

Laboratory Work 1

Title

Determination of moisture content of food products using an infrared moisture analyzer and determination of the mass fraction of dry matter based on solution density.

Objective of the Work

- To determine the moisture content of food products using an infrared (IR) moisture analyzer.
- To study the method for determining the mass fraction of dry matter based on solution density.
- To develop skills in processing experimental data and evaluating measurement results.

Theoretical Background

1. Concept of Moisture Content

Moisture content (W) is the ratio of the mass of water contained in a product to the total mass of the product. It is expressed as a percentage (%). Moisture content significantly affects the quality, shelf life, and technological properties of food products.

2. Principle of Operation of an Infrared Moisture Analyzer

An infrared moisture analyzer determines moisture content by continuously measuring the decrease in sample mass during heating. Drying is carried out using infrared radiation. As a result of the experiment:

- initial mass of the sample (m_0)
 - mass of the dried sample (m_1)
- are obtained, and the moisture content is calculated automatically by the device or using a formula.

Moisture content is calculated as:

$$W = (m_0 - m_1) / m_0 \times 100 \%$$

3. Mass Fraction of Dry Matter

The mass fraction of dry matter (X_{dm}) represents the proportion of all components of the product excluding water, relative to the total mass of the product.

$$X_{dm} = 100 - W$$

For liquid food products (e.g., juices, syrups), the dry matter content can be determined using solution density.

4. Determination Based on Solution Density

Solution density (ρ) is defined as the mass per unit volume and is expressed in g/cm^3 or kg/m^3 . For many food solutions, there is an empirical relationship between density and dry matter content, which is determined using calibration curves or reference tables.

General procedure:

- Measure the density of the solution
- Determine the mass fraction of dry matter using a calibration table or equation

Equipment and Materials

- Infrared moisture analyzer
- Analytical balance
- Density measuring device (hydrometer or pycnometer)
- Thermometer
- Measuring cylinder
- Food product samples (flour, sugar solution, juice, etc.)

Experimental Procedure

A. Determination of Moisture Content Using an IR Moisture Analyzer

1. Prepare the infrared moisture analyzer and set it to zero.
2. Grind the sample if necessary and spread it evenly on the sample pan.
3. Record the initial mass of the sample (m_0).
4. Select the appropriate drying temperature and time.
5. After drying is complete, record the mass of the dried sample (m_1).
6. Record the moisture content displayed by the analyzer or calculate it using the formula.

B. Determination of Dry Matter Fraction Based on Solution Density

1. Measure the temperature of the solution and adjust it to 20 °C if required.
2. Measure the density of the solution using a hydrometer or pycnometer.
3. Using the measured density value, determine the mass fraction of dry matter from a reference table or calibration curve.
4. Record the results in a table.

Calculations

1. Moisture content:

$$W = (m_0 - m_1) / m_0 \times 100 \%$$

2. Mass fraction of dry matter:

$$X_{\text{dm}} = 100 - W$$

(or determined from density–dry matter reference data)

Results Presentation

Parameter	Value
Initial mass, m_0 (g)	
Dried mass, m_1 (g)	
Moisture content, W (%)	
Density, ρ (g/cm ³)	
Dry matter fraction, X_{dm} (%)	

Conclusion

In this laboratory work, the moisture content of a food product was determined using an infrared moisture analyzer, and the mass fraction of dry matter was determined based on solution density. The obtained results are important for assessing the quality and technological properties of food products.