METHODS FOR DETERMINING THE MASS FRACTION OF MOISTURE WITH CONSIDERATION OF MEASUREMENT UNCERTAINTY

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The determination of the mass fraction of moisture is an important task in the analysis of various products such as feeds, foodstuffs, agricultural materials and other biological samples. Moisture content affects the quality, shelf life and processing properties of products. Accurate measurement of moisture content is essential for product quality control, regulatory compliance and to ensure efficient use of materials.

Purpose of the study. The aim of this study is to investigate methods for determining the mass fraction of moisture, taking into account factors affecting the accuracy of the analysis, such as equipment errors, analysis conditions and human factors. Particular attention is paid to the calculation of measurement uncertainties to ensure the reliability of the results.

Material and methods. The work is based on the results of the analysis of scientific and technical information, normative documents (GOST 21094-75) and studies devoted to methods of moisture determination, its physical and chemical properties and application of modern technologies.

Results and their discussion. The paper reflects the study which includes the following stages:

1 Analysing the theoretical basis of different methods of moisture determination, including classical (e.g. gravimetric) and modern (spectral methods).

2. study of normative requirements for accuracy, repeatability and reproducibility of the results established in GOST 21094-75.

3. assess the influence of factors such as sample type, analysis conditions and equipment on measurement uncertainties.

4. Comparison of the advantages and disadvantages of each method in terms of accuracy, speed, cost and applicability to different product types.

As a result of the study, the classification of methods for determining the mass fraction of moisture is given. Based on the analysis performed, the methods of moisture content determination can be divided into the following groups: classical and modern.

Classic methods include gravimetric, distillation.

Gravimetric method – based on drying the sample to a constant mass at a certain temperature.

Distillation method – involves separating water by distillation.

State-of-the-art methods include NIR spectroscopy, machine learning techniques.

NIR spectroscopy – analysing the spectral characteristics of the sample.

Machine learning methods – predicting moisture content based on input parameters.

All of the methods discussed aim to quantify moisture content, but differ in principle of operation, speed of analysis, cost and destructiveness.

Table – General characteristics of the methods

sign	Gravimetric method	NIR spectroscopy	Machine learning method
Principle of action	Drying	Spectrum analysis	Forecasting based on algorithms
Speed of analysis	Prolonged	Quick	Depends on the model
Equipment	Laboratory supplies	Spectrophotometer	Computer, sensors

Accuracy	High	High	Depends on the quality of the data
Destructiveness	Destructive	Non-destructive	Non-destructive
Cost	Low	High	High

The major sources of uncertainty in moisture determination include:

– Equipment uncertainties: for example, an error of ±0.001 g on a weighing scale can significantly affect the results of the analysis.

– Human error: operator error during sample preparation or reagent addition.

– Variations in sample composition: sample heterogeneity can lead to different results with different parts of the sample.

– Conditions of analysis: changes in temperature, air humidity or pressure.

Conclusion. Based on the analysis, it can be concluded that the choice of method for determining the mass fraction of moisture depends on the type of product, required accuracy, equipment availability and budget. While classical methods remain relevant for small laboratories, modern technologies such as spectroscopy and machine learning offer new opportunities for automation and improved accuracy. Accounting for measurement uncertainties can improve the reliability of results and ensure regulatory compliance.

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MATHEMATICAL KINEMATIC MODEL OF CRANK-CRANK MECHANISM

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The aim of the study is to develop a mathematical kinematic model of crank and connecting rod mechanism.

The research is devoted to the creation of a mathematical kinematic model of the crank-crank mechanism, which allows for a detailed analysis of its operation and optimisation of parameters for specific tasks.

Material and мethods. The work is based on the results of analyses of scientific and technical information. Trigonometric transformations and numerical methods are used in the work.

Results and their discussion. The geometrical model of the crank mechanism is constructed based on the following parameters:

– crank length ; r

– connecting rod length ; l

– crank angle θ (measured in relation to the horizontal axis);

– slider position (coordinate x);

The coordinates of the slider x_p are calculated using the formula: