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METHODS FOR DETERMINING DEFECT LEVELS FOR LABORATORY DEVICES

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Abstract

This article describes mathematical formulas and theoretical analysis methods for determining and preventing malfunctions of measuring devices. In selectivity studies, the effects of possible halal components are usually investigated by adding these substances to both blanks and working samples and observing the response. The obtained results are usually used to calculate the actual halal effects.

Key words: Selectivity, standard, uncertainty quality, calibration, failure rate, metrological characteristics, measurement errors, failure rate.

МЕТОДЫ ОПРЕДЕЛЕНИЯ УРОВНЯ ДЕФЕКТНОСТИ ЛАБОРАТОРНЫХ ПРИБОРОВ

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Аннотация

В данной статье описаны математические формулы и методы теоретического анализа для определения и предотвращения неисправностей измерительных приборов. В исследованиях селективности влияние возможных халяльных компонентов обычно исследуют путем добавления этих веществ как к холостым, так и к рабочим образцам и наблюдения за реакцией. Полученные результаты обычно используются для расчета фактического халяльного эффекта.

Ключевые слова: Селективность, стандарт, неопределенность качества, калибровка, интенсивность отказов, метрологические характеристики, погрешности измерений, интенсивность отказов.

Introduction

Nowadays, every specialist needs to know the parameters in his field of activity and their measurement methods, measuring tools, and their technical descriptions. In addition, it is necessary for technical specialists to know the means of control of measured and evaluated quantities and the issues related to their use [1].

One of the main directions of scientific and technical development is the creation of perfect control-measuring devices, devices and systems that measure quantities more accurately [2].

The study of the science "Fundamentals of metrology" requires students to know the basic concepts of metrology, terms, definitions, measurement methods and tools, as well as their metrological descriptions, measurement errors and their evaluation.

Selectivity: The degree to which a measurement method unambiguously responds to specific measurement parameters. In selectivity studies, the effects of possible halal-inducing components are usually investigated by adding these substances to both blanks and working samples and observing the response. The results obtained are usually used to show that the true halal effects are insignificant. Because such studies directly detect response variability, these data can be used to estimate the uncertainty associated with potential pollutants, in addition to providing information on the range of pollutant concentrations [3].

Follow-up: It is important to be able to reliably compare results obtained in different laboratories or at different times. This is ensured by the fact that all

laboratories use the same measuring scale or the same "counting point". In many cases, this includes initial national or international benchmarks, and in perfect cases (for the purpose of a long-term agreement). This is achieved by establishing a calibration chain leading to the International System of Units (SI). Analytical scales are a good example. Each scale is calibrated using standard stones, which in turn are calibrated against national standards, thus interacting with the original standard of kilograms. An unbroken chain of comparisons leading to a known starting value provides "tracking" to a common reference point and ensures that different people use the same measurement tools [4]. In routine measurements, the agreement of measurements between different laboratories (or the agreement of simultaneous measurements) is achieved by specifying the follow-up of all relevant intermediate measurements used to obtain or verify the result of measurements. Therefore, tracking is an important concept in all fields of measurement.

Tracking is closely related to uncertainty, and tracking allows all related measurements to be placed on an agreed-upon measurement scale, where uncertainty is the 'durability' of chain links and similar describes the expected level of agreement between the laboratories performing the measurements.

In general, the uncertainty of a result that is traceable to a specific standard is expressed as the standard's uncertainty and the measurement uncertainty associated with that standard.

Monitoring of the result of the analytical methodology should be determined by the addition of the following procedures (treatments):

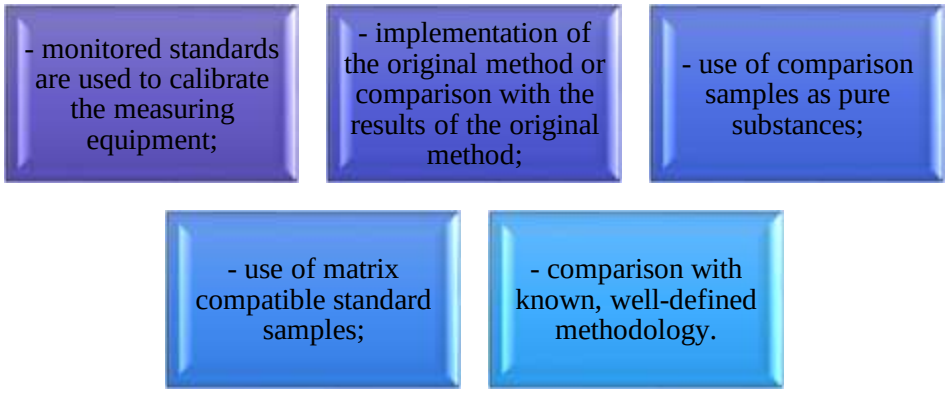

Figure 1: The monitoring scheme of the result of the analytical method

Calibration of the measuring equipment: In all cases, the calibration of the used measuring equipment should be monitored against a suitable standard. The measurement step of a method is often calibrated using a comparison sample whose quantitative description is traceable to SI. This practice ensures that the results for this part of the methodology are traceable to the SI. However, it is also necessary to define tracking for operations that precede the measurement phase [5].

Metrological reliability of measuring instruments

During the operation of any measuring instrument, a malfunction or breakdown can occur, which is called a malfunction.

Metrological reliability is a property of measuring instruments. Maintaining the specified values of metrological properties for a certain period of time under normal modes and operating conditions. It is characterized by failure rate, probability of failure-free operation and time between failures.

The failure rate is determined by the formula below.

$$\Lambda = \frac{L}{N \cdot \Delta t},$$

where L is the number of failures;
N is the number of similar elements;
Dt is the time period.
Failure rate for a measuring instrument consisting of n types of elements.

$$\Lambda_{\text{сум}} = \sum_{i=1}^{n} \Lambda_i \cdot m_i,$$

where mi is the number of elements of i-type.
There will be a chance of failure.

$$P(t) = \exp\left(-\int_0^t \Lambda_{\text{сум}}(t) \cdot dt\right).$$

Runtime cancellation

$$T_{\text{ср}} = \int_0^{\infty} P(t) \cdot dt.$$

For a sudden failure where the degree of failure does not depend on the time of operation of the measuring instrument;

$$\Lambda_{\text{сум}}(t) = \Lambda_{\text{сум}} = \text{const};$$

$$P(t) = \exp(-\Lambda_{\text{сум}} \cdot t);$$

$$T_{\text{ср}} = L/\Lambda_{\text{сум}}.$$

The calibration interval that provides the specified probability of failure-free operation is determined by the formula

$$T_{\text{мп}} = \frac{\ln(1 - P_{\text{мо}})}{\ln P(t)},$$

where Pmo is the probability of metrological failure during the time between inspections;
R(t) is the probability of failure-free operation.

The calibration interval can be adjusted during operation.

Use of reference samples as pure substances

Monitoring can be demonstrated using a reference sample in the form of a pure substance or sample containing a known amount of the pure substance. This can be done, for example, by adding certain additives to blank samples or to the sample being analyzed. However, it is always necessary to evaluate the difference in the response of the measurement system for the standard used and the sample being analyzed. Unfortunately, in many cases, especially when adding certain additives, the correction for this difference in responses can be as large as the uncertainty of this correction. In this way, even though the tracking of the result can generally be set to SI units, in practice the uncertainty of the result may be unacceptable or unquantifiable except in

the simplest cases [6]. If uncertainty cannot be quantified, then no tracking is established.

Application of a standard sample: Traceability is demonstrated by comparing the measurement results obtained on a standard sample that is close to the matrix, with the certified value of this standard sample [7-8]. This matching "matrix" can reduce uncertainty when a standard sample is available, compared to using the reference sample as a pure substance. If the standard sample value is traceable to SI, then these measurements are traceable to SI units. However, even then, the uncertainty of the result can be unacceptably large or even unquantifiable, especially in cases where there is insufficient agreement between the sample composition and the standard sample composition.

In conclusion, using formulas for sudden failure of laboratory measuring devices used in every field, it is possible to achieve accuracy and failure rate for a measuring instrument composed of different elements. detection is very important in production and this article is also based on improving production efficiency by detecting these errors and preventing failures.

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