

BIPM Capacity Building & Knowledge Transfer Programme

2021 BIPM - TÜBİTAK UME Project Placement

REPORT

Project Name	Enhancing humidity and moisture calibration and measurement capability of NMIE temperature laboratories through skill development in the areas
Description	Moisture content in solid materials can be determined by different techniques. One of the most reliable techniques (method) nowadays is Oven Drying Method (Loss on Drying). In this project oven drying method to determine the moisture content in wood pellet was used.
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Motivation & Introduction

Moisture adversely affects many materials and products in their dimensional stability, mechanical strength, microbial activity, corrosion and other chemical stability, handling characteristics, thermal properties and more. This affects thermal efficiency of buildings, and product quality in foods, pharmaceuticals, agriculture, solid and liquid fuel, concrete, timber, chemicals and materials processing. Moisture is critical to the performance of many materials, particularly coatings and adhesives. The moisture content of wood is also responsible for dimensional changes, which are an important consideration for many applications. Hence reliable moisture measurement can be a key to innovation in a wide variety of areas.

The NMIE Humidity and Moisture Laboratory sought training on this subject in a well-equipped external laboratory in order to gain knowledge and experience in line with the aim of improving the accuracy of its moisture determination services.

The BIPM and the National Metrology Institute of Turkey (TÜBİTAK UME) joint training initiative entitled 2020 "BIPM - TÜBİTAK UME project placements" presented a good opportunity to obtain the required knowledge and experience. The objective of the research was to gain theoretical knowledge and practical experience to carry out measurements on determination of moisture content in solid materials, understand the measurement system, identify system elements, and update the existing calibration procedures and measurement uncertainty budgets.

Research

When determining moisture in wood and wood-based materials, reference measurements are carried out using an oven drying method. This method is recognized today as the most reliable basis for quality insurance in moisture measurements of a wide range of solid materials.

Calibration of balances using reference weights assures traceability to oven loss-on drying moisture content measurement.

So, in this study I used an international standard, ISO 18134-1:2015 Determination of Moisture content Oven Dry Method, to determine the moisture content in wood pellet by oven drying method.

Preparation

I prepare the following apparatus to achieve my goal in determination of moisture content in wood pellet.

- Oven for drying wood pellet sample;
- Glass Vial with lid-to store sample;
- Desiccators for avoiding any pick up or loss of moisture from the sample;
- Analytical Balance with resolution of 0.01mg for weighing sample and glass vial.

Procedure

i. Preparation of the dish

- I dry the glass vial and its lid for 1 hour in the oven set at 105 °C.
- Then I take out the dish and its lid from the oven and allow cooling to room temperature in the desiccator for 1 hour.
- Weigh the dish and its lid on analytical balance of resolution 0.01 mg.

ii. Test portion

I place three test portions (samples) of weight m_1 , m_2 and m_3 into the prepared glass vial. Cover the glass vial with its lid and weigh onto the analytical balance.

iii. Determination

I place the glass vial containing the test portion with the lid removed but alongside or beneath the glass vial, in the oven set at 105 °C and dry for 1 hour.

In every 15 minutes, during 1 hour drying, I removed the moist gas from the oven and replaced by Nitrogen (N_2) gas in order to have dry air inside the oven.

After one hour of drying I fit the glass vial and place it in the desiccator for another one hour to cool to room temperature.

After cooling of one hour I weigh the fitted glass vial on the analytical balance.

iv. Number of Determination

I carried out the above determination seven times (7 hours) until the sample dried and got stable reading.

v. Expression of results

The loss in mass (moisture content of wood pellet) at 105 °C expressed as a percentage by mass, is equal to:

$$MC = \frac{m_1 - m_2}{(m_1 - M_0)} \times 100\%$$

Where

M_0 is the mass of the glass vial and lid,

m_1 is the mass of the glass vial, test portion and lid before drying,

m_2 is the mass, in grams, of the glass vial, test portion and lid after drying.

And finally, I take as a result the arithmetic means of the seven determinations.

Uncertainty Contributions

The uncertainty contributions that I take for the determination of moisture content of wood pellet on the oven drying method are summarized in the table below.

No.	Description	Estimate		Sensitivity coefficient		Probability distribution	Divisor	Contribution to combined uncertainty	
1	Initial mass of the sample (M_1)	-	g	-	%w/g	Normal	1	-	%w
2	Final mass of the sample (M_2)	-	g	-	%w/g	Normal	1	-	%w
3	Balance calibration	-	g	-	%w/g	Normal	2	-	%w
4	Balance repeatability	-	g	-	%w/g	Normal	1	-	%w
5	Balance resolution	-	g	-	%w/g	Rectangular	1.732	-	%w
6	Balance drift	-	g	-	%w/g	Rectangular	1.732	-	%w
7	Effect of convection	-	g	-	%w/g	Rectangular	1.732	-	%w
8	Homogeneity of the samples	-	%w	-	%w/%w	Rectangular	1.732	-	%w
Combined Uncertainty								-	%w
Expanded Uncertainty								-	%w

My final result for the determination of moisture content in wood pellet would be the arithmetic mean of the seven determinations and the expanded uncertainty.

Conclusions and Future Work

Participation in “BIPM - TÜBİTAK UME project placements” allowed me to improve my technical skills and build knowledge towards the goal for improving the existing measurement system. These knowledge and skills will assist me to update NMIE’s procedures and uncertainty budgets of measurement in the determination of moisture content by oven drying method. From the experience gained through my studies, I will produce a project plan to participate in an inter-laboratory comparison and to submit CMCs.

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