METROLOGICAL SUPPORT OF MEASUREMENT OF KINEMATIC VISCOSITY OF LIQUID MEDIA TAKING INTO ACCOUNT UNCERTAINTY OF MEASUREMENTS

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Abstract. *The articles disassemble the content of the metrological traceability of the presented viscosity of the poor. Viscost is a free liquid liquid backlight transmitted in one direction. Thus, viscosity is a freelance training by the mayor, mainly of which is a hung chemical horse and a dimensional molecule. K naibolee rasprostranym methods of viscosity measurement are capillary, rotary, falling ball methods, vibrational (oscillatory or oscillative), plant. Depending on the measurement method used, the formation of a cinematic, dynamic and assimilated viscous liquid will be determined.*

Keywords: *liquid media, viscosity, measurement, viscometer, metrological observations, metrological provision, calibration.*

Viscosity is the property of liquids to resist the movement of one part of it relative to another under the influence of the applied external force. Thus, viscosity is a measure of internal friction, which mainly depends on the chemical composition and size of the molecules of the substance.The most common methods of measuring viscosity include capillary, rotary, falling ball method, vibration (vibrational), conditional [1-5]. Depending on the measurement method used, the value of kinematic, dynamic or conditional viscosity of the investigated liquid is determined.Many important decisions are based on the results of chemical quantitative analysis; results are used, for example, to estimate yields, to check materials against specifications or statutory limits, or to estimate monetary value. Whenever decisions are based on analytical results, it is important to have some indication of the quality of the results, that is, the extent to which they can be used to achieve the stated goal. Users of chemical analysis results, especially in those areas related to international trade, are facing increasing pressure to eliminate duplication of effort often expended in obtaining them [6-8]. Confidence in data from outside the user's own organization is a prerequisite for achieving the above goal.

In some analytical chemistry sectors, it is now a formal (often legal) requirement for the laboratory to introduce quality assurance measures to ensure the ability and provide data of the required quality. Such measures include: use of proven methods of analysis; использование определенных процедур внутреннего контроля качества; participation in proficiency testing programs; accreditation based on ISO / IEC 17025: 2017 and establishing traceability of measurement results. Depending on the type of information available about the quantity and on the possible variability of the quantity value (statistical or non-statistical), it is known that the uncertainties of the input quantities are estimated by type A or type B [9-14].

If the information about a quantity is statistical, that is, it is obtained experimentally by repeated measurements or tests, then its standard uncertainty due to random effects is estimated by type A (1) [4,5]:

$$u_A(\bar{x}) = s(\bar{x}) = \sqrt{\frac{1}{n(n-1)} \cdot \sum_{i=1}^{n} \left(x_i - \bar{x}\right)^2} \quad (1)$$

where $\bar{x}$ is the estimate (arithmetic mean) of the input X quantity; x_i – result of the i-th observation of the input quantity; n – number of observations.

In this case, the experimental variance of observations is estimated by (2):

$$s^2(x) = \frac{1}{n-1} \cdot \sum_{i=1}^{n} \left(x_i - \bar{x}\right)^2 \quad (2)$$

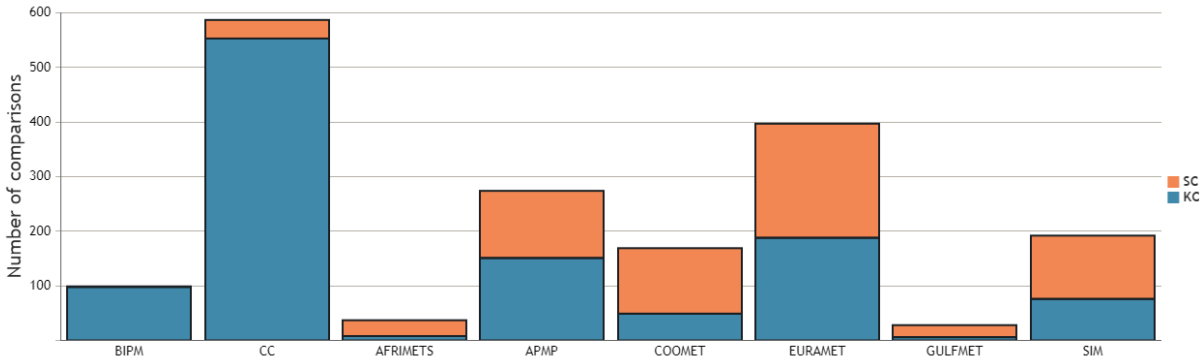
Before measuring, first of all, we compile a list of influencing factors on the expanded measurement uncertainty.

The relevance of this project lies in the wide application in areas such as, quality assessment and safety of agricultural products, dietary dietary supplements (dietary supplements) and other areas mentioned above. At the same time, this Project uses a viscosity meter kit designed to assess the quality and safety of products in the oil, fuel, medical, cosmetology, geological and construction industries and other environmental sectors, as well as to control the technologists.

Uzbekistan is a member of the regional metrological organization COOMET, the indicators of these and other organizations in important comparisons specified in line 2 [15-18].

Figure 1.

Calibration and measuring metrological safety institutes



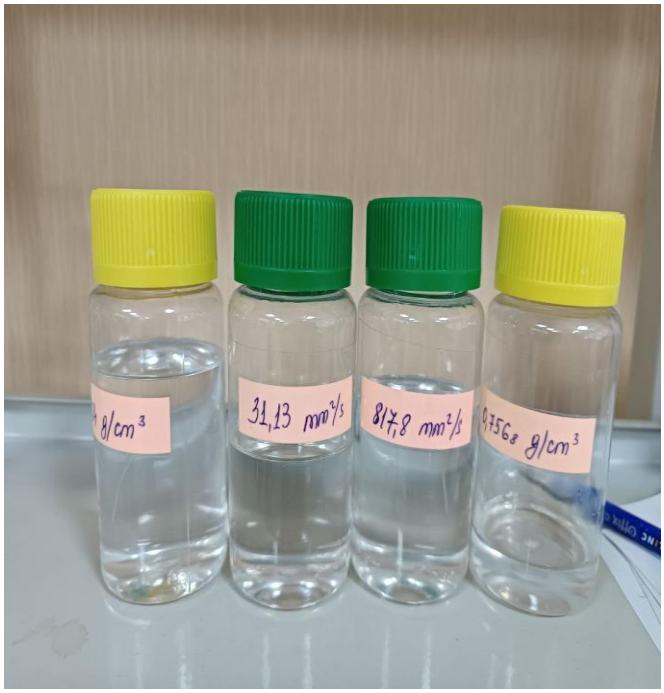
One of the main and no less urgent tasks is the organization of metrological control (comparison, calibration, certification) of operating measuring viscometers used in these areas of the economy.

An urgent issue is the creation of conditions for improving the quality and competitiveness of domestic products through the development and improvement of systems for calibrating measuring instruments, the development of mechanisms for mutually beneficial cooperation in the field of metrology with international and regional metrological organizations.

Fig.2 and 3 show standard images in quality of metrological traceability tools.

Figure 2. Calibration buffer screens for metrological traceability

Figure 3. Working standard images for metrological nature of viscozimeters (metrological traceability established)



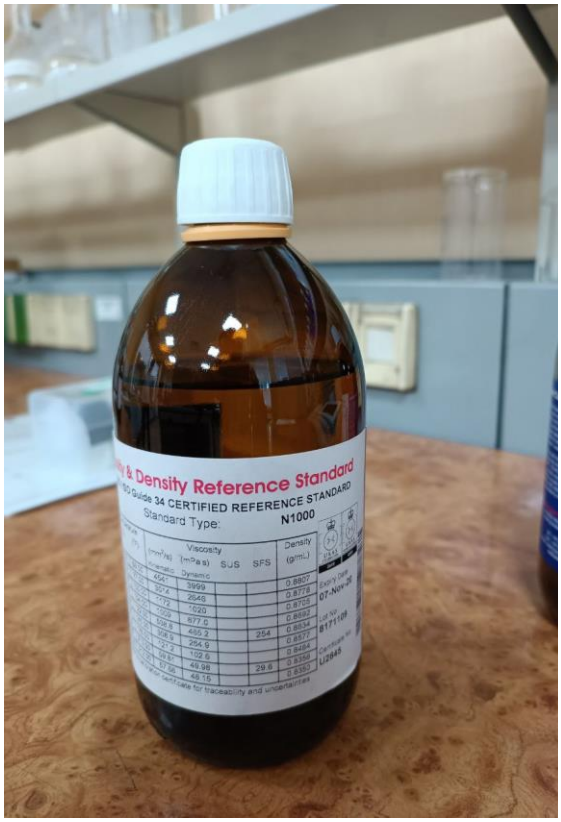
Testing and calibration laboratories for ensuring metrological traceability up to the International System of Units (SI) is one of the main technical requirements of the international standard ISO/IEC 17025:2017 "General requirements for the competence of testing and calibration laboratories," which is achieved with the assistance of the integration of the Republic of Uzbekistan into the international economy and international systems to ensure the uniformity of measurements as an equal partner. To date, according to the State Unitary Enterprise "Accreditation Center," there are more than 600 laboratories in the state register, the technical competence of which has been officially confirmed [17-21]**.**

To date, the creation and implementation of a complex of equipment (installations, equipment) for reproducing a unit of kinematic viscosity of a liquid is an urgent task in the implementation of the Agreement "On the mutual recognition of national standards and certificates of calibration and measurements issued by national metrological institutes" (CIPM MRA), approved by the organization of the International Bureau of Measures and Weights (1999, October 14, France, Paris). As a result, an important step is being taken in demonstrating the national measuring and calibration capabilities of the Republic of Uzbekistan in the International Database of Calibration and Measuring Capabilities (KCDB), which will allow modernizing the technical capabilities of the state system for ensuring the uniformity of measurements.

In photo 4, the appearance of the standard image of cinematic viscosity is certified according to ISO 17034.

Figure 4.

Certified standard image of cinematic and dynamic viscosity of liquid according to ISO 17034. certificate of statutory metrological traceability of measurements



In the oil and gas industry, about 30 industrial enterprises operate, which produce products such as gasoline, diesel fuel, jet fuel, various types of oils, fuel oil, bitumen, polyethylene of various grades, marketable natural and liquefied gas, oil and gas chemical equipment, gas balloon equipment, etc.

According to the Department of Oil Refining, Petrochemistry, Storage and Transportation of Petroleum Products, according to the results of January-September 2020, the company processed 1 million 380.9 thousand tons of hydrocarbon raw materials. As a result, 620.1 thousand tons of gasoline, 469.2 thousand tons of diesel fuel, 67.4 thousand tons of jet fuel and 78.2 thousand tons of fuel oil were produced.

In accordance with the Law "On Metrology" No. ZRU-614, MI data must undergo primary, periodic, extraordinary, inspection or expert verification. Verification of viscosity measuring instruments in accordance with GOST 8.025-96 "GSI. The state verification scheme for measuring the viscosity of liquids "should be carried out using state standards of the second category, which are standard samples (CO) of the viscosity of the liquid, or by the method of direct comparison using comparator liquids. The need for a large nomenclature of CO fluid viscosity is determined by the variety and functionality of viscosity measurement instruments.

Thus, the development of stable and uniform CO viscosity of a liquid, certified in the ranges of values of different temperatures (from minus 40 ° C to 20 ° C and from 100 ° C to 150 ° C) is an urgent task. The development and implementation of state working standards that store and transmit units of dynamic and kinematic viscosity of a liquid in the range of temperature values from minus 40 ° C to 150 ° C will increase the number of types of metrologically provided MI, which, in turn, will create the basis for the development of a system for ensuring the uniformity of measurements in this area. The development and study of RS will solve not only the problem of the lack of verification tools for viscometric devices in the

temperature ranges from minus 40 ° C to 20 ° C and from 100 ° C to 150 ° C, but will also allow using these samples as comparator liquids during comparisons, certification and calibration of standards [22-24].

The implementation of the project will allow the implementation of a number of US standards (ASTM D 2162, ASTM D 445-18, ASTM D 2162-17) and other international standards for measuring the viscosity of liquids.

The purpose of this project is to improve the metrological provision of measurements of the viscosity of liquid media in the temperature range from minus 40 ° C to 150 ° C by developing and studying state working standards for units of dynamic and kinematic viscosity of liquid, as well as standard samples.

To achieve this goal, it is necessary to solve the following tasks [25-27]:

─ analyze the state of metrological support for measuring the viscosity of liquids to determine the directions of solving the problem of the lack of verification tools for the viscosity MI in the temperature range from minus 40 ° C to 150 ° C;

─ developing a procedure for transferring the size of the unit of kinematic viscosity of the liquid of the first discharge in the range of values from 0.4 to 1,0·105 mm2/s;

─ training and advanced training of personnel in organizing metrological support of liquid viscosity measurement tools, implementation of the procedure for transferring the size of measurement units to working measuring tools (calibration, comparison, certification);

─ pilot comparisons of a set of equipment for reproducing a unit of kinematic viscosity of a liquid in accredited metrological laboratories within the framework of the Interstate Council for Standardization, Metrology and Certification (MGS), as well as taking into account the recommendation of the Euro-Asian Cooperation of State Metrological Organizations (COOMET) of the COOMET R/GM/11:2006 document "Regulation on Comparisons of Standards of National Metrological Institutes of COOMET" ";

─ development of software for metrological control, evaluation of accuracy characteristics of experimental data at transfer of unit size of kinematic viscosity of equipment complex for reproduction of unit of kinematic viscosity of liquid;

─ selection and justification of methods and means of measuring the density of a liquid suitable for measurements in the temperature range from minus 40 ° C to 150 ° C;

─ development of a draft updated State Verification Scheme for liquid viscosity measuring instruments in terms of traceability of measuring instruments intended for use in the temperature range from minus 40 ° C to 150 ° C.

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