PAPER

MANUFACTURERS ASSOCIATION
OF SOUTH AFRICA (PAMSA)

GUIDELINES

Moisture Content Measurement in Recovered Paper Grades

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MOISTURE CONTENT MEASUREMENT IN RECOVERED PAPER GRADES

GUIDELINES

The purpose of this document is to provide **a generic guideline* on the procedures and methods used to measure moisture content** in baled pre- and post-consumer recovered paper grades.

**This document should in no way be viewed as an industry standard. Moisture content measurement protocols may differ from mill to mill.*

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A. Abbreviations and definitions

Abbreviation	Meaning
OEM	Original Equipment Manufacturer
SOP	Standard Operating Procedure
DC	Dielectric Constant
LCD	Liquid Crystal Display
GN	Guidance Note

Definitions

Keyword	Definition
Moisture content	Water or moisture content is the quantity of water contained in a material.
Bale	A large wrapped or bound bundle of recycled paper, hay, or cotton.
Population	All the inhabitants of a particular place.
K4	Kraft grades corrugated containers. - Consists of corrugated containers having liners of kraft or test liner.
K3	New corrugated kraft waste. - Consists of new corrugated cuttings, sheets, and unused boxes as generated by corrugating converters having liners of kraft or test liner.
Raw materials	The basic material from which a product is made.
Suppliers	People or organizations that provide something needed such as a product or service.
Recycled paper grades	Paper discarded as used, superfluous, or not fit for use.
LCD	A form of visual display used in electronic devices, in which a layer of a liquid crystal is sandwiched between two transparent electrodes.
Handheld devices	A moisture measuring device that is portable, able to be used by a single operator, and has its own power supply
Dielectric measurement	Capacitive or dielectric moisture content measurements are non-destructive methods. The measurement principle is based on a capacitive electric field. The field forms between the probe head and the respective test material whereby a higher moisture content leads to a high dielectric constant that increases the capacity. The capacitive method is a relative measurement, which means the test result is given as the difference between the dry and the wet material.

B. Purpose and scope of the document

Paper recycling mills in South Africa that acquire pre - and post-consumer recovered paper grades will test for moisture content of the bales thereof. The moisture measurement procedures and methods will differ from mill to mill.

The suppliers must bear in mind that the **prescribed moisture content limit** allowed is a **maximum of 12%** for brown recovered paper grades K3/K4. However, this might not be applicable to all recycled paper grades as **HL1/HL2 might be a maximum of 10%**.

If the test shows excessive moisture, a more rigorous test can be done with a significant increase in the number of moisture tests per bale.

It is important that the equipment utilised for measuring moisture undergo calibration as per the manufacturers' (OEM) requirements, be subject to regular maintenance, and be used by trained operators.

Figure 1: Photos showing typical handheld devices (Aqua Boy and EMCO AP-500 respectively)

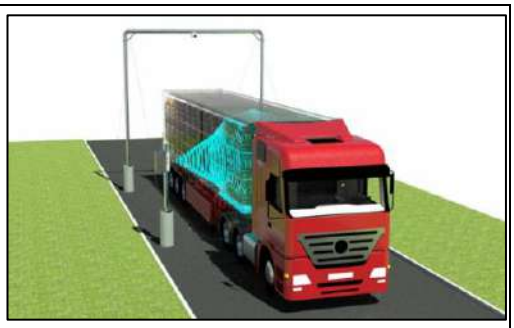

Figure 2: Diagram of a microwave moisture measuring station (from HNPA)

C. Handheld devices

There are many handheld devices available for measuring the moisture content of baled material. The devices come in two principal types:

- With probes
- Use of dielectric measuring principles.

1. Probes

The moisture content is measured by inserting a probe into the bale. The moisture content is recorded on the measuring device:

Advantages	Disadvantages
• Easy to use • Readily available	• Limited depth of penetration due to material resistance and, strength and length of the probe • Only measures moisture in a small area • Can have variable results due to density and type of material within the same bale

2. Dielectric measuring devices

Moisture content is measured by placing the flat plate of the measuring device on the surface of the bale according to the manufacturer's operating procedure and then triggering the scan. The moisture content is recorded on the device. *Note: a value for the material type will have to be set into the scanning device.* (Refer to the device manufacturer's operating manual).

Advantages	Disadvantages
• Easy to use • 300mm to 500mm penetration	• Limited penetration of the bale • Restricted sample area • Requires technical knowledge to calibrate the instrument for differing material types

Measuring process for handheld devices

- All measurements are to be taken in consultation with the device manufacturer's specifications, methodology, and test requirements.
- Testing should only be carried out using trained operators.
- The mills have their own test requirements and protocols, but in principle the testing of the bales will include the following:
    - Visually inspect the contents of the truck noting the condition and appearance of the bales and estimate the material content of the bales. Based on the visual inspection (or mill-specific test protocols) a test regime for the bales on the truck will be determined. Factors affecting the sample size could include:
        - Dominant material type of the bales
        - Condition of the bales
        - Visible excess moisture
        - Reliability of the supplier of the bales

Some mills might also do quality control on all brown recovered paper delivered. Four to five bales are taken off the truck by the clamp truck driver, they weigh the bales and then break the bales open and check for outthrows and prohibited material in accordance with the K3/K4 grade specification. If over the specification, the load will be rejected and returned to the supplier.

In terms of moisture, some mills also deduct the moisture of above 12% directly from the confirmed weight.

- Take samples using the recommended test procedure.
- Take readings as per the determined protocol.

Sample size	Frequency on bale	Position on bale	How to pick Bale
Population (100%)	Once on each bale	Centre	N/A
75%	Twice on each bale selected	Top and bottom	Random
50%	3 times on each bale selected	Top, centre, and bottom	Random

Table 1: Sample Protocol

3. Operational notes

- Trucks to be parked in a dedicated off-loading bay to ensure the safety of operators doing the quality control of the recycled paper load.
- Only approved ladders and lift machinery to be used for accessing the upper bales
- In some cases, brown recovered paper loads must be taped/strapped, and it is removed by the truck driver and assistant at the mill. After it is removed, visual inspection is done. If the load meets the requirements, moisture testing is done, and then four to five bales are removed and broken open to measure the out-throws and prohibitive materials.
- All results to be logged.
- Operators to always wear appropriate PPE.

D. Microwave measurement stations:

Some mills have now installed sophisticated microwave measurement stations that scan the complete truck as it passes through a measurement station. The scanning technology allows for the moisture content to be measured across the full width of the truckload giving an accurate reflection of the load moisture content. The moisture content is automatically sent to a centralised system and can be appended to the weighbridge information. Using laser-based remote sensing a map of the moisture content of the truckload is produced and an average moisture content is calculated.

Advantages	Disadvantages
• Sophisticated measurements and recording of data, can integrate with other systems allowing easy information analysis. • Automated	• Expensive • Fixed measurement station • Requires dedicated infrastructure • Requires trained operators

Generic operating procedure:

- The truck arrives at the site and proceeds to the weighbridge, the truck is weighed, and visual inspection of the load is carried out.
- The truck is directed to the quality control station where it follows the directions of the station operators and the traffic light system (if installed), and the truck is scanned while in motion. If required, covers on the load will be removed (or drawn open) before entering the measurement station.
- On exiting the measurement station, the truck will be directed to a holding area where the moisture content measurement documentation (and weighbridge information of the systems are integrated) will be handed to the truck operator.
- The truck will then proceed to the offloading area.
- Typically, the following information will be produced:
    - A report containing unique reference information and an average moisture content.
    - An analysis of the moisture content of the entire load.