



Heat-Drying Moisture Analyzer

Measuring Moisture Content of Plastics

Table of Contents

Basics

1. Measuring Moisture Content of Plastics with a Heat-Drying Moisture Analyzer ...	02
1-1. Cautions when Measuring Moisture Content of Plastics	02
1-2. About Polyamide (Nylon) Plastics	03
2. Plastic Measurement Guide Function	04

Actual Measurements

2. Examples of Measuring Moisture Content of Plastics	05
2-1. ABS (Acrylonitrile Butadiene Styrene Copolymer)	05
2-2. ABS + PC (Mixture)	06
2-3. PA6 (Polyamide 6)	07
2-4. PA66 (Polyamide 66)	08
2-5. PA46 (Polyamide 46)	09
2-6. PBT (Polybutylene Terephthalate)	10
2-7. PC (Polycarbonate)	11
2-8. PET (Polyethylene Terephthalate)	12
2-9. PMMA (Polymethyl Methacrylate)	13
2-10. POM (Polyoxy methylene)	14
2-11. PP (Polypropylene)	15
2-12. PS (Polystyrene)	16

Application of the Analyzer

3. How to Adjust to Karl Fischer Moisture Analyzer Results	17
3-1. General Method	17
3-2. Deviation in Measurement Results	19

Basics

1. Measuring Moisture Content of Plastics with a Heat-Drying Moisture Analyzer

1-1. Cautions when Measuring Moisture Content of Plastics

Plastic pellets are used as a material in the production of high-quality molded plastic parts, so control of their moisture content is important. The heat-drying moisture analyzer is easier to operate and can measure moisture in a shorter time than the Karl Fischer method or the loss on drying method using an oven. ASTM D6980 specifies that a heat-drying moisture analyzer **device equipped with a mass sensor capable of weighing at a readability of 0.0001 g** must be used since the moisture content of plastic pellets is very low, at less than 1%, and the decrease in moisture content due to drying is also small. When measuring the moisture content of plastic pellets, it is recommended that you use the **MS-74A(T)**, which can weigh to a readability of 0.0001 g, and **at least a 20 g mass sample**.

The measurement principle of the heat-drying moisture analyzer is the same as the loss on drying method, which uses an oven-like dryer to dry the sample, but their heat source and temperature control are different. Therefore, **with a heat-drying moisture analyzer, it is not possible to use the measurement conditions of the loss on drying method**.

If, as with the loss on drying method, heating is performed with a heat-drying moisture analyzer for a long period of time, such as 2 hours or more, there may be errors in the moisture content rate caused by errors from the mass sensor being warmed for a long period of time.



The separate document **User's Handbook** contains information on the measurement principle, test sample, adjustment/calibration, Windows software, and maintenance of the heat-drying moisture analyzer. Please refer to it with this document.

Q1 Do measurement conditions differ depending on color?

A1 As dark colors such as black absorb infrared rays more easily than light colors such as white, fine adjustments such as changing the drying temperature may be necessary.

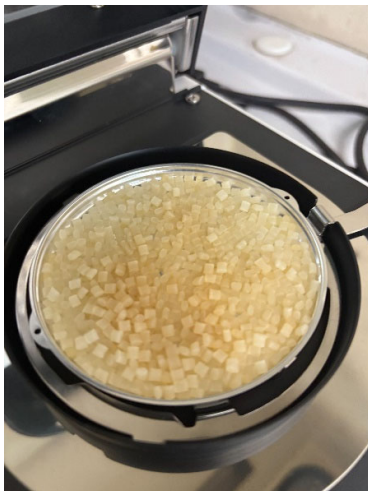
Q2 Can moisture content be measured with the same measurement conditions for the same type of plastic made by different manufacturers?

A2 The same type of plastic will have different formulations and manufacturing environments depending on the manufacturer. It may be necessary to make fine adjustments to existing measurement conditions.

1-2. About Polyamide (Nylon) Plastics

A property of polyamide (nylon) plastics is they change color under heating or drying conditions.

Appropriate drying temperature setting



Higher than appropriate drying temperature setting

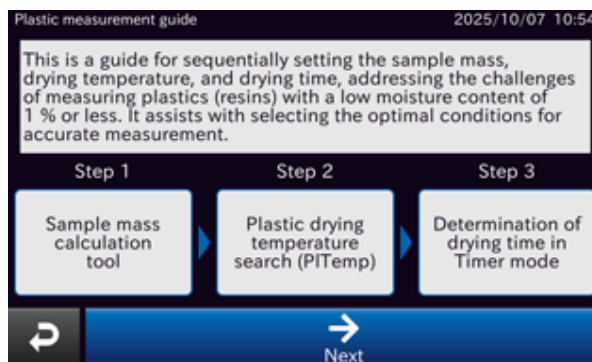


Take care when setting the temperature as yellowing of the sample will occur even when the appropriate drying temperature for a moisture analyzer is set.

The photo on the left shows a light yellow PA6 (polyamide 6) sample after moisture measurement at the appropriate temperature setting. The outside of the sample is the original color, but it is slightly darker near the center. The photo on the right shows the same sample after measuring moisture at a higher temperature than the appropriate temperature. The color is brown overall and shiny dark brown especially in the center (partially melted).

2. Plastic Measurement Guide Function

The **MS-74AT** and **MX-53AT** are advanced types equipped with an LCD display with 5-inch touch panel and they also feature a plastic measurement guide function. The Plastic Measurement Guide function allows the user to set the necessary measurement conditions to accurately measure the moisture content of plastics: (1) mass, (2) drying temperature, and (3) drying time by performing only two or three sample measurements. The appropriate measurement conditions for moisture measurement can be derived in a shorter time than through repeat trial and error.



(1) Mass

The required mass is calculated either by selecting the expected moisture content or by performing the actual moisture content measurement of the sample.

(2) Drying temperature

Heat the sample sequentially from 100 °C to 200 °C in 20 °C increments (factory default setting). After heating at each temperature, visually check for changes (melting, burning, etc.) in the sample and input whether changes are present or not to derive the appropriate drying temperature.

When visually checking for changes in the sample, note that polyamide (nylon) products will become discolored even at the appropriate drying temperature, as mentioned above.

(3) Drying time

Heat the sample for a set period of time and calculate the optimal drying time from the rate of change in moisture content while heating.

Please refer to the MS-74AT / MX-53AT Instruction Manual for details on the Plastic Measurement Guide function and operation.

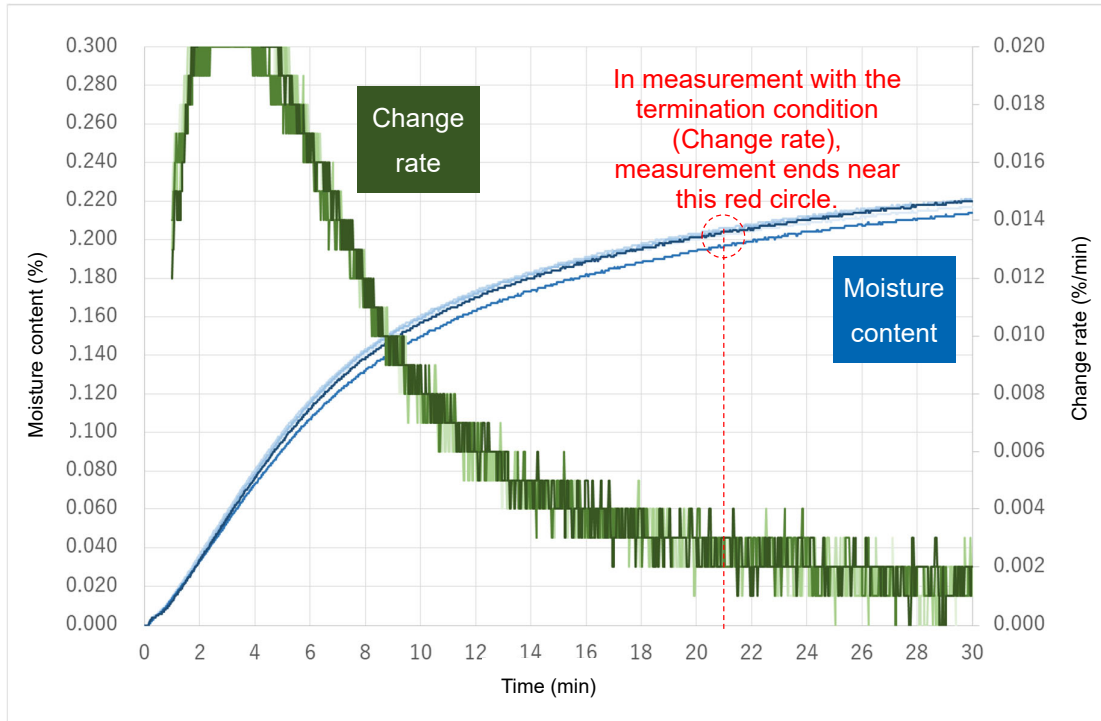
Actual Measurements

2. Examples of Measuring Moisture Content of Plastics

2-1. ABS (Acrylonitrile Butadiene Styrene Copolymer)

Color: White Mass: 25 g

Measurement result with MS-74A



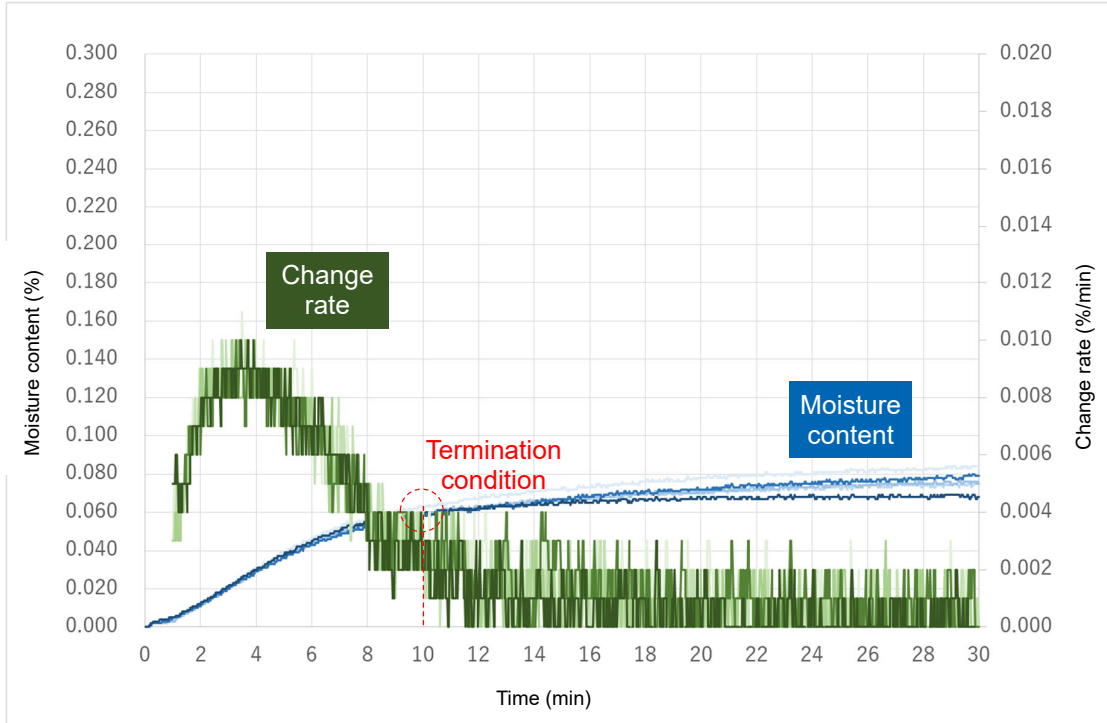
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	130 °C	120 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	21 min	22.3 min	30 min
Average moisture content	0.203%	0.223%	0.192%
Reproducibility (standard deviation)	0.0027%	0.0015%	0.0097%

2-2. ABS + PC (Mixture)

Color: White Mass: 25 g

Measurement result with MS-74A



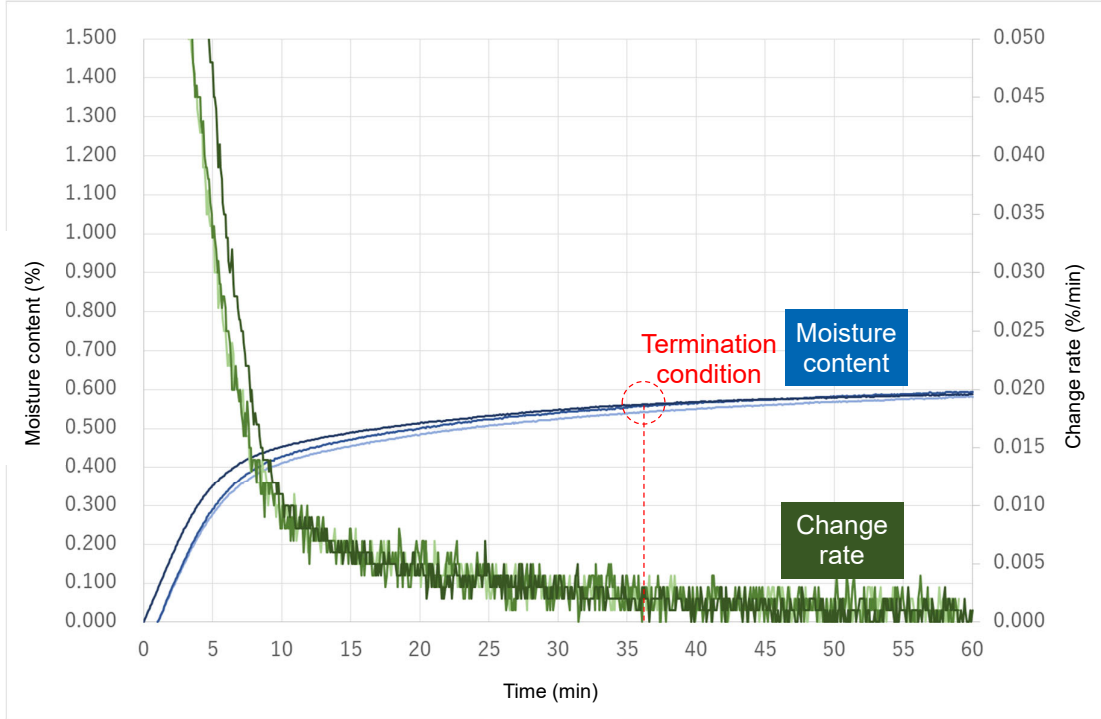
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	130 °C	110 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	10 min	19.3 min	30 min
Average moisture content	0.058%	0.098%	0.077%
Reproducibility (standard deviation)	0.0026%	0.0120%	0.0015%

2-3. PA6 (Polyamide 6)

Color: Light yellow Mass: 15 g

Measurement result with MS-74A



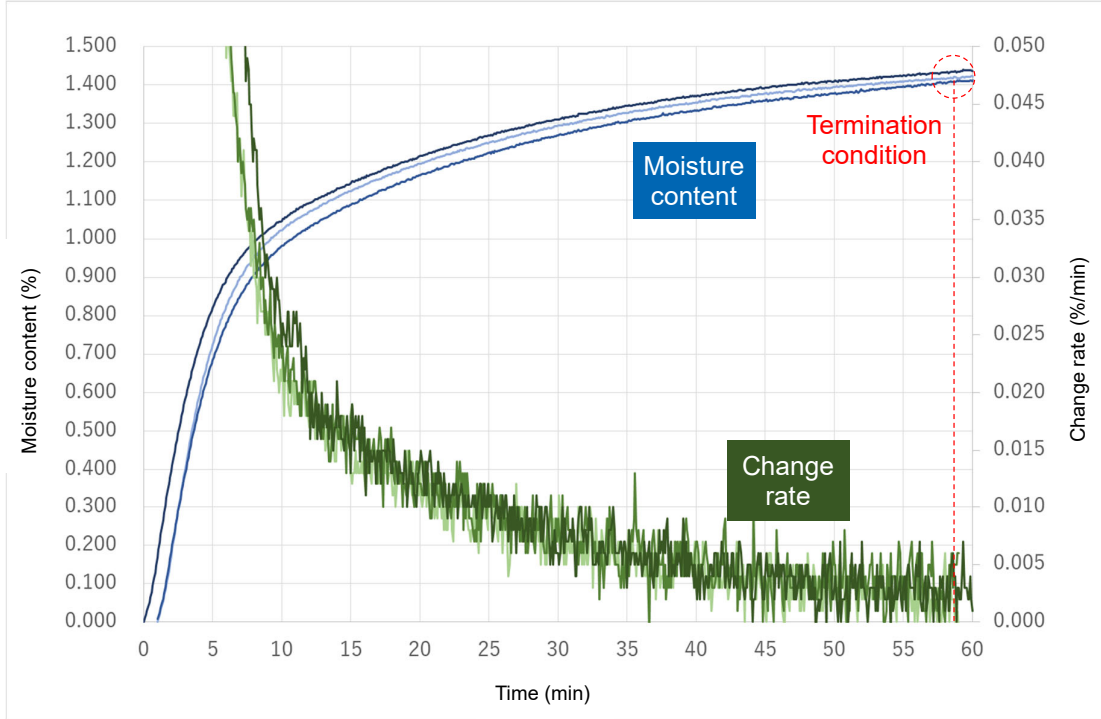
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	150 °C	150 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	36 min	30.6 min	30 min
Average moisture content	0.555%	0.523%	0.588%
Reproducibility (standard deviation)	0.0095%	0.0102%	0.0058%

2-4. PA66 (Polyamide 66)

Color: Light green Mass: 15 g

Measurement result with MS-74A



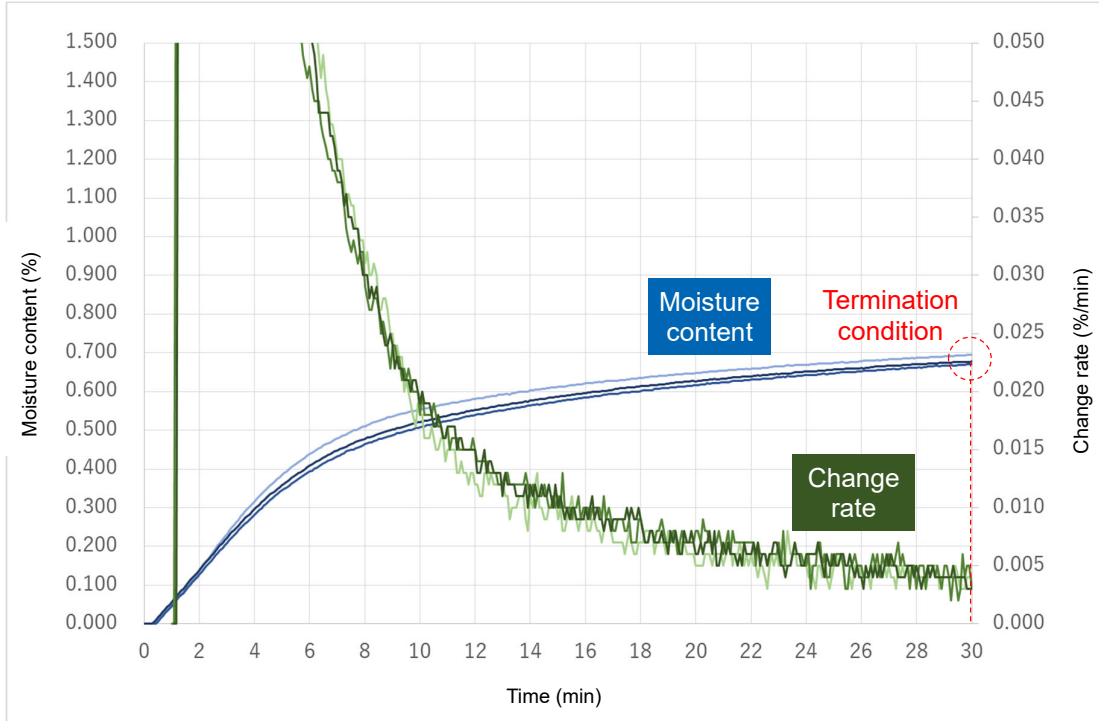
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	150 °C	150 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	58 min	58.2 min	30 min
Average moisture content	1.420%	1.414%	1.463%
Reproducibility (standard deviation)	0.0112%	0.0197%	0.0128%

2-5. PA46 (Polyamide 46)

Color: White Mass: 15 g

Measurement result with MS-74A



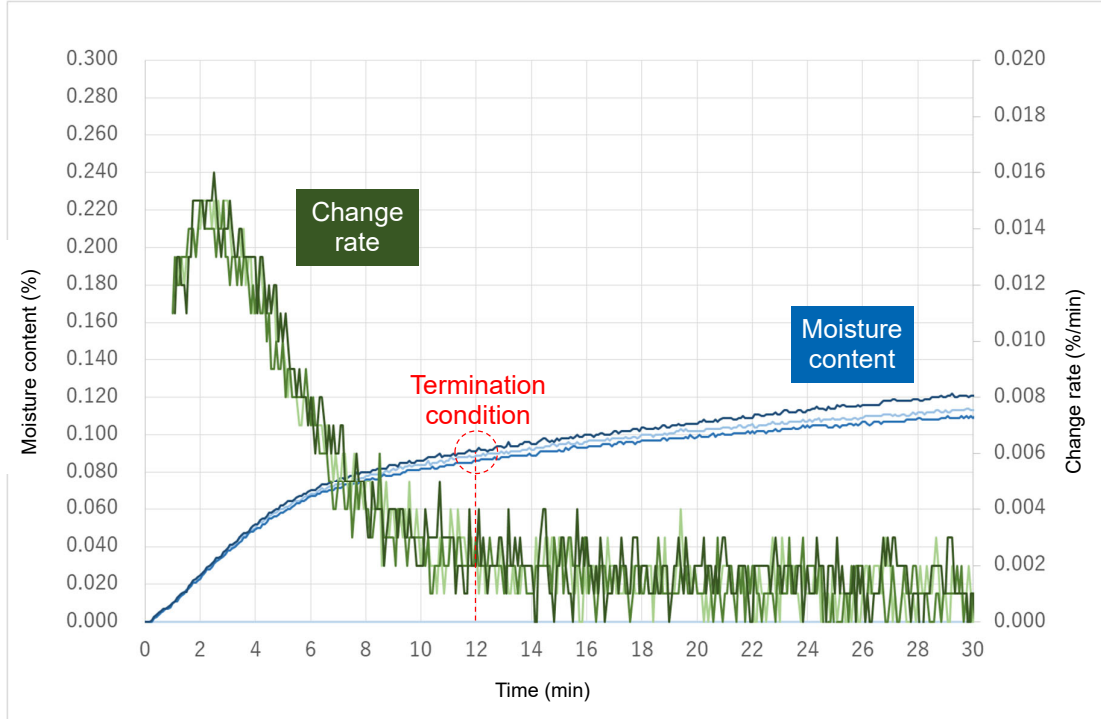
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	160 °C	160 °C	-
Termination condition (Change rate)	30 min	0.001%/min	30 min
Termination condition (Measurement time)	30 min	33.1 min	30 min
Average moisture content	0.681%	0.703%	0.746%
Reproducibility (standard deviation)	0.0123%	0.0150%	0.0056%

2-6. PBT (Polybutylene Terephthalate)

Color: White Mass: 20 g

Measurement result with MS-74A



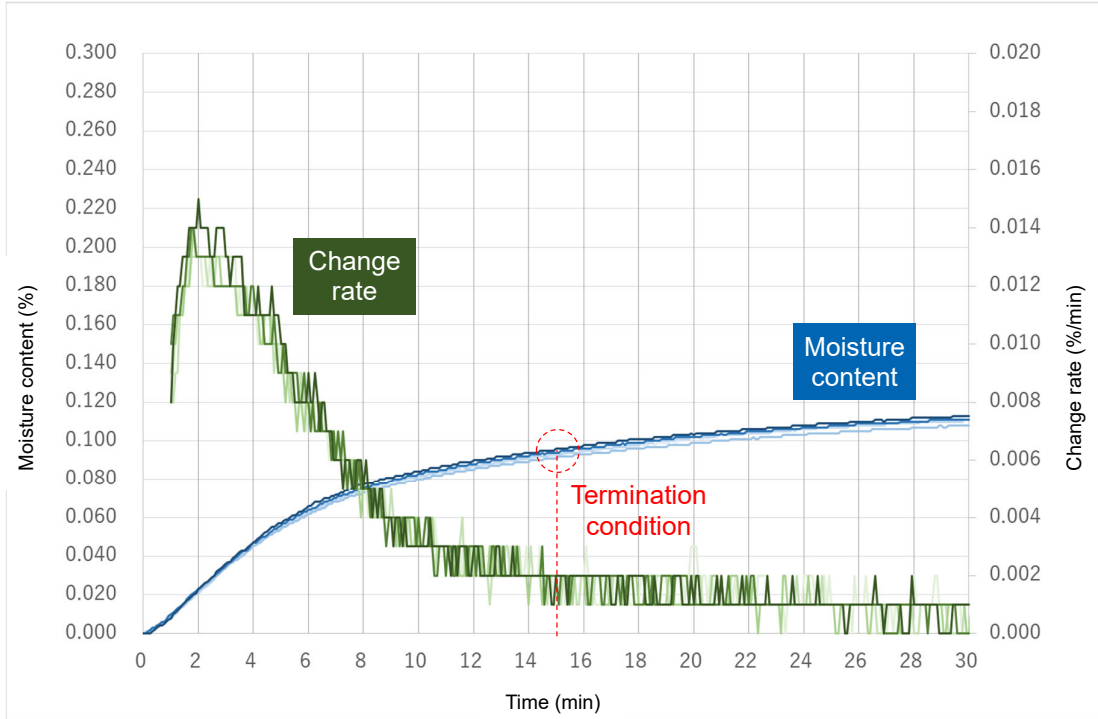
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	120 °C	120 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	12 min	8.2 min	30 min
Average moisture content	0.089%	0.123%	0.087%
Reproducibility (standard deviation)	0.0025%	0.0076%	0.0066%

2-7. PC (Polycarbonate)

Color: Transparent Mass: 25 g

Measurement result with MS-74A



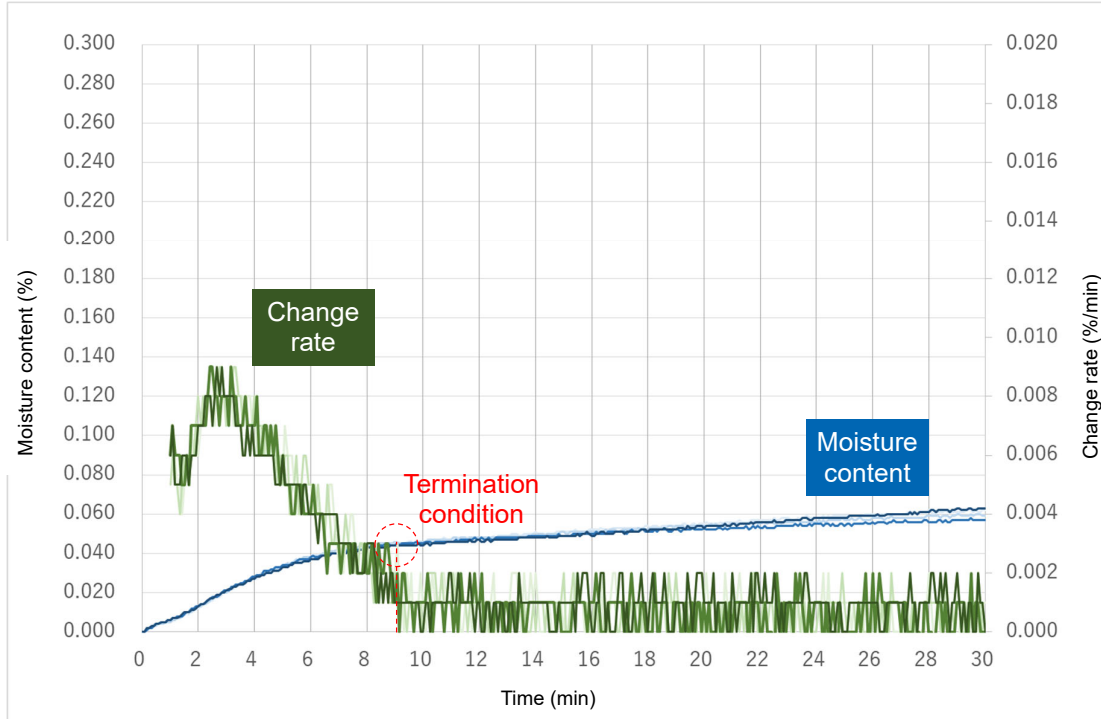
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	130 °C	120 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	15.0 min	15.9 min	30 min
Average moisture content	0.093%	0.101%	0.077%
Reproducibility (standard deviation)	0.0020%	0.0040%	0.0021%

2-8. PET (Polyethylene Terephthalate)

Color: White Mass: 25 g

Measurement result with MS-74A



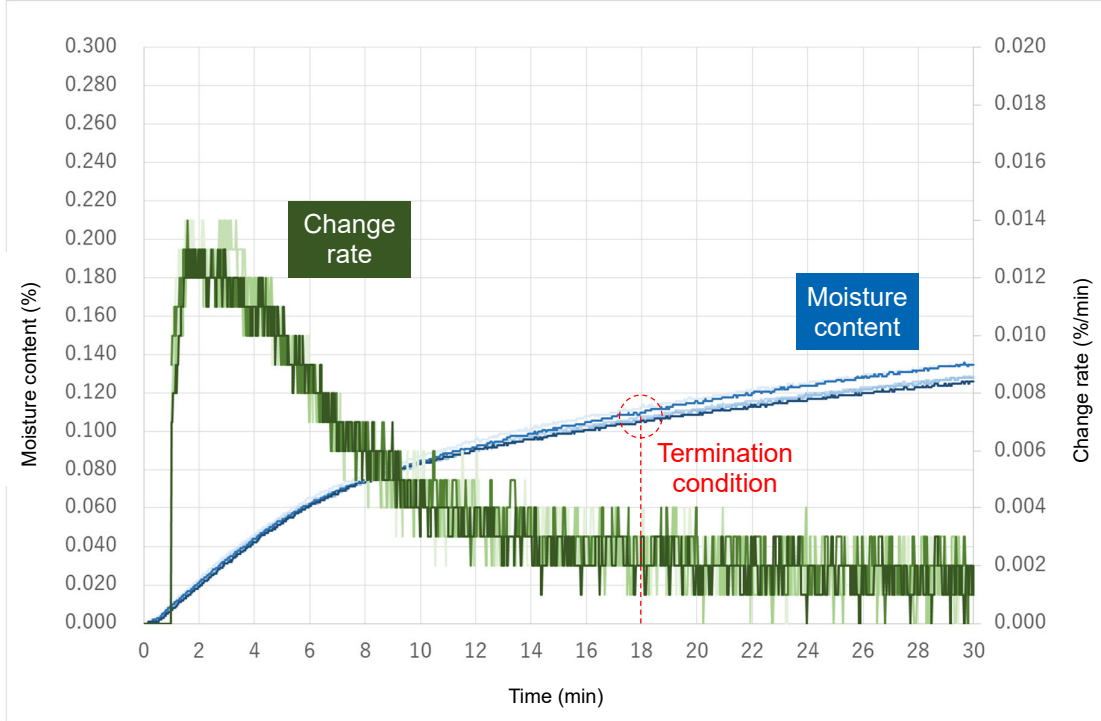
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	160 °C	160 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	9 min	30 min	30 min
Average moisture content	0.045%	0.052%	0.027%
Reproducibility (standard deviation)	0.0008%	0.0070%	0.0025%

2-9. PMMA (Polymethyl Methacrylate)

Color: Transparent Mass: 25 g

Measurement result with MS-74A



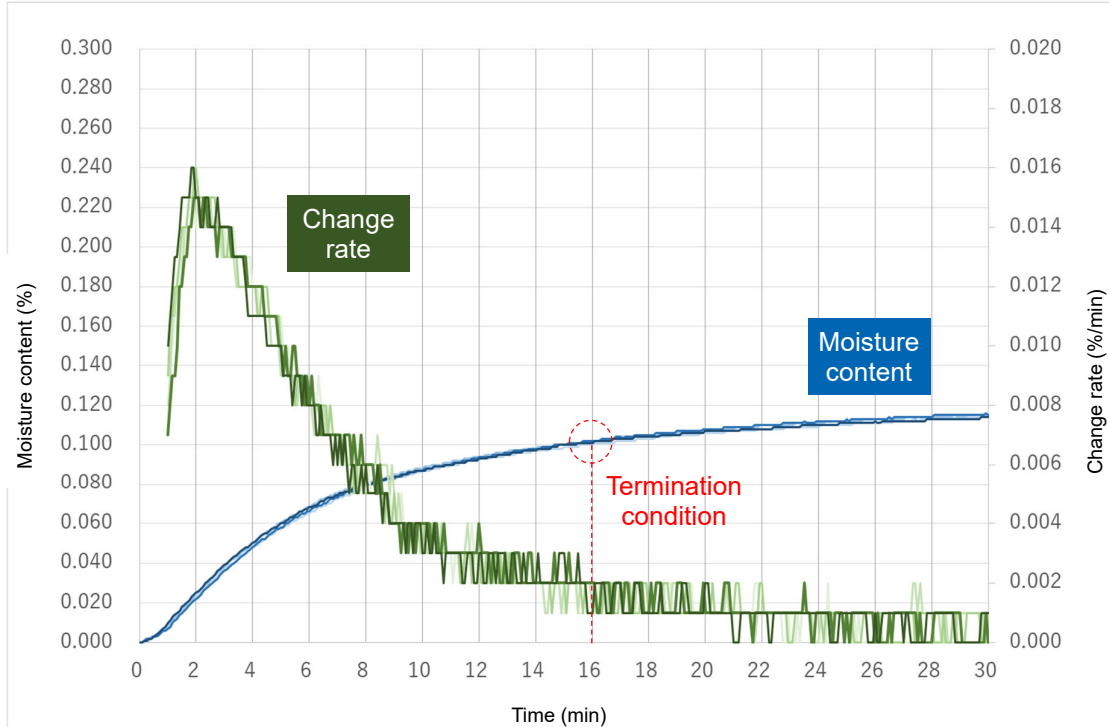
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	100 °C	90 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	18 min	35.7 min	30 min
Average moisture content	0.107%	0.191%	0.254%
Reproducibility (standard deviation)	0.0077%	0.0120%	0.0075%

2-10. POM (Polyoxy methylene)

Color: White Mass: 25 g

Measurement result with MS-74A



Measurement Results Comparison

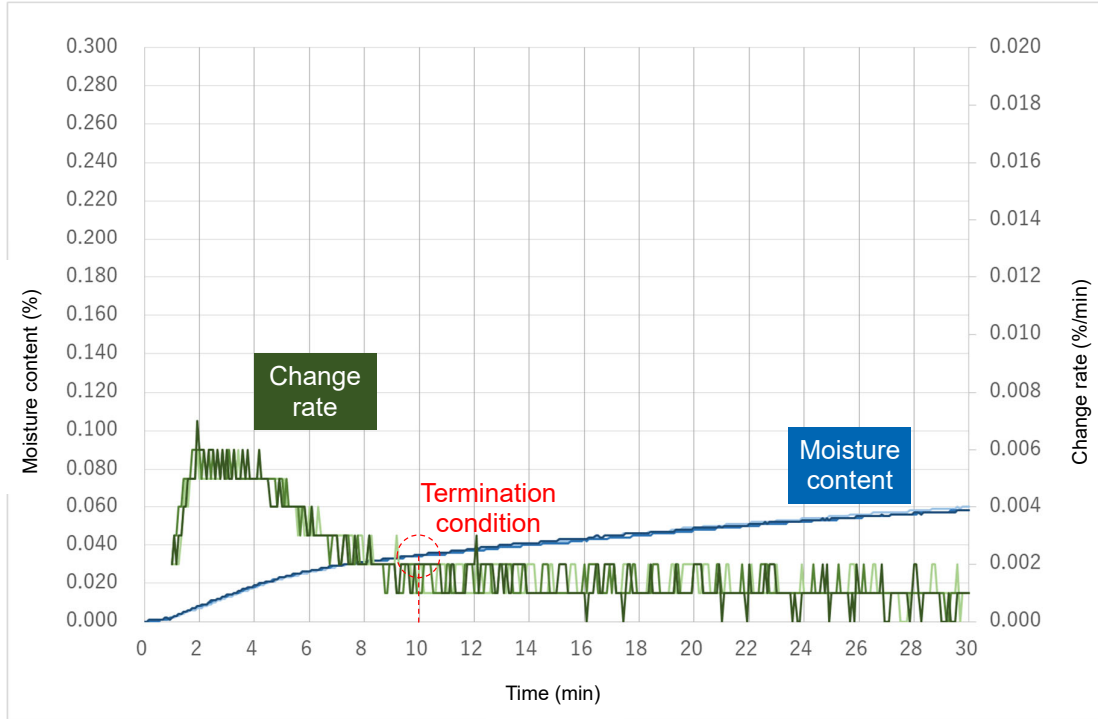
Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	130 °C	120 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	16 min	18.2 min	30 min
Average moisture content	0.101%	0.130%	0.087%
Reproducibility (standard deviation)	0.0009%	0.0031%	0.0022%

2-11. PP (Polypropylene)

Color: White Mass: 25 g

Measurement result with MS-74A



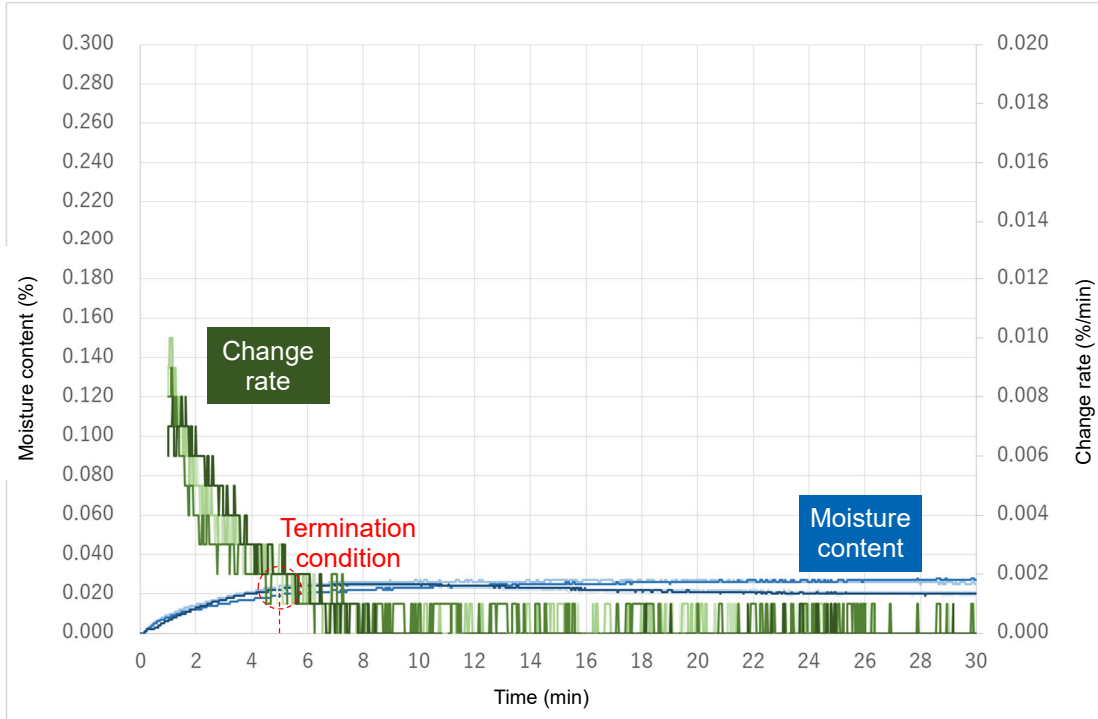
Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	130 °C	120 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	10 min	7.3 min	30 min
Average moisture content	0.034%	0.036%	0.004%
Reproducibility (standard deviation)	0.0012%	0.0083%	0.0002%

2-12. PS (Polystyrene)

Color: Blue Mass: 25 g

Measurement result with MS-74A



Measurement Results Comparison Table

	MS-74A	Third-Party Heat-Drying Moisture Analyzer	Karl Fischer Moisture Analyzer
Drying temperature	70 °C	70 °C	-
Termination condition (Change rate)	0.001%/min	0.001%/min	30 min
Termination condition (Measurement time)	5 min	5.9 min	30 min
Average moisture content	0.022%	0.029%	0.009%
Reproducibility (standard deviation)	0.0023%	0.0021%	0.0012%

Application of the Analyzer

3. How to Adjust to Karl Fischer Moisture Analyzer Results

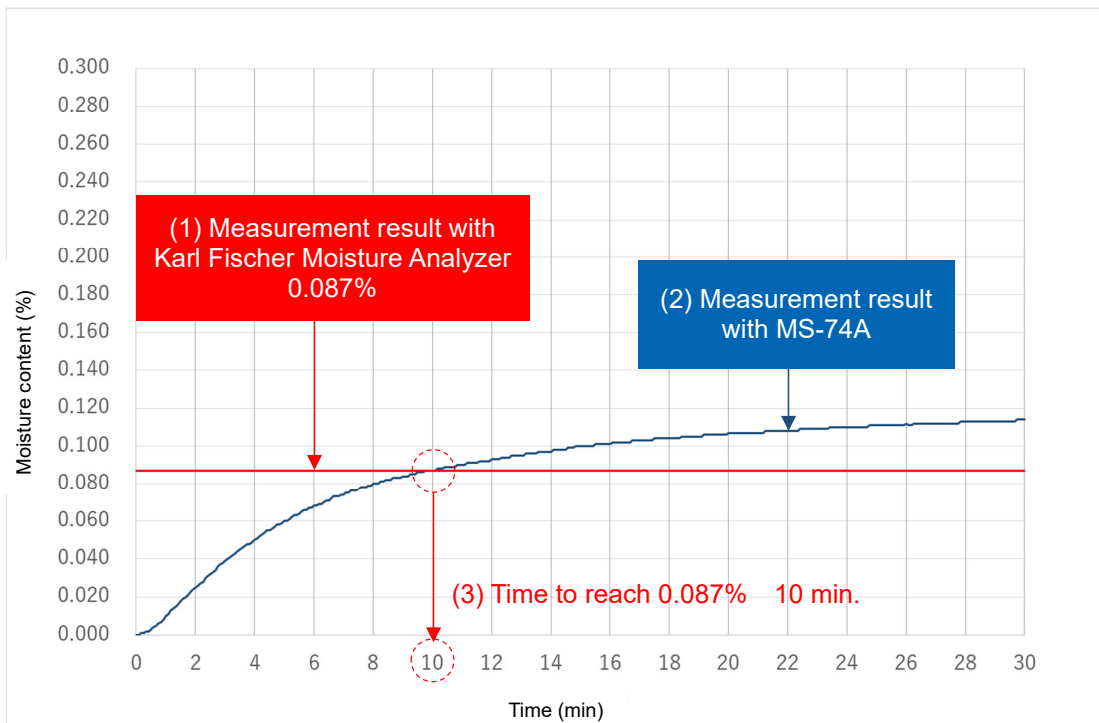
3-1. General Method

The following procedure with the **MS-74A** adjusts POM (polyoxy methylene) measurement results to a Karl Fischer moisture analyzer.

- (1) Measure the moisture content with a Karl Fischer moisture analyzer.
- (2) Measure the moisture content with the **MS-74A** for an extended period of time. (Set the appropriate temperature at which the sample does not change.)
- (3) Check the time it takes to reach the same value as the measurement result of the Karl Fischer moisture analyzer.
- (4) Set the measurement time of **MS-74A** to 10 min. obtained in (3).
- (5) Measure the moisture content rate with these measurement conditions from now on.

Work Example

Sample: POM (Polyoxy methylene) Mass: 25 g Drying temperature: 130 °C Measurement time: 30 min

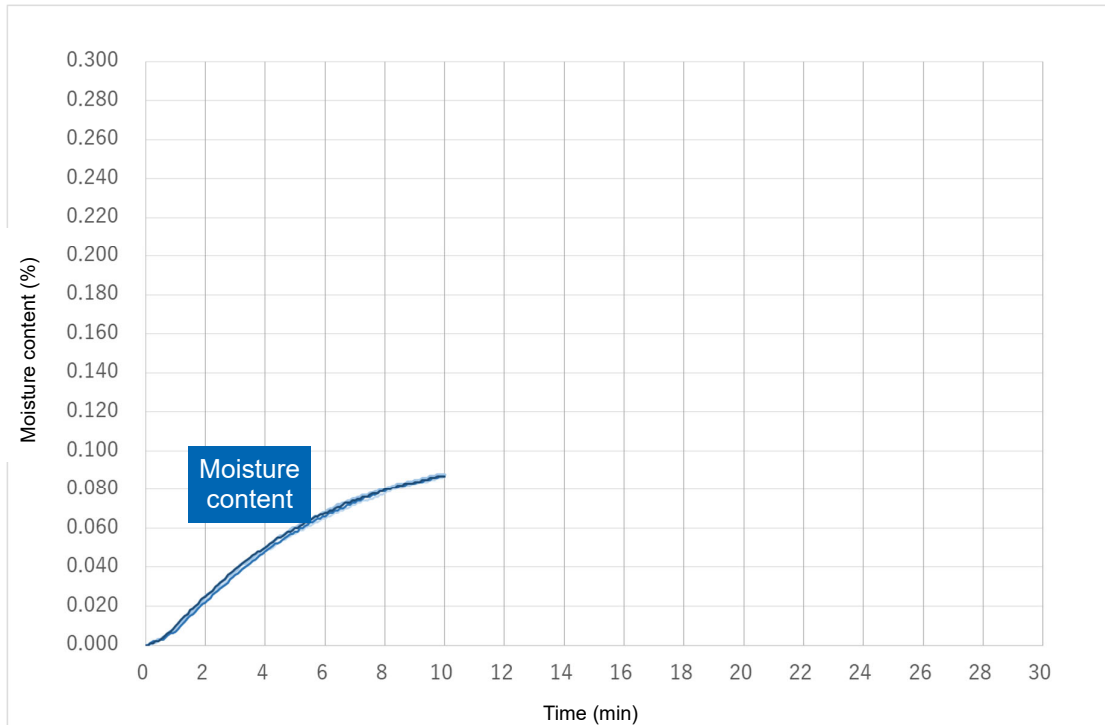


The **MS-74A** measurement result is 0.087%, the result of the Karl Fischer moisture analyzer measurement, at 10 min. so, set the timer mode measurement condition to 10 min. for subsequent

measurements.

The following graph displays the results of five **MS-74A** measurements with the measurement time set to 10 min.

Sample: POM (Polyoxy methylene) Mass: 25 g



	MS-74A	Karl Fischer Moisture Analyzer
Drying temperature	130°C	-
Termination condition	10 min	30 min
Measurement time	10 min	30 min
Average moisture content	0.087%	0.087%
Reproducibility (standard deviation)	0.0006%	0.0022%

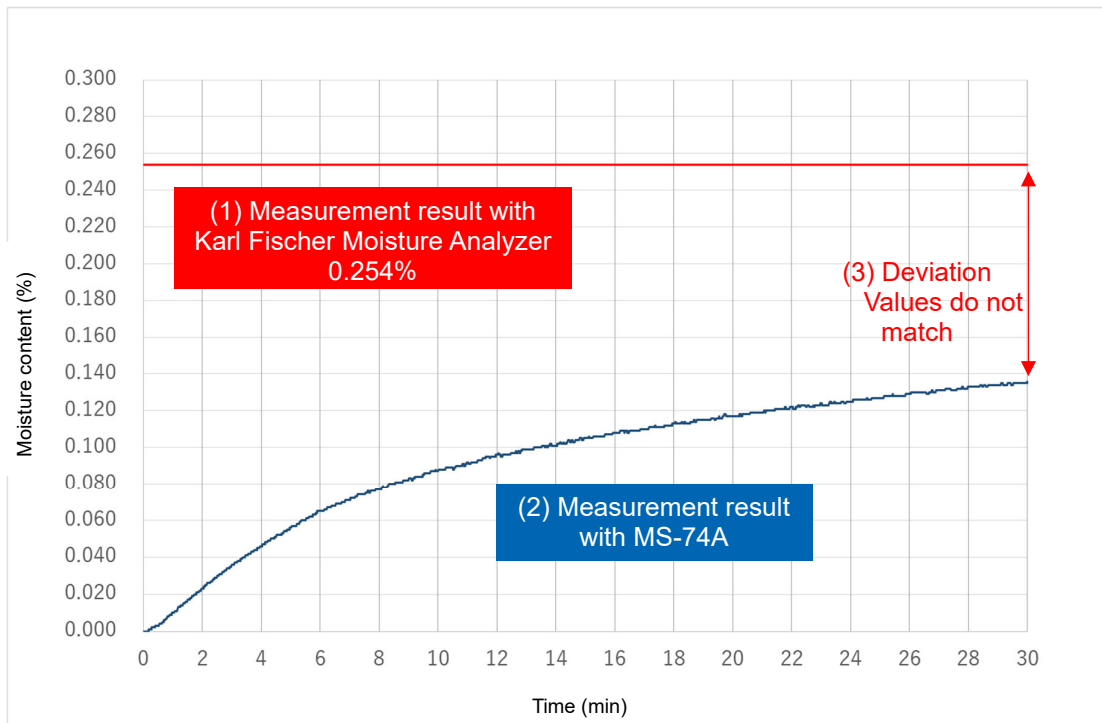
3-2. Deviation in Measurement Results

In this example, there is a large deviation between the **MS-74A** measurement result and the Karl Fischer moisture analyzer result. The following procedure with the **MS-74A** adjusts PMMA (polymethyl methacrylate) measurement results to a Karl Fischer moisture analyzer.

- (1) Measure the moisture content with a Karl Fischer moisture analyzer.
- (2) Measure the moisture content with the **MS-74A** for an extended period of time. (Set the appropriate temperature at which the sample does not change.)
- (3) Check the time it takes to reach the same value as the measurement result of the Karl Fischer moisture analyzer.
- (4) If 30 minutes of measurement with **the MS-74A** does not give the same result as the Karl Fischer moisture analyzer, change the temperature setting and mass, and measure again.
- (5) Set the **MS-74A** measurement time to 25 min., calculated by performing steps (3) and (4).
- (6) Measure the moisture content rate with these measurement conditions from now on.

Work Example

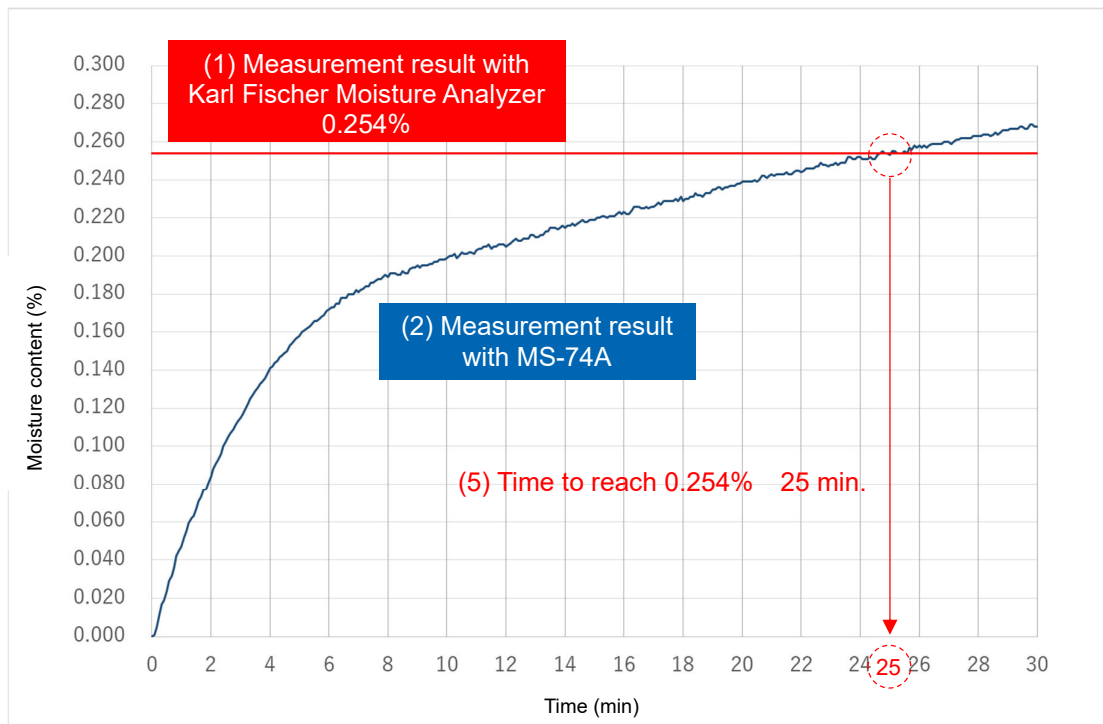
Sample: PMMA (Polymethyl Methacrylate) Mass: 25 g Drying temperature: 100 °C Measurement time: 30 min



PMMA tends to not easily evaporate moisture, resulting in a longer measurement time. If it is difficult to match the Karl Fischer moisture analyzer results as in the above figure, measures such as reducing the sample mass or increasing the drying temperature are necessary.

Change the sample mass from 25 g to 10 g and the drying temperature from 100 °C to 110 °C, and measure again.

Sample: PMMA (Polymethyl Methacrylate) Mass: **10 g** Drying temperature: **110 °C** Measurement time: 30 min



After changing the measurement conditions, the **MS-74A** measurement result is 0.254%, the Karl Fischer moisture analyzer measurement result, at 25 min. so, set these conditions for subsequent measurements.