INGEDE Method 7

99-12

Entry Inspection for Sorted Graphic Paper for Deinking 1.11 (formerly D39), Unbaled Delivery

1 Purpose and scope of application

This INGEDE method describes a procedure to control the quality of a particular recovered paper delivery. It is to be applied to the receipt of loosely delivered sorted graphic paper for deinking (1.11, formerly D39).

The time available for entry inspection of delivered recovered paper is relatively short. Yet, the quality of the raw material recovered paper has a major impact on the entire production process which is taken into account both by the way in which entry inspections are performed and by the quality parameters considered.

The present method does not provide an exhaustive description of entry inspection as a whole. Accordingly, it does not, e.g., consider inspection of delivered recovered paper with regard to correctness, weight, etc. which are being taken for granted. It is of limited use only for detecting hidden deficiencies of a particular recovered paper delivery. A quick recovered paper entry inspection is rather performed to be able to assess whether the delivered recovered paper meets the required quality specifications.

For important instructions as to how to perform entry inspection and to interpret the results obtained, see Chapter 6 “Comments”.

2 Recommendations for an entry inspection

The conditions mentioned below are applicable to entry inspection as a whole unless specified otherwise in the instructions for individual control parameters.

2.1 Ambience conditions

a) Entry inspection may either be performed in store halls or outdoors.

b) The reference surface should be exposed to antiglare illumination (light colour: neutral white).

2.2 Observation conditions

a) The reference surface to be inspected should measure at least 30 m^2.

b) The reference surface should be observed from a distance not exceeding 2 m.

c) The observation angle should not be parallel to the reference surface. The sample should be inspected from an observation post from where the entire reference surface may be overlooked.

2.3 Calibration

Calibration of visual inspection results has to be performed gravimetrically. It serves to determine the weighting factors f_W, to provide practical training to inspection staff and to verify visual inspection results.

3 Procedure of entry inspection

The following quality parameters are to be checked: general condition at the time of delivery, odour, mould and rotting, moisture, delivery age as well as recovered paper composition (percentages of the various desired papers and unusable materials).

3.1 Recovered paper condition at the time of delivery

An assessment of the general condition of the delivered recovered paper requires close-up observation of the unloading process in compliance with applicable safety provisions. During unloading, particular attention is to be paid to untypical sounds, recovered paper flow behaviour and formation of dust.

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3.2 Odours, mould and rotting

The unloaded delivery is to be subject to close-up examination from various angles. Particular attention is to be paid to untypical odours and indications of mould and rotting.

3.3 Moisture

At 20 different spots distributed as evenly as possible along the sides of the pile of unloaded recovered paper, organoleptic moisture tests are to be carried out so as to be able to detect potential conspicuous moistening. In the case of excessive moistening, the moisture content is to be evaluated.

3.4 Age

Inspection staff are to pick one sample newspaper of legible appearance date from each of the 20 different and evenly distributed spots along the sides of the recovered paper pile. The newspaper's age is then determined by subtracting its date of publishing from the date of sampling. The subtraction result is indicated in complete months and is usually rounded up.

The average age of the delivery is to be established on the basis of the average age of the newspaper samples taken. It is indicated in complete months and is usually rounded up.

3.5 Recovered paper composition

Recovered paper composition is determined by means of visual inspection which is performed in three steps:

a) assessment of the fraction of unwanted materials
b) assessment of the fraction of desired papers, newspapers and magazines excluded
c) assessment of the fraction of newspapers and magazines.

Recovered paper composition may either be determined according to the instructions provided below or in compliance with specific operational instructions.

3.5.1 Assessment of unwanted materials

In a first step, the fractions of papers and boards not suited for deinking as well as of non-paper components are to be assessed. To this effect, the number of items of any of these components visible on the observation surface is to be counted or estimated and related to the applicable assessment unit. It is then to be multiplied by the weighting factor, thus yielding the proportion of the individual components in a particular lot in weight per cent.

All fractions of the individual components taken together yield the proportion X of unwanted materials (see table 1).

3.5.2 Assessment of desired papers

In a second step, the composition of desired papers is to be estimated. To this effect, the proportion of papers which are not newspapers, magazines or the like is first to be assessed in analogy to the instructions provided in Chapter 3.5.1, thus obtaining the proportion of "other papers" in weight per cent.

In a third step, newspaper and magazine fractions are to be assessed as newspaper/magazine ratio (e.g. 60:40, total = 100). When multiplying these by the relevant weighting factors it should be borne in mind that newspaper and magazine fractions then only constitute a part of the respective delivery. The formulae provided in lines 5 and 6 of Table 1 have taken this into account. The result thus obtained indicates the respective proportion of these components in weight per cent.

The proportion Y of desired papers is the sum of all proportions of individual components.

When added up, X and Y thus have to amount to 100 per cent.

3.5.3 Assessment of recovered paper composition

The components listed in Table 1 are to be understood as minimum differentiation. A more subtle differentiation is generally possible. The relevant assessment units have to be countable or assessable and referred to in the inspection sheet. The weighting factors f_W are to be determined by means of calibration. Should an assessment of the proportion of "other papers" (no newspapers or magazines) prove to be not practicable, this category may be omitted.

In case that components are not within the scope of the assessment unit, they have to be

mentally combined to or split up into the applicable assessment unit.

4 Verification of visual assessment results

Subsequent to the determination of the weighting factors, visual assessment accuracy occasionally is to be verified. To this effect, as in the case of the determination of the weighting factors, gravimetric measurements are to be taken on a sufficient number of deliveries to establish recovered paper composition. Results obtained by means of visual assessment and gravimetric measurement should differ less than ± 20 % (cf. Table 2) as related to the gravimetrically determined overall proportion of the respective component. In the case of dependent assessments (proportion newspapers/magazines), assessment accuracy has to relate to the component of the smaller proportion. Should the acceptable difference be exceeded, a new calibration is to be performed.

While visual assessment does not yield sufficiently accurate and thus acceptable results which renders necessary new calibration, visual assessment results are acceptable in cases 2, 3, 5 and 6 and consequently do not require renewed calibration.

5 Calibration

Calibration serves the following purposes: determination of the weighting factors f_W, practical training to inspection staff and long-term verification of visual recovered paper entry inspection results. First of all, the components to be examined and the relevant assessment units have to be defined. The same component allocation criteria are to be applicable to both visual assessment and gravimetric measurement. Initially, the relevant weighting factors have to be set one ($f_W = 1$). Visual assessment and gravimetric measurement of component fractions are to be performed on a sufficient number of recovered paper deliveries. It is further to be ensured that the samples taken have a sufficient size (cf. 6.10.2). The value pairs thus obtained are to be entered into an *xy*-diagram. Assessments are to be considered acceptable if the coefficient of correlation r is superior to r = 0.75. For all value pairs (point cloud) obtained for a particular component a trend or regression line may be established. The weighting factor

Table 1: Calculation formulae for visual assessment of recovered paper composition

No.	Component	Assessment unit	Number	Weighting factor f_W	Proportion in total lot (% weight)
Unwanted components					
1	Board (brown, grey, white)	Number of DIN-A4 sheets	a	f_{w1}	$A = a \cdot f_{w1}$
2	Dyed papers	Number of DIN-A4 sheets	b	f_{w2}	$B = b \cdot f_{w2}$
3	Non-paper materials	Pieces, volume, mass	c	f_{w3}	$C = c \cdot f_{w3}$
			Total proportion of unwanted components		**X = A + B + C**
Desired papers					
4	Other papers	Overall proportion [%]	e	f_{w4}	$E = e \cdot f_{w4}$
5	Newspapers	Ratio news/mag [%]	g	f_{w5}	$G = [(100\%-(X+E))/100\%] \cdot g \cdot f_{w5}$
6	Magazines	Ratio news/mag [%]	h	f_{w6}	$H = [(100\%-(X+E))/100\%] \cdot h \cdot f_{w6}$
			Total proportion of desired papers		**Y = E + G + H**
			Total		**X + Y = 100 %**

news = newspapers, mag = magazines etc.

Table 2: Exemplary calculation for variations between visual assessment and gravimetric determination of individual component proportions

Case	Component	Overall proportion determined (%)		Variation (%)	
		visually	gravimetrically	absolute	relative
1	Newspapers	60	40	20	50
	Magazines	40	60		33
2	Newspapers	60	50	10	20
	Magazines	40	50		20
3	Newspapers	60	66.7	6.7	10
	Magazines	40	33.3		20
4	Newspapers	60	70	10	14
	Magazines	40	30		33
5	Cardboard containers	6	5	1	20
6	Cardboard containers	5	6	1	17

f_W results from the regression line gradient angle. It may be read directly from the angle, if gravimetric values are outlined on the *y*-axis and visually assessed values on the *x*-axis. The number of measurements to be taken depends on the number and size of suppliers, but ultimately only on the scope of the value pairs obtained. It is recommended to perform at least 10 inspections per main grade and supplier.

In case that no acceptable correlation should be obtained due to the fact that, e.g., the current assessment unit does not yield a linear correlation between visual assessment and gravimetric measurement, a new assessment unit is to be defined.

6 Explanatory comments

6.1 Inspection site

Visual inspections carried out outdoors may be strongly affected by the prevailing atmospheric conditions.

6.2 Illumination

With regard to the technical implementation of suitable illumination, the employers' liability insurance association provisions as specified in the German *BG Arbeitsstättenrichtlinie 7/3* (Employers' Liability Insurance Association Place of Work Directive 7/3) and *DIN 5035 Parts 1 and 2* for artificial illumination for interiors may be applicable. Given the examples provided below, a nominal light intensity of 200 lux and the light colour neutral white are recommended.

	Light intensity	**Light colour**
Store halls containing similar goods	50–200 Lux	Neutral white
Searching activities	100 Lux	Neutral white
Reading activities	200 Lux	Neutral white
Paper screening	700 Lux	Daylight white

6.3 Reference surface

All data provided refer to the unloaded recovered paper. The reference surface depends on the plant premises and should always be kept constant. An unloading angle smaller than 60° and simultaneous forward motion of the truck during unloading usually ensure sufficient loosening up of the recovered paper delivery and, at the same time, a reference surface larger than 30 m². The recovered paper is not to be inspected in the container it has been delivered in

unless it is obvious that a particular delivery is to be rejected.

6.4 Observation angle

The observation angle depends on the vertical and horizontal distance between eyes and the observed spot on the reference surface. Inspection staff should be positioned at a site from where the entire reference surface may be overlooked.

6.5 Recovered paper condition at the time of delivery

During unloading, non-paper components develop characteristic odours which are indicative of soiled containers or major fractions of non-paper components. The moisture content of the delivered paper also affects flow behaviour and sounds to be perceived when the paper hits the ground during unloading. Formation of dust may indicate extended storage prior to delivery.

6.6 Odours

Untypical odours comprise all odours which are not characteristic of paper and may be attributed to solvents, varnishes, mineral oils, etc., but may also be an indication of mould.

6.7 Moisture

If a sample is to be taken to determine the moisture ratio of the delivered recovered paper, the conditions applicable to representative sampling are to be observed.

6.8 Age

Age in this context is not to be understood as the mass-specific average age of a particular delivery, but rather as an indication of long storage periods which mainly affect deinkability of offset papers (newspapers, in particular).

6.9 Recovered paper composition

It may be very tedious to obtain a single complex assessment unit for all non-paper components and/or paper composites. It is thus recommended to differentiate this parameter in a suitable way.

In case that the category “other papers” is not considered, it has to be borne in mind that it may still account for an important percentage of the total delivery (up to 20 per cent are permitted).

6.10 Calibration

6.10.1 Statistics

The sample which is subject to gravimetric measurement has to have a sufficient size and to be objective, i.e. not influenced by the sampler. It largely depends on the distribution of the respective feature to be examined (here an item of recovered paper composition) in the delivery. Material losses may not be incurred during sampling.

With regard to the value pairs obtained one has to be aware of measuring inaccuracies. A linear correlation between (visual) assessment and (gravimetric) measurement has been assumed – whether this is actually the case largely depends, however, on the assessment unit and the distribution of the delivery component concerned. A linear correlation may also exist for individual segments only, which, however, merely applies within the range of the value pairs obtained. Theoretically, all equalizing lines obtained would have to run through the origin of the *xy*-axes. It is, however, to be expected that minimum concentrations are required for individual components to appear on the surface, which is why the straight line is subject to a shift *k* along the *y*-axis ($\Rightarrow A = f_W \cdot a + k$).

The measurements taken must not be mutually dependent, i.e. the deliveries to be inspected have to be selected at random and must not be restricted to the best or worst lots. It is important to provide a sufficient number of value pairs for the entire range of maximum and minimum proportions of a particular component.

6.10.2 Implementation

No universal specifications are available as to the size of the sample to be taken. It should, however, not be inferior to 30 kg, i.e. 0.15 per cent of a delivery of 20 tons. Where possible, the largest sample size should be chosen. A wheel loader which is particularly suited for sampling picks a sample from the recovered paper pile and empties it into a stable sample container – either a metal box (closed on its sides and at the bottom), a chemical container

which has been shortened to approx. 1-2 m^3 or a bricklayer's bucket. The volume of the sample container limits the size of the sample taken. The sample is then being weighed and subsequently sorted according to the various components and applicable allocation criteria. Finally, the individual components are also being weighed. To be more specific and informative, the allocation criteria may be further differentiated in the case of gravimetric determination of component fractions which is not possible, however, in the case of visual inspection.

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