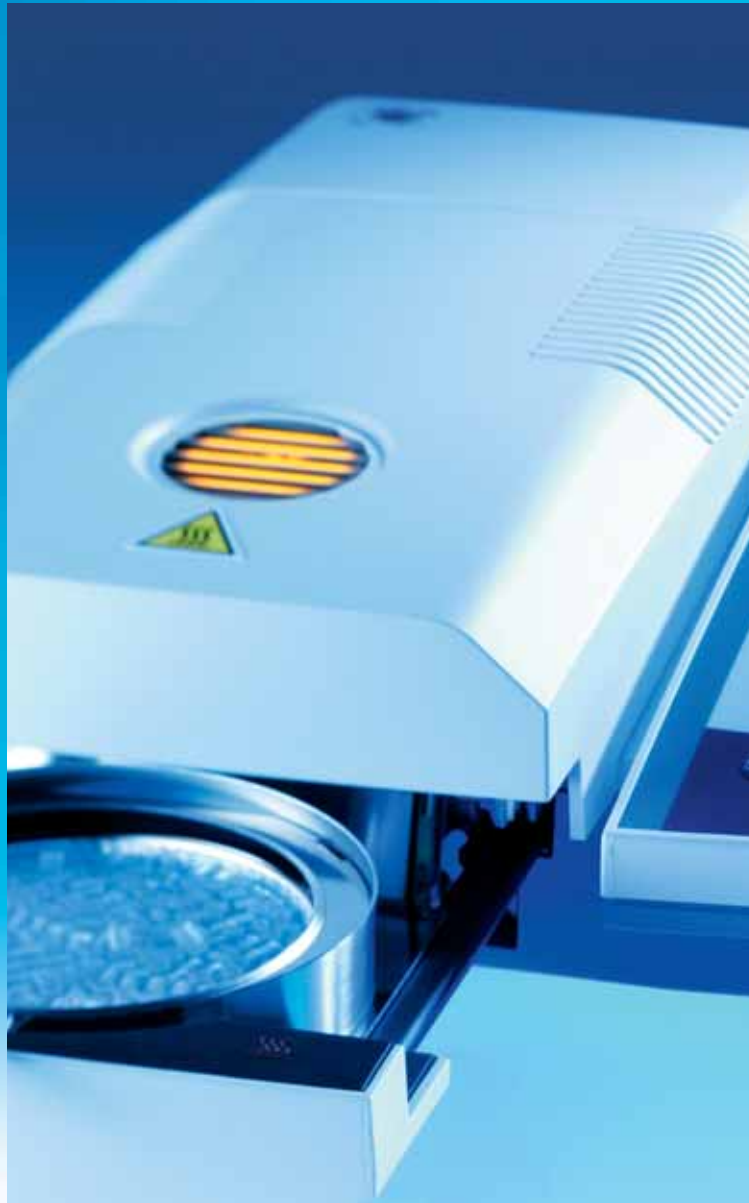


Application Solutions



Determination of
Moisture Content
in Plastics

Precise
Practical
Chemical-free

Plastics Methods for HR83

METTLER TOLEDO

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Moisture Determination Method Collection



(Photograph courtesy of Wild & Küpfer AG Switzerland)
Moisture determination of plastics is an important step for the injection molding process.

HR83 in plastics industry

Both manufacturers of plastic parts and their clients focus on quality and rapid production processes. The right moisture content of your raw materials ensures trouble-free compounding and injection molding, smooth surfaces and ideal mechanical properties of the injection-molded parts. With the HR83 Moisture Analyzer METTLER TOLEDO offers the ideal instrument for a simple and accurate moisture content determination on the factory floor.

Disclaimer

We carefully developed the methods with METTLER TOLEDO HR83 Halogen Moisture Analyzer and Karl-Fischer titrator. However, you should still test the information provided for its suitability to your intended purpose. As the use and transfer of an application are beyond our control, we cannot accept responsibility for this. The general safety rules and precautions of the manufacturer (e.g. for chemicals or solvents) must be observed.

How to use HR83 Moisture Analyzer



Moisture determination with HR83

Position HR83 instrument at suitable location, connect it to the power supply and give it 30 minutes for acclimatization. Level and adjust balance and heating module. Use the recommended standard settings for plastics (page 4). After switch-on and preheating period of 15 minutes the instrument is ready for use.

Place the aluminum sample pan in the instrument, preheat it for 1 minute at the standby temperature 100 °C and tare it. Distribute the sample fast and evenly in the sample pan and start the drying process. For simplification and acceleration of your daily work it is useful to program all settings for a particular material in the HR83. You can recall the method at a keystroke and HR83 immediately operates with the corresponding settings.

Reference method Karl Fischer titration

To determine the reference value the coulometric Karl Fischer titrator DL39 from METTLER TOLEDO was used. In combination with the Stromboli oven sample changer the DL39 enables up to 13 samples to be titrated in unattended operation. The samples were automatically transferred into a temperature controlled oven from where the evolved water was transferred to the titration cell via an applied nitrogen flow. The Software LabX Pro Titration was used for instrument control and data management.



For further product and application information please visit
Literature: ASTM D 6869-03

► www.mt.com/Karl-Fischer

Recommendations for HR83

Recommended standard settings for all plastics

Vibration adapter: High

Resolution: High (0.1mg)

Standby temperature: 100°C, permanent (first measurement after 15 min of preheating)

Drying program: step drying

step 1: 5 min at temperature T_1

step 2: 0 min at temperature T_1

T_1 : final drying temperature

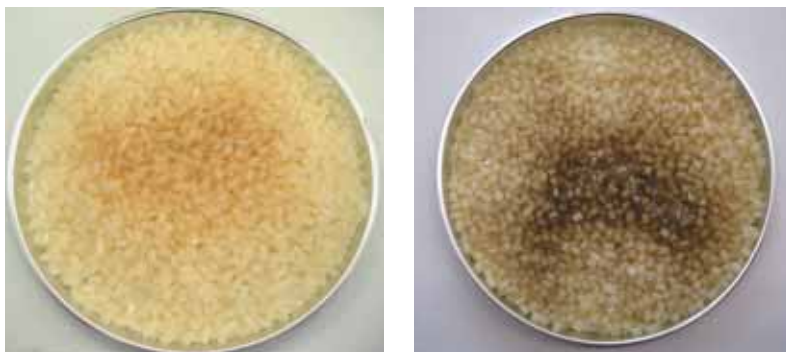
Switch-off criterion: 5

Sample weight: 30 g

Preheat aluminium sample pan for 1 min at standby temperature, then tare it.

Material specific drying temperature (T_1)

Select a temperature such that moisture evaporates and result matches the reference value obtained by Karl-Fischer titration. Melted material or color changes are indications of too high temperatures. However, sometimes browning of the sample cannot be avoided as in the case of polyamides.



Left photograph shows a well chosen drying temperature, material is neither melted nor has the color changed. The photograph on the right clearly shows signs of burning and therefore too high temperatures (melted material, color changes).

Sample handling

If sample is not analyzed immediately, store sample material in airtight container, fill the container completely in order to reduce the amount of air in the container and thereby minimize uptake of moisture during storage.



Frequently asked questions

Question

Can I use the same method for a plastic which is reinforced as for a non-reinforced?

I have a colored resin, can I use the same parameters as applied for the uncolored resin?

How about determination of moisture content of plastics containing plasticizers?

I am using Karl-Fischer titration with an oven; can I use this oven temperature for HR83?

There is an existing method for a polymer from a specific resin supplier available. Can I use this method for the same polymer but from a different supplier?

Answer

Reinforced plastics contain glass or other materials which do not interfere. Therefore, you can use the same method.

Adaptation of temperature due to different absorption characteristics is suggested, e.g. for a black resin use a heating temperature which is approx. 10°C lower compared with a white resin.

Because the thermogravimetric measuring principle recognizes the loss of plasticizers as moisture, special care needs to be taken. E.g., if possible, dry with low temperatures so plasticizers do not evaporate.

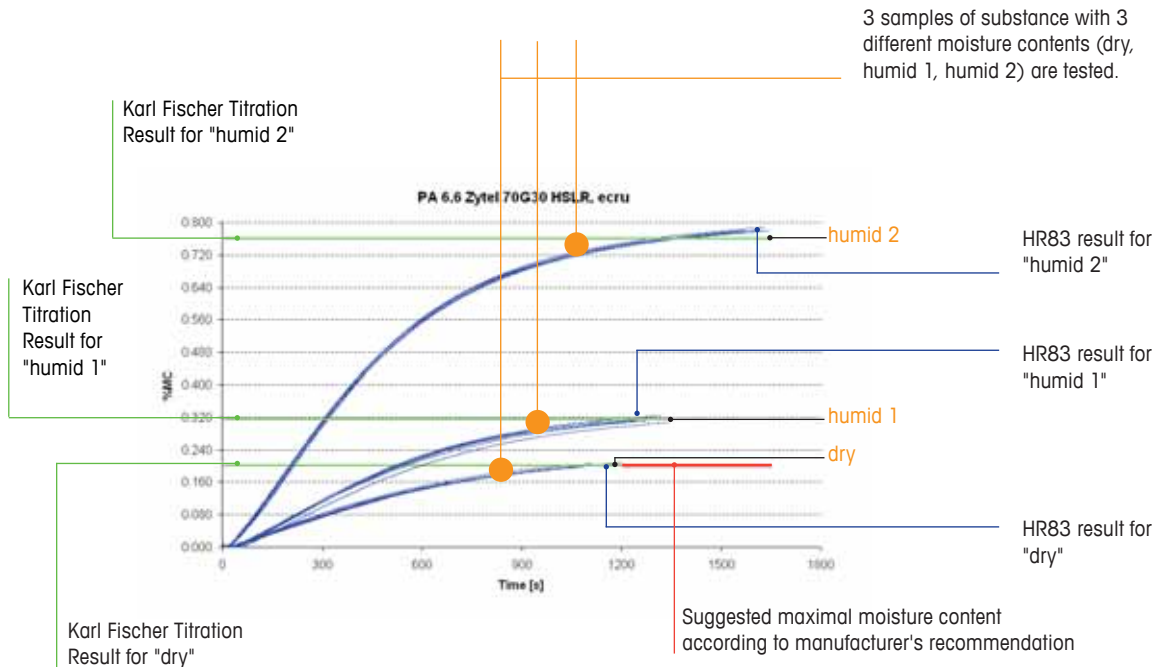
The oven temperature from Karl-Fischer titration can not be transferred one-to-one to the HR83. Our experience shows that the heating temperature of the HR83 is approximately 30°C lower.

The existing method is a good indication, but an adaptation may be needed as the composition of polymers from different suppliers can vary.



Explanation of Diagrams

The measurement performance of the HR83 Moisture Analyzer is illustrated with a diagram for each substance showing the drying curve in reference to the results obtained with Karl Fischer Titration.



The resolution of the HR83 is 0.001% MC (Moisture Content) or 10 ppm.
The conversion of % MC to ppm may be required:

10 ppm = 0.001% MC
100 ppm = 0.01% MC
1000 ppm = 0.1% MC

Explanation of diagram

- Three samples of a substance are tested, each sample with a different moisture content (dry, humid 1, humid 2).
- The moisture content as determined with Karl Fischer Titration (green line, average value)
- The moisture content as determined using the HR83 Moisture Analyzer (blue lines, each line represents one measurement).
- The red line indicates the typical value for the maximum admissible moisture content for processing of pellets. Always refer to the instructions of the materials supplier for the specific value for a material.

Specific sample requirements

The maximum permissible moisture content of pellets for processing must always be based on the manufacturer instructions. Values noted herein are only typical values and may not be suitable for your specific material or process.

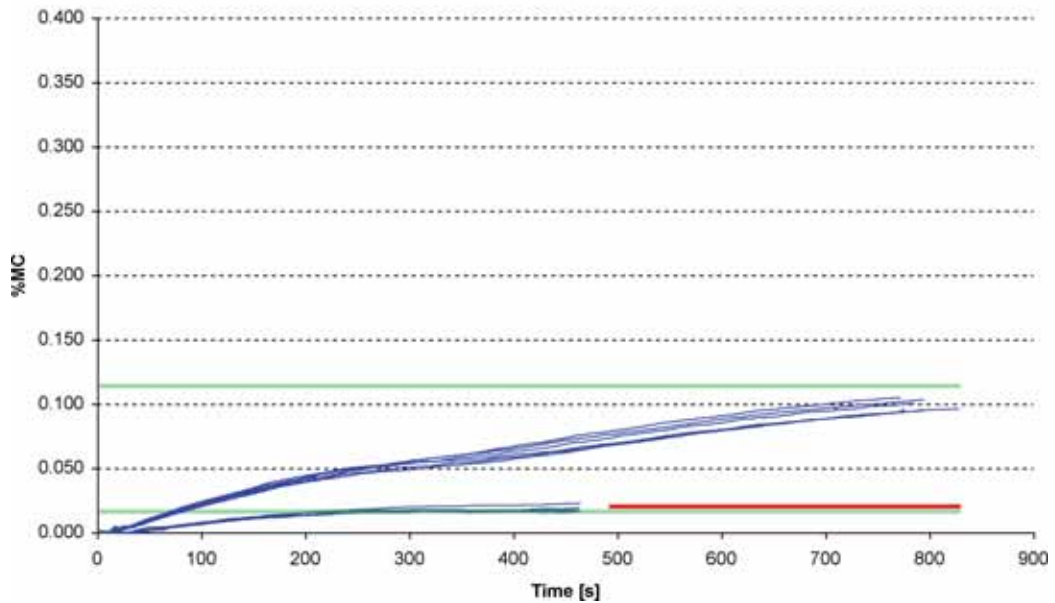
The drying parameters noted have been determined by testing of common plastics. It is not intended that these parameters are inclusive for every grade or color of every plastic. Optimization of drying method parameters may be needed for best results with a specific material.

PC (Polycarbonate)

Description of sample

PC, white

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 130°C, 0 min at 130°C, 130°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Lexan® 141R	0.02	0.15	Medium viscosity

* Information obtained from manufacturer.

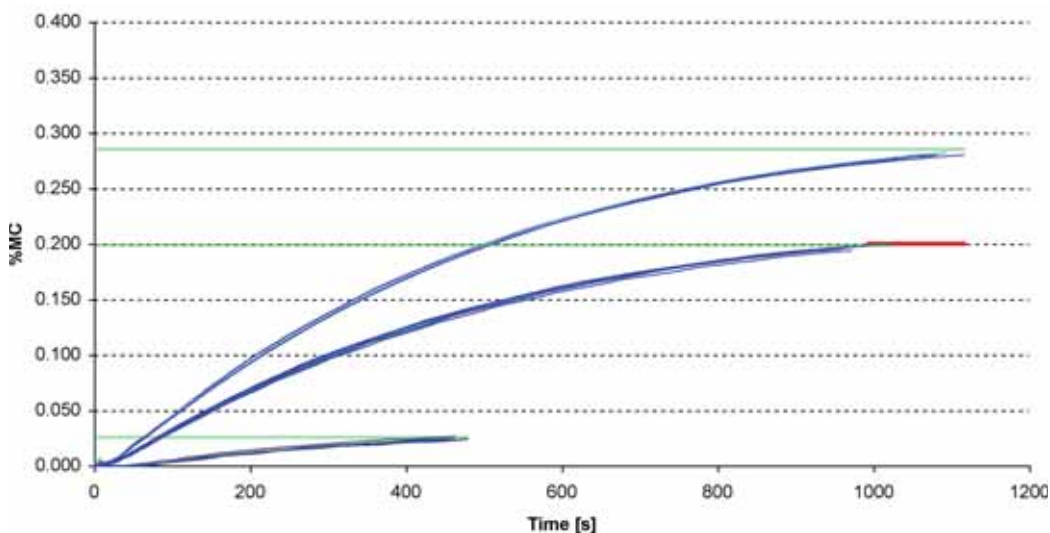
Blue curves: Drying curves measured with the HR83 Moisture Analyzer
 Green lines: Moisture results obtained by Karl-Fischer titration
 Red line: Typical value for maximum moisture content for processing

POM (Polyoxymethylene)

Description of sample

POM, white

Measurement results for 3 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 130°C, 0 min at 130°C, 130°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Hostaform C9021	0.2	0.2	High rigidity, good chemical resistance, high resistance to thermal and oxidative degradation, low moisture absorption

* Information obtained from manufacturer.

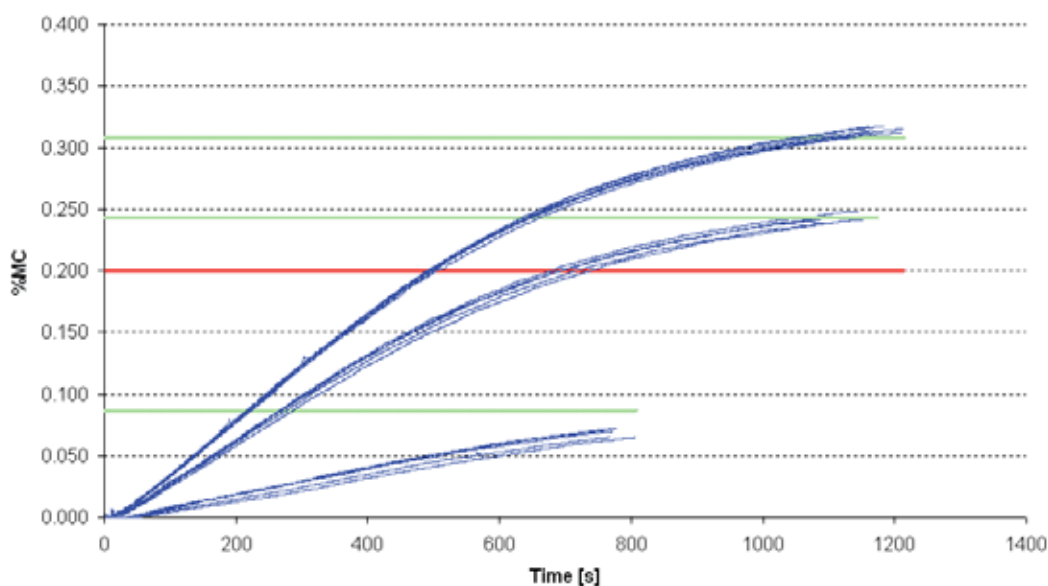
Blue curves: Drying curves measured with the HR83 Moisture Analyzer
 Green lines: Moisture results obtained by Karl-Fischer titration
 Red line: Typical value for maximum moisture content for processing

ABS (Acrylonitrile butadiene styrene)

Description of sample

ABS, white

Measurement results for 3 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 130°C, 0 min at 130°C, 130°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Novodur® P2H-AT	0.2	–	Standard impact strength, easy flowing, high gloss, contains antistatic additives

* Information obtained from manufacturer.

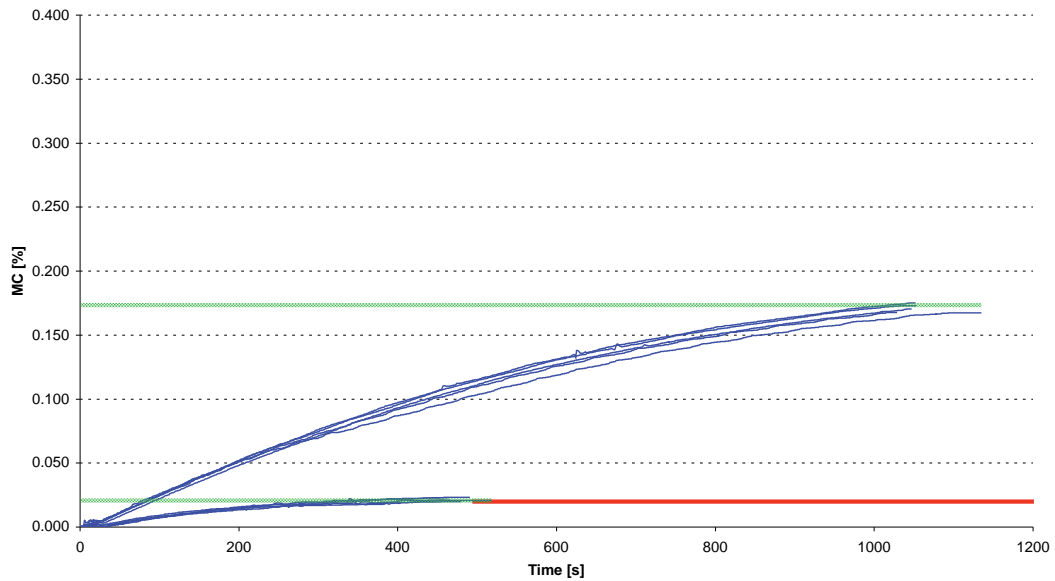
Conclusion The manufacturer's specification on maximum moisture content of the plastic pellets for processing (e.g. injection molding) can be verified reliable, easy and fast with the HR83 Halogen Moisture Analyzer.

ABS + PC (Blend)

Description of sample

ABS+PC, ecru

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 110°C, 0 min at 110°C, 110°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Cycloyl® C1000A	0.02	0.2	Excellent processability, platable

* Information obtained from manufacturer.

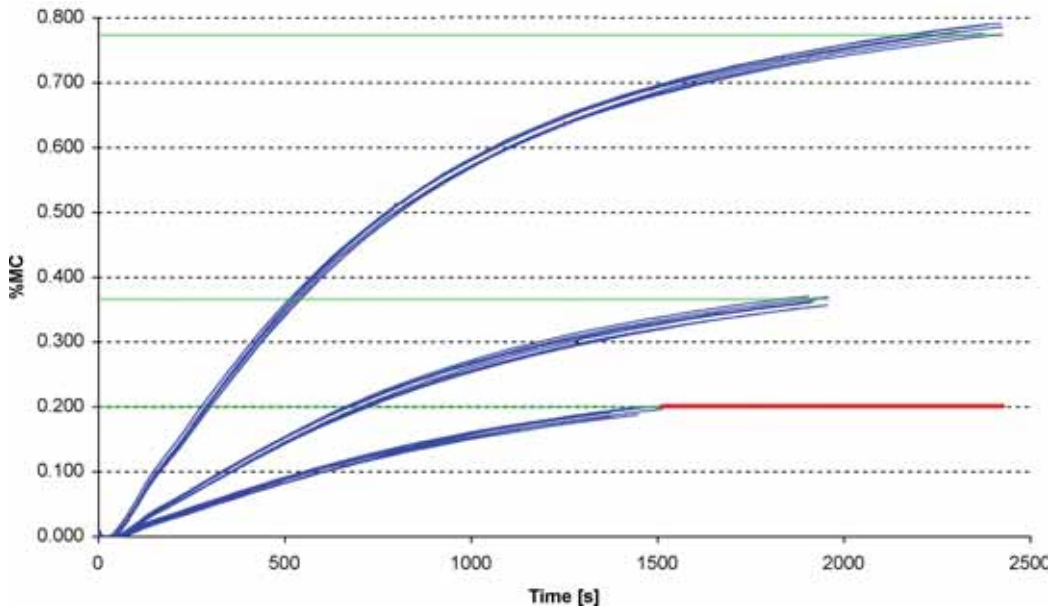
Blue curves: Drying curves measured with the HR83 Moisture Analyzer
 Green lines: Moisture results obtained by Karl-Fischer titration
 Red line: Typical value for maximum moisture content for processing

PA6 (Polyamide 6)

Description of sample

ABS, white

Measurement results for 3 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 130°C, 0 min at 130°C, 130°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Schulamid® 6 MV	0.2	2.3	Medium viscosity

* Information obtained from manufacturer.

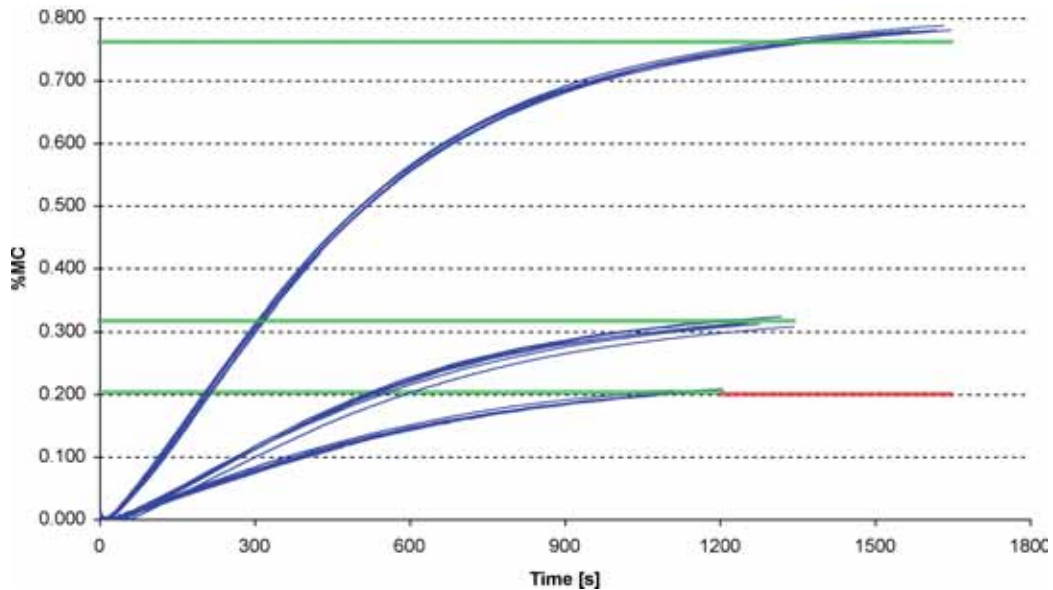
Conclusion The manufacturer's specification on maximum moisture content of the plastic pellets for processing (e.g. injection molding) can be verified reliable, easy and fast with the HR83 Halogen Moisture Analyzer.

PA6.6 (Polyamide 66)

Description of sample

PA 66 - GF 30, ecru

Measurement results for 3 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 160°C, 0 min at 160°C, 160°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Zyfel® 70G30HSLR NC010	0.2	1.9	PA66, 30% glass fibre reinforced, heat stabilized, lubricated, hydrolysis resistant

* Information obtained from manufacturer.

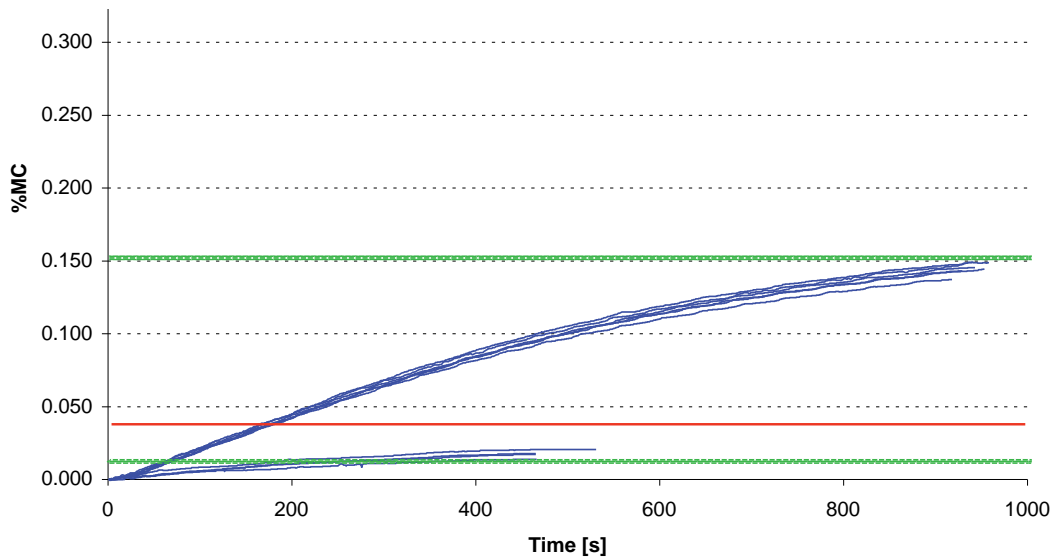
Blue curves: Drying curves measured with the HR83 Moisture Analyzer
 Green lines: Moisture results obtained by Karl-Fischer titration
 Red line: Typical value for maximum moisture content for processing

PBT (Polybutylene terephthalate)

Description of sample

PBT, light-grey

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 120°C, 0 min at 120°C, 120°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Crastin® SO653 NC010	0.04	0.2	20% glass bead filled, low moisture absorption, lubricated, warp resistant

* Information obtained from manufacturer.

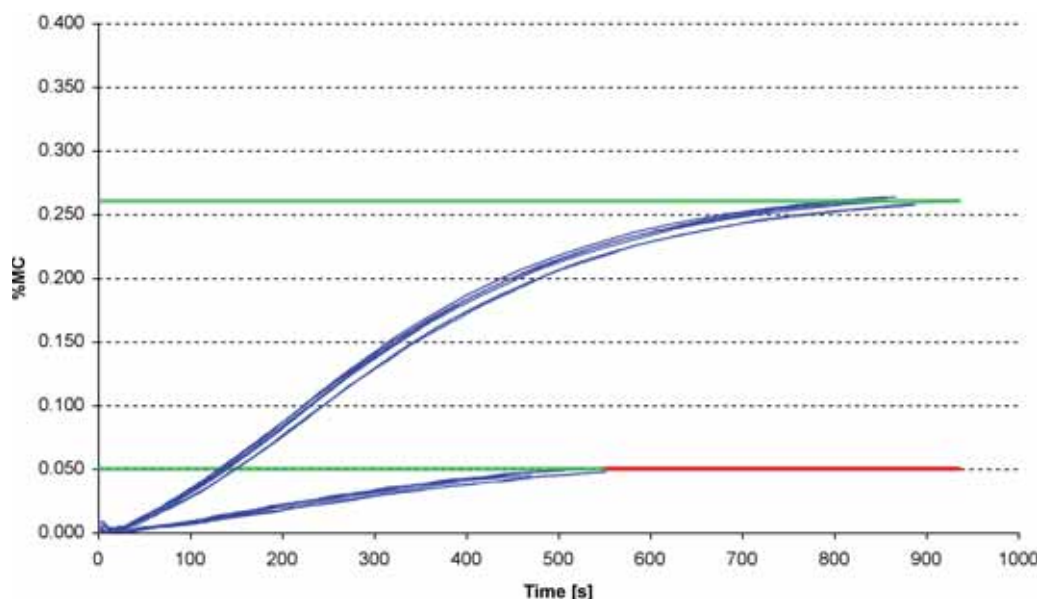
Conclusion The manufacturer's specification on maximum moisture content of the plastic pellets for processing (e.g. injection molding) can be verified reliable, easy and fast with the HR83 Halogen Moisture Analyzer.

PET (Polyethylene terephthalate)

Description of sample

PET, transparent

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 160°C, 0 min at 160°C, 160°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Eastar EN058	0.05	0.19 (water absorption)	Copolymer, crystalline

* Information obtained from manufacturer.

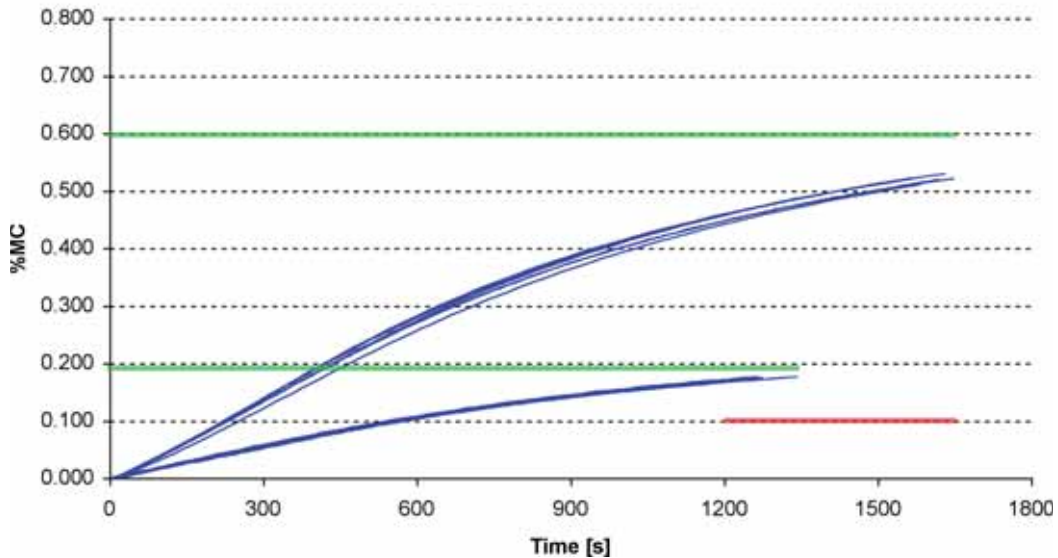
Blue curves: Drying curves measured with the HR83 Moisture Analyzer
 Green lines: Moisture results obtained by Karl-Fischer titration
 Red line: Typical value for maximum moisture content for processing

PMMA (Polymethyl methacrylate)

Description of sample

PMMA, transparent

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 100°C, 0 min at 100°C, 100°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Plexiglas® 6N	0.1	0.6	Very good mechanical properties, high heat deflection temperature, excellent flow/melt viscosity

* Information obtained from manufacturer.

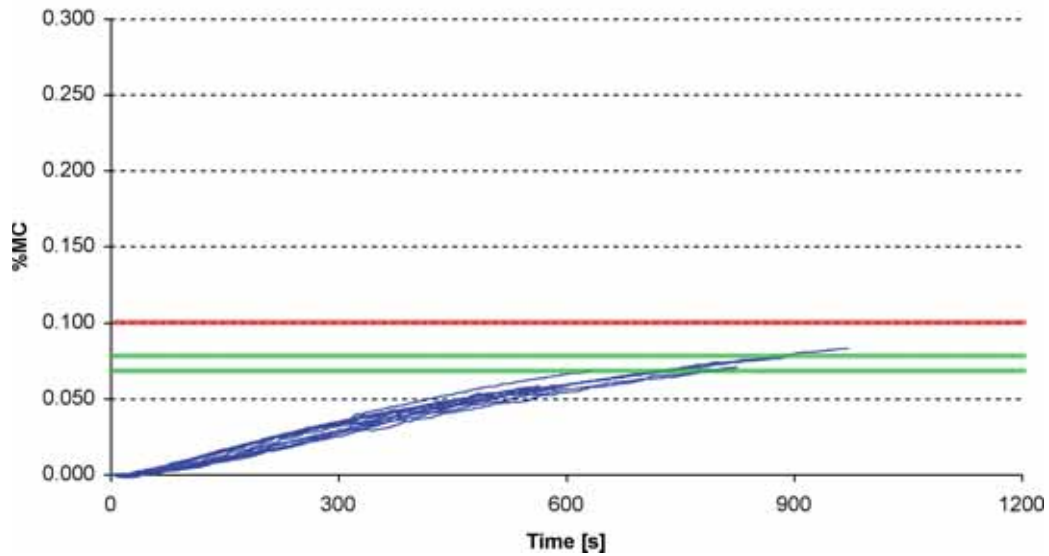
Conclusion The manufacturer's specification on maximum moisture content of the plastic pellets for processing (e.g. injection molding) can be verified reliable, easy and fast with the HR83 Halogen Moisture Analyzer.

TPU (Thermoplastic polyurethane)

Description of sample

TPU, transparent

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 115°C, 0 min at 115°C, 115°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Pearlthane® 11T85UV	0.1	–	UV-resistant

* Information obtained from manufacturer.

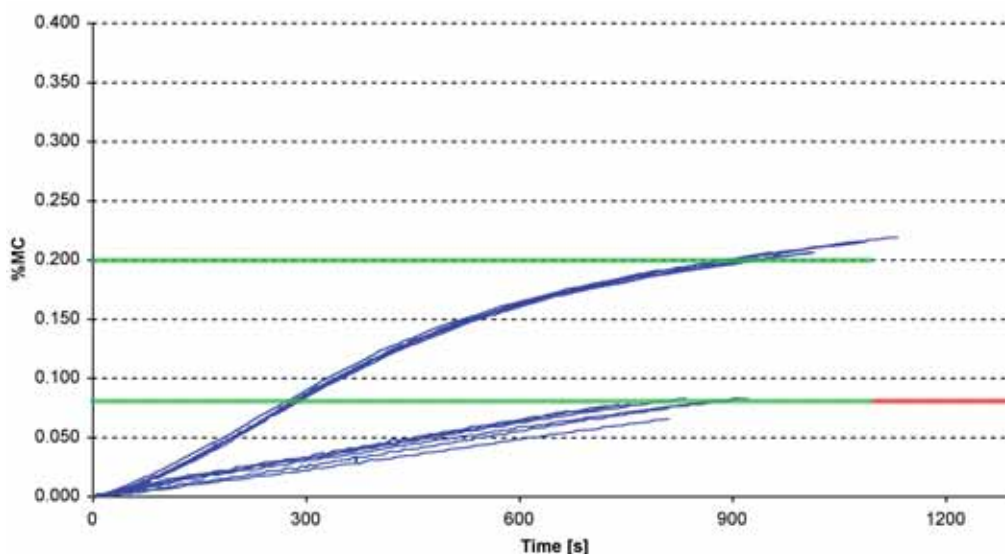
Blue curves: Drying curves measured with the HR83 Moisture Analyzer
 Green lines: Moisture results obtained by Karl-Fischer titration
 Red line: Typical value for maximum moisture content for processing

TPV (Thermoplastic vulcanizate)

Description of sample

TPV, ecru

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 135°C, 0 min at 135°C, 135°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Santoprene TPV 241-73	0.08	–	Good chemical and heat aging resistance, recyclable, ozone resistant, flexible at low temperature

* Information obtained from manufacturer.

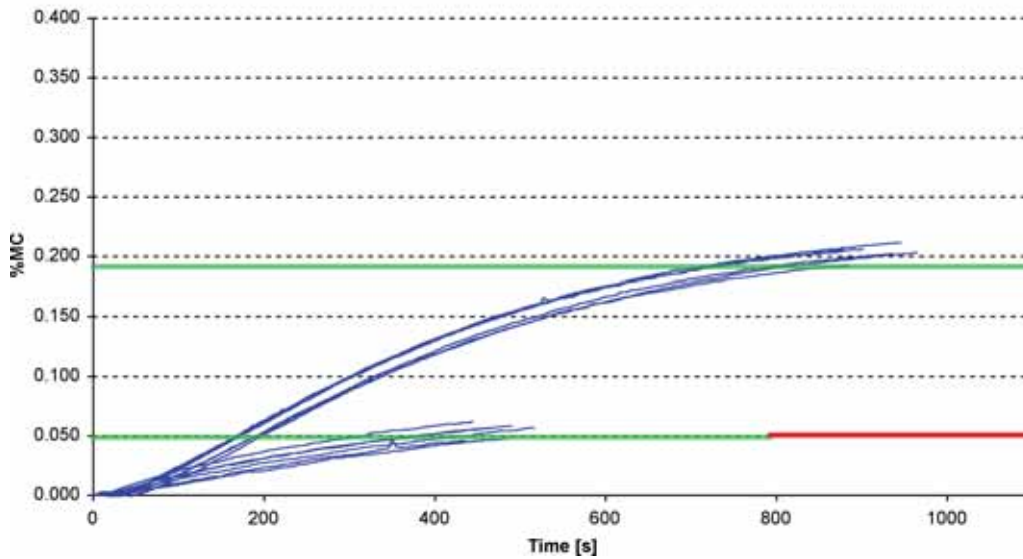
Conclusion The manufacturer's specification on maximum moisture content of the plastic pellets for processing (e.g. injection molding) can be verified reliable, easy and fast with the HR83 Halogen Moisture Analyzer.

PA46 (Polyamide 46)

Description of sample

PA46, ecru

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C] 5 min at 160°C, 0 min at 160°C, 160°C

Sample weight [g] 30

Switch-off criterion 5

Drying program Step

High resolution (0,1 mg) active

Standby temperature 100°C for ≥ 15 min.

Vibration adapter high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Stanyl® TW341	0.05	3.7	Heat stabilized

* Information obtained from manufacturer.

Blue curves:

Green lines:

Red line:

Drying curves measured with the HR83 Moisture Analyzer

Moisture results obtained by Karl-Fischer titration

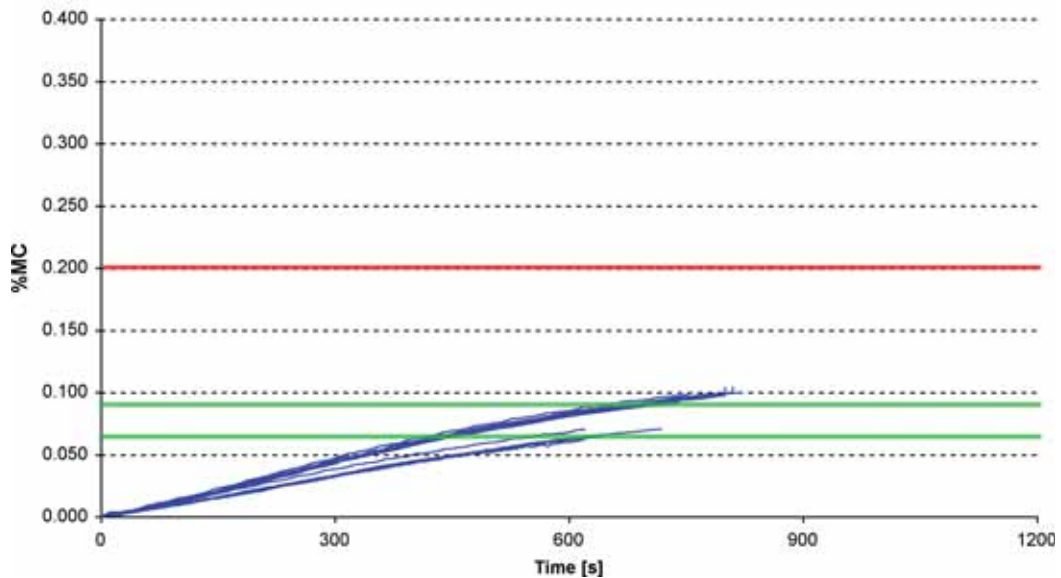
Typical value for maximum moisture content for processing

PVC (Polyvinylchloride)

Description of sample

PVC, white

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 145°C, 0 min at 145°C, 145°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Benvic® ER381	0.2	–	–

* Information obtained from manufacturer.

Conclusion The manufacturer's specification on maximum moisture content of the plastic pellets for processing (e.g. injection molding) can be verified reliable, easy and fast with the HR83 Halogen Moisture Analyzer.

PA12 (Polyamide 12)

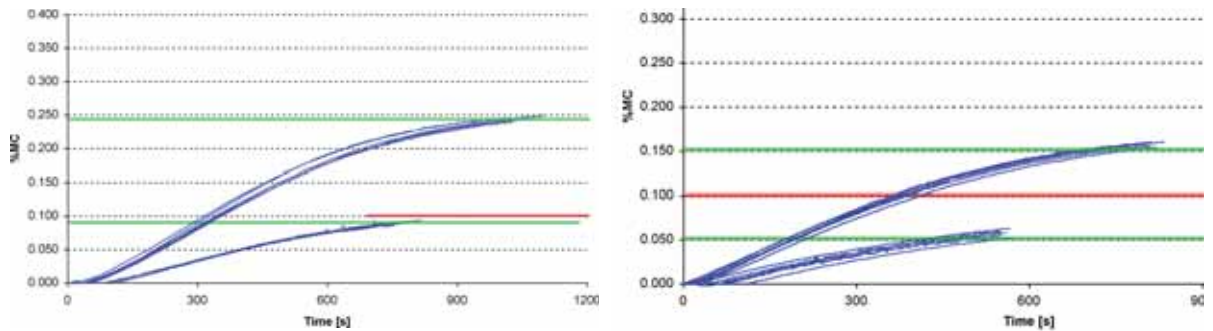
Description of sample (1)

PA12, white

Description of sample (2)

PA12-GF50, white

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 145°C, 0 min at 145°C, 145°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50RH) [%]*	Description*
(1) Grilamid® L25	0.1	0.7	Very tasteless, high toughness, good chemical resistance
(2) Grilamid® LV-5H	0.1	0.4	50% glass fibre reinforced, heat stabilized, good chemical resistance, good UV stability, very dimensional stable, very low shrinkage

* Information obtained from manufacturer.

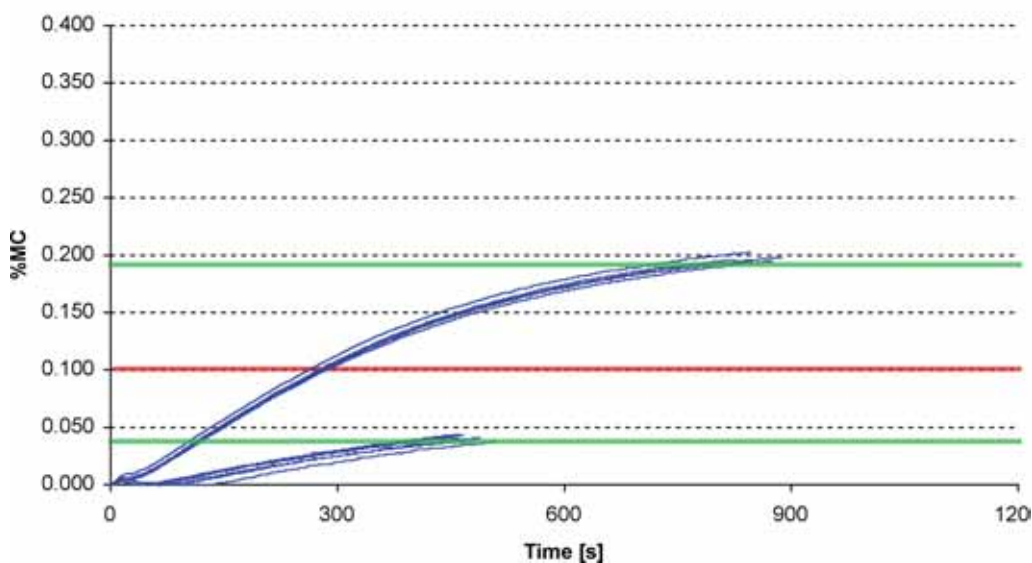
Blue curves: Drying curves measured with the HR83 Moisture Analyzer
 Green lines: Moisture results obtained by Karl-Fischer titration
 Red line: Typical value for maximum moisture content for processing

PA12 (Polyamide 12)

Description of sample

PA12-GF50, black

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 135°C, 0 min at 135°C, 135°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Grilamid® LV-5H	0.1	0.4	50% glass fibre reinforced, heat stabilized, good chemical resistance, good UV stability, very dimensional stable, very low shrinkage

* Information obtained from manufacturer.

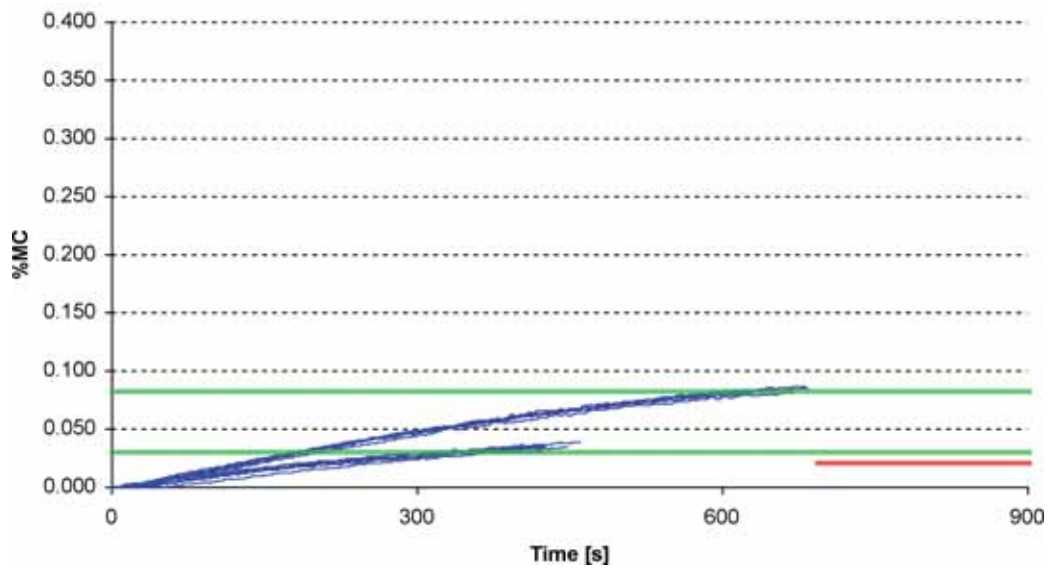
Conclusion The manufacturer's specification on maximum moisture content of the plastic pellets for processing (e.g. injection molding) can be verified reliable, easy and fast with the HR83 Halogen Moisture Analyzer.

PEI (Polyether Imide)

Description of sample

PEI, amber

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	5 min at 160°C, 0 min at 160°C, 160°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Ultern® 1000 Resin	0.02	0.7	ECO compliant, Food contact acceptable

* Information obtained from manufacturer.

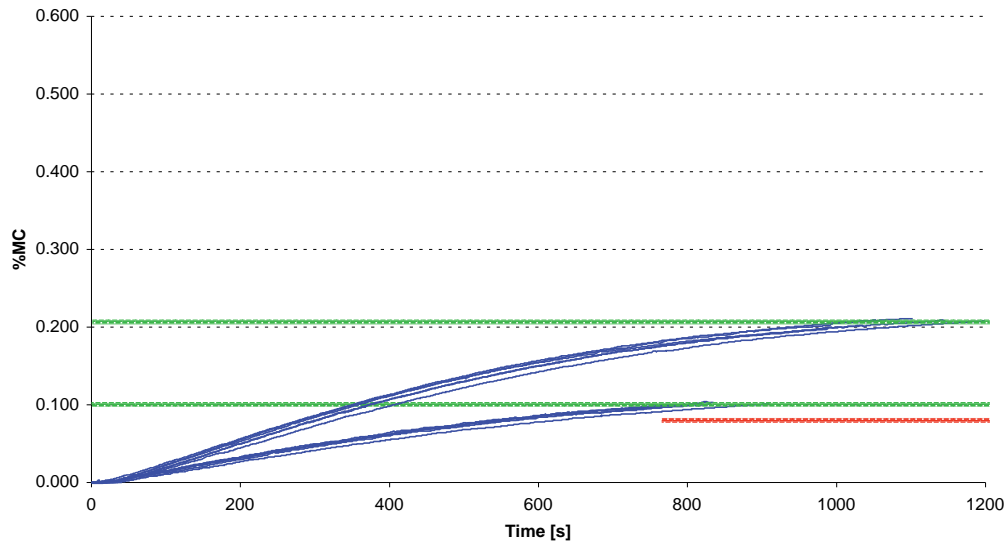
Blue curves: Drying curves measured with the HR83 Moisture Analyzer
 Green lines: Moisture results obtained by Karl-Fischer titration
 Red line: Typical value for maximum moisture content for processing

TPE (Thermoplastic Polyester Elastomer)

Description of sample

TPE, ecru

Measurement results for 2 different moisture contents



HR83: setting of drying method parameters

Temperature [°C]	3 min at 115°C, 0 min at 115°C, 115°C
Sample weight [g]	30
Switch-off criterion	5
Drying program	Step
High resolution (0,1 mg)	active
Standby temperature	100°C for ≥ 15 min.
Vibration adapter	high

Commercial name	Suggested max. moisture for processing [%]*	Humidity absorption (23°C/50rH) [%]*	Description*
Hytrel® 7246	0.08	0.2	High modulus grade, contains non-discoloring stabilizer

* Information obtained from manufacturer.

Conclusion The manufacturer's specification on maximum moisture content of the plastic pellets for processing (e.g. injection molding) can be verified reliable, easy and fast with the HR83 Halogen Moisture Analyzer.

Precise Moisture Analysis

HR83 is the ideal instrument for moisture determination on the factory floor: You obtain the same moisture results as with Karl Fischer titration (reference method) without the need of any chemicals.

HR83 Halogen Moisture Analyzer

Perfect Results? Certainly.

Ultra-fast drying
The HR83 uses a special drying agent and a special drying method to ensure fast and accurate drying of samples for each type of sample.

Precision & repeatability
The accuracy, repeatability and precision of the HR83 is guaranteed by the use of a special drying agent and a special drying method. The HR83 also features a special drying method to ensure fast and accurate drying of samples for each type of sample.

Full compliance to SOP and regulations
The HR83 is fully compliant with all relevant regulations and standards. It is also fully compliant with all relevant regulations and standards.

HR83 Halogen Moisture Analyzer
The professional solution for fast and regulated environments.

AutMed - Reduces development time
The HR83 features a special drying agent and a special drying method to ensure fast and accurate drying of samples for each type of sample.

IPac Moisture
The HR83 is fully compliant with all relevant regulations and standards. It is also fully compliant with all relevant regulations and standards.

METTLER TOLEDO

HR83 Moisture Analyzer Brochure

Karl Fischer Titrators

Easy and reliable KF titrations
From 1 ppm to 100%

Maintenance KF Titrators
C121, C122

Automatic KF Titrators
C123, C124

Over sample changer
S1000

METTLER TOLEDO

Karl Fischer Titrators Brochure

www.mt.com/moisture

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Subject to technical changes
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Printed in Switzerland 11795881
MarCom Greifensee