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METROLOGICAL SUPPLY FOR COTTON MATERIALS

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ABSTRACT: This article discusses the issues of metrological support of moisture meters for cotton materials. Moisture meters are analyzed as a device designed to measure, control or regulate the moisture content of a substance, verify the moisture meter by a metrological authority and calibrate the results. As a result of the theoretical and experimental work performed, we have created a universal microprocessor-based microwave moisture meter with increased sensitivity, the operation of which is based on the dependence of the absorption or reflection of microwave radiation energy on the concentration of water in the extractant.

KEYWORDS: Metrological support, humidity, moisture meters of cotton materials, verification of moisture meters, raw cotton, control and management of technological processes, electrophysical characteristics of wet materials.

I. INTRODUCTION

Humidity is one of the main measured properties of many objects in the technological industries that determine the quality of products. The physical, biochemical, mechanical and technological properties of raw materials and products and their shelf life, as well as equipment performance, depend on humidity. Humidity at various stages of production and transportation also affects production costs.

Humidity should be measured at almost all stages of the technological process: during processing, acceptance, storage and transportation of raw materials, semi-finished products and finished products. In all moist products, its moisture content is closely related to moisture content, and if the moisture content decreases, then its equilibrium is disturbed.

Therefore, at present, one of the most important areas of analytical instrumentation is the development and research of new progressive methods and devices for monitoring the moisture content of materials, which allow to comprehensively solve the problems of managing technological processes in the agro-industrial complex, as well as used to conduct scientific research on the composition and properties of wet materials.

II. RELATED WORK

In the production of various products, including the processes of drying, dehydration or moistening, the moisture parameter is the most important indicator that determines the conditions for maximum production of the target



product of a given quality from a unit of raw materials, the level of energy consumption and the optimal performance of the equipment.

For the Republic of Uzbekistan, raw cotton and products of its processing are of great economic importance. The development of the agro-industrial complex of the Republic of Uzbekistan is directly related to the production and processing of raw cotton. The moisture content of cotton and cotton materials is the most important parameter at all stages of their processing, affecting energy consumption, yield and quality of finished products.

Of particular relevance is the task of interfacing moisture meters with modern automated control and management of technological processes and production in general. Microprocessors make it possible to simplify the analog parts of devices, to reduce possible errors due to the use of automatic correction based on reference signals and measures of physical quantities.

The main tasks facing developers are:

- ✓ study of electrophysical characteristics of wet materials (raw cotton, cotton seeds, grain and products of its processing) and their system analysis;
- ✓ development of new principles for the construction of measuring transducers for measuring the quality (moisture, density, concentration) of products;
- ✓ development of mathematical models of moisture converters for
- ✓ on the basis of which structural diagrams of improved converters will be developed;
- ✓ analysis and study of the main characteristics of moisture measuring transducers;
- ✓ creation of new effective devices for measuring humidity and other
- ✓ parameters.

Over the past few decades, in our country and abroad, to measure the moisture content of raw cotton and products of its processing, grain and cereals, as well as various bulk materials, a number of modifications of microwave moisture meters have been developed and partially brought to the design performance [1], which requires deep metrological research for the purpose of their metrological support and introduction into production (cotton growing, cotton processing industry, cotton seeds, grain and grain products).

III. EXPERIMENTAL RESULTS

An urgent and important task of moisture metering is the creation of a universal automated aggregate complex of humidity measuring instruments. The moisture meter is designed to control the moisture content of various materials both during the acceptance of products or raw materials from procurement points, and during processing at various stages of the technological process.

The main of the most important conditions for improving product quality is obtaining reliable measurement information about the parameters, characteristics and properties of finished products, components, technological processes, raw materials and materials. The guarantee of the reliability of measurement information is to ensure the uniformity of measurements. A set of measures, called metrological support, is aimed at maintaining it [2].

Metrological support is understood as the establishment and application of the scientific and organizational foundations of technical means, rules and norms necessary to achieve unity and the required accuracy of measurements (Fig.1).

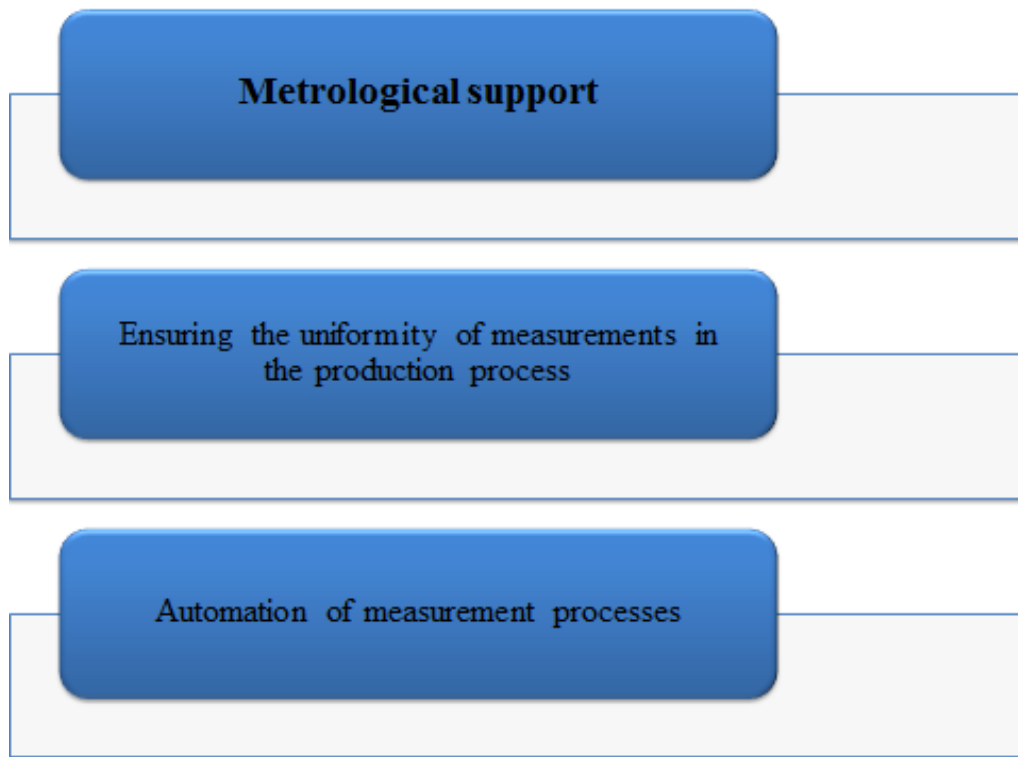


Fig.1. Metrological assurance of products at the stages of the life cycle

Moisture meter - a device designed to measure, control or regulate the moisture content of a substance. Verification of the moisture meter by the metrological body - determination of its error and determination of suitability for use. When calibrating moisture meters, the average value of the parameter is set at a given moisture content of the substance. As a result of the calibration, the average nominal calibration characteristic of the moisture meter is established, which may not correspond to any of the types of substances.

The verification of moisture meters does not mean the determination by the metrological body of its error, but the verification of whether it exceeds the normalized value in the specific conditions of its use.

One of the main features of moisture meters as objects of verification is that during their verification it is necessary to check the error in reproducing the nominal calibration characteristic by the moisture meter and thereby determine the suitability of the moisture meter for its intended use. In the case when the property of the substance used in the measurement of humidity has changed, it is necessary to recalibrate the moisture meter.

Moisture meters as objects of verification differ in that their error significantly depends on the value of the measured humidity. As the humidity increases, the error of its measurement, as a rule, increases.

Due to the fact that the error of the moisture meter depends on the measured humidity and the type of product, their verification must be carried out in several sections of the scale, evenly distributed over the entire measurement range.

As a result of the theoretical and experimental work performed, we have created a universal microprocessor-based microwave moisture meter with increased sensitivity, the operation of which is based on the dependence of the absorption or reflection of microwave radiation energy on the concentration of water in the extractant [3]. The moisture meter is built on a block-modular basis. The cuvette with the sample is rotated around the vertical axis by a stepper motor, which is controlled by a switch located on the cover of the moisture meter. The signals from the microwave modules and the temperature sensor, passing through the sample, are fed to the basic measuring device, here the signals of the attenuation and phase shift of the microwave wave and the temperature of the sample are formed into standard signals for interfacing with the microcontroller.



The microprocessor performs all computational operations. After calculating the polynomial, the moisture content of the material is displayed digitally through the indicator.

Verification of microwave moisture meters is an expensive and time-consuming task. Reference [4] shows the verification scheme proposed by us for microwave moisture meters of raw cotton and cotton materials. It contains the installation of the highest accuracy, exemplary measuring instruments of various categories, working measuring instruments and means of transferring the unit of measurement from higher to lower ranks.

The installation of the highest accuracy is designed to reproduce the unit of moisture content of cotton materials and transfer the size of this unit with the help of exemplary measuring instruments with a working measuring instrument used in the national economy to ensure the uniformity of measurements in the country.

Measurements of the moisture content of cotton materials should be based on a unit reproducible by the installation of the highest accuracy. The installation of the highest accuracy consists of a group of air-thermal installations [5]. The range of reproducible humidity values is 5-30%. The standard deviation of the reproduction unit is not more than 0.02%. The transfer of the unit size of the installation of the highest accuracy to exemplary measuring instruments of the 1st category is carried out by direct comparison.

As moisture simulators and working measuring instruments, we propose to use raw cotton moisture simulators [6] and a high-precision microwave moisture meter [7] developed by our scientific group.

At present, some elements of the verification scheme, including working measuring instruments, have already been developed. Below we consider some elements of such verification schemes. To ensure the possibility of introducing moisture meters into industry, we propose to use the principle of checking the nominal calibration characteristic, which is as follows: in the measuring channel of the microwave tract of the moisture meter, in the absence of material in the primary measuring transducer, the weakening of the material is introduced in turn, at its minimum, maximum and average moisture content.

Fixed attenuators can be used as an exemplary measure. In our proposed version, a p-i-n attenuator, a built-in and measuring channel of a microwave moisture meter, is used as an exemplary measure. In this case, the attenuation values are determined by the amount of current supplied to the control input of the attenuator.

The power supply has three calibrated current outputs. When these currents are applied to the control input of the exemplary attenuator, they introduce attenuation into the measuring channel of the moisture meter, corresponding to predetermined values of the minimum, average and maximum moisture content of the material. The verification process consists in comparing the readings of the moisture meter in accordance with the humidity values specified in the passport of the moisture meter.

IV. CONCLUSION

Production tests and operation of microwave moisture meters for a number of years in cotton ginning, oil extraction, and grain processing industries have shown the possibility of their use to control the moisture content of these materials. They provide the necessary measurement accuracy, are reliable and easy to operate.

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