to be defined, since it is essential for the fragmentation filtrate darkening. With the predicted growth rates for inkjet and with the current state of its deinkability, this printing technology represents a real threat for deinking mills. Currently, an intensive dialogue with the OEMs for inkjet systems is one of the major of stickies. To this end, INGEDE Method 12 has been developed.[9] By this method, adhesive applications are pulped together with deinking chemicals and woodfree copy paper, which is free of stickies (Figure 15). As in deinkability testing, it is necessary to simulate the industrial process conditions of the deinking plants.

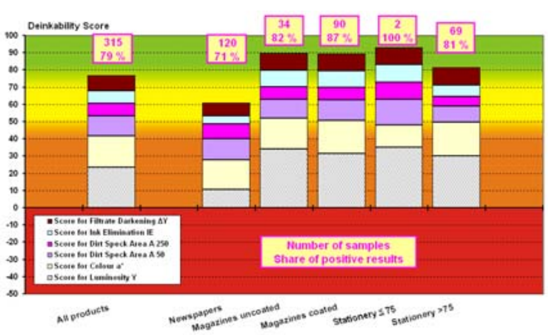

Figure 12: Deinkability test results by benchmarking category

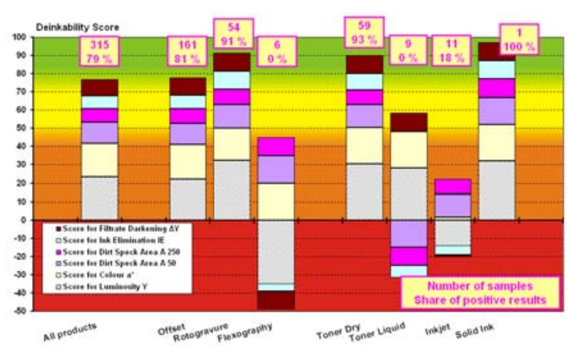

Figure 13: Deinkability scores of tests with different printing technologies

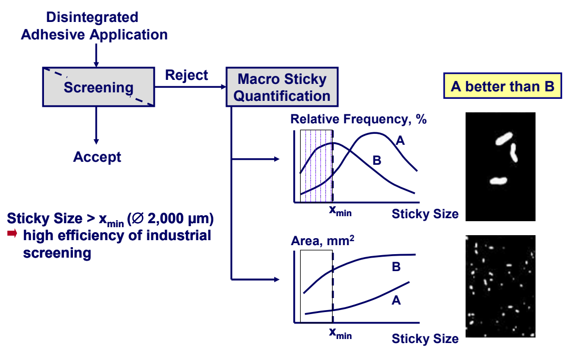

Figure 14: Assessment of the sticky potential of adhesive applications in graphic papers

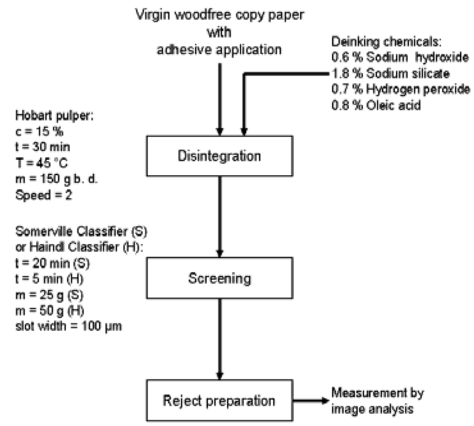

Figure 15: Flowchart of INGEDE Method 12

As known from literature,[10] glued spines are not normally critical for recycling, if they are made with hot-melt glues. Among them, polyurethane hot-melt glues perform even better. Hardly any label products fulfil the recycling criteria. The thin films and the chemical nature of the used dispersion glues provide a big challenge for recycling. There is an indication that the UV-cured dispersions behave much more favourably in recycling.

As a tool for improving the recyclability of adhesive applications, INGEDE aims at establishing a corresponding assessment scheme, as for deinkability scores. To this end, PMV in Darmstadt is currently performing a survey with different types of adhesive applications, including about 200 printed products.[10] Also, the suitability of including tests on microstickies into the assessment scheme is discussed. INGEDE finances the major part of this research work and receives important technical input and some significant co-funding from the following industry associations: bvdm (Bundesverband Druck und Medien – German association of the printing industry), FEICA (Fédération Européenne des Industries de Colles et Adhésifs – Association of European adhesives and sealants manufacturers), and FINAT (Féderation Internationale des Fabricants et Transformateurs d'Adhésifs et Thermocollants sur Papiers et Autres Supports – world-wide association for manufacturers of self-adhesive labels and related products and services).

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