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"An investment in knowledge always pays the best interest." Benjamin Franklin

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THE IMPORTANCE OF UNCERTAINTY DETERMINATION DURING TECHNOLOGICAL TEMPERATURE MEASUREMENTS

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ABSTRACT

As we know, one of the trends in the development of metrological control activities of enterprises and organizations is the calibration of measuring instruments through the assessment of measurement uncertainty. This process is an important factor to increase the accuracy of measurements, ensuring product quality, minimize the amount of waste products and increase the competitiveness of the organization. Such a parameter can be, for example, the standard deviation (mean squared error of the measurement results) or a number that is exactly divisible by it, or the width of the confidence interval. Measurement uncertainty combines several components. Some of these components can be estimated based on the statistical distribution of the results of a series of observations and characterized by their standard deviations. Considering that more than 50% of the measurements performed during technological processes are covered by temperature measurements, then we can say that the errors occurring during temperature measurements directly affect the quality of the product significantly. In the conducted research, the uncertainty in the temperature measurements performed during the technological processes was determined and the importance of determining this uncertainty was analyzed.

Keywords: Metrological assurance, temperature measurements, technological process, statistical distribution, thermodynamics, uncertainty, metrology, accuracy, error, calibration.

Introduction

According to the Law of the Republic of Azerbaijan "On Ensuring the Uniformity of Measurements", the calibration of measuring instruments is considered as a set of operations performed to determine the actual values of the metrological characteristics of the measurement. In this regard, if the measuring instrument used during the technological process is not intended for use in the field of state regulation of ensuring the uniformity of measurements or will not be used, then that measuring instrument can be subjected to the calibration procedure. Thus, in the Republic of Azerbaijan, the calibration procedure of measuring instruments is considered a voluntary process, unlike the verification procedure [1].

It should be noted that any legal entity (individual entrepreneur) without accreditation for the right to carry out calibration works has the right to calibrate measuring instruments, because according to the Law of the Republic of Azerbaijan "On Ensuring the Uniformity of Measurements", such accreditation is voluntary. In this case, the calibration of the measuring instruments should be carried out using standards of quantitative units that can be traced in accordance with the state primary standards of the corresponding quantitative units. This involves determining the fact that the quantitative units of standards used during calibration comply with state standards and have valid inspection certificates. Accreditation of the right to calibrate measuring instruments, as mentioned above, is voluntary, but it is more convenient to obtain this right for the metrological



service in order to recognize the results of calibration, as well as to improve the image of the enterprise as a whole [2].

According to the ISO/IEC 17025-2017 standard, a mandatory part of the calibration of measuring instruments is the estimation of measurement uncertainty. As we mentioned, measurement uncertainty is a non-negative parameter that characterizes the spread of quantitative values attributed to the measured quantity on the basis of measurement data. The measurement result of the quantity should be accompanied by some quantitative characterization of the quality of the measurement result, so that it is possible to assess its reliability when using this result. Without such information, the measurement results cannot be compared with each other or with the values specified in the specification or standard. This requires an easy-to-use, understandable and generally accepted procedure to characterize the quality of a measurement result, that is, to estimate and express its uncertainty [3-4].

We use correlation of the terms of the theory of uncertainty with the terms of the classical theory of accuracy (in brackets):

- Uncertainty of the measurement result (error of the measurement result),
- uncertainty type A (random error),
- type B uncertainty (systematic error),
- the standard uncertainty (standard deviation of the error) of the measurement result,
- expanded uncertainty (confidence limits) of the measurement result,
- coverage probability, coverage probability (confidence probability),
- coverage ratio, coverage ratio (error distribution coefficient)

The concept of measurement uncertainty refuses to divide these groups into systematic and random errors, referring to the difficulty of distinguishing them. Instead, data processing approaches are classified into two types: A and B.

The differences between these groups, as in the case of errors, are not based on the sources of occurrence, but on the method of obtaining their values. The classification of measurement uncertainty into types A and B is presented only to show that there are two different ways of estimating uncertainty components. Both estimation methods are based on the probability distribution, and the uncertainty components (regardless of the estimation method) are quantitatively characterized by the same parameter - the standard deviation. Type A conditions are estimated as standard uncertainties equal to the standard deviations of the arithmetic means of multiple measurements. Type B conditions are estimated as standard uncertainties, which are obtained from periodic data on the variability of input quantities [5-6].

A Type B uncertainty assessment can be based on the following information:

- information from the calibration certificate;
- the value of the quantity taken from authoritative publications;
- information on the standardized metrological characteristics of the measuring instrument.

Calculation of the uncertainty of the temperature measuring instrument

As we know, thermoelectric converters are often used in industrial and laboratory temperature measurements. This is due to the possibility of their application in a wide range of temperatures, as well as the convenience of installation. Like any measurement, temperature measurement using TP is characterized by the degree of approximation of the result to the true value. There are two approaches to estimating parameters of measurement accuracy. One approach is based on the concepts and terms of the theory of uncertainty, the other - on the concepts and terms of the



theory of errors, which are still more widely used in normative documents in the field of metrology, used in the Wold metrology system of ensuring the unity of measurements. Currently, in some standards related to thermometry, the term "measurement uncertainty" has been introduced instead of the term "measurement error". The concept of "uncertainty of measurements" has received worldwide distribution and is introduced as a mandatory condition for the certification of verification laboratories according to the international standard ISO/IEC 17025 [7].

The concept of "measurement uncertainty", which is currently being introduced into practice, makes it quite easy to calculate the measurement uncertainty both in production and in the laboratory, and to compare the measurement results obtained in different laboratories. Knowledge of the uncertainty of the measurements taken in production allows you to optimize technological processes with greater accuracy. The purpose of this work is to determine the uncertainty of temperature measurement by thermocouples using various measuring circuits. [8-9]

In the course of the study, the calculation of the measurement uncertainty during the calibration of the PR320 temperature calibrator with an upper measurement limit of 1300 °C and a reduced allowable error of 0.5% was performed.

As a reference, a PR320 temperature calibrator with an upper measurement limit of 1300 °C and a reduced permissible error limit of 0.02 % was used, as well as a 5649 R type thermocouple with a relative permissible error limit of ± 0.03 %.

We present the measurement uncertainty calculation for the 30-40 °C point.

Calculation of uncertainties and processing of measurement results ISO/IEC Guide 98-3:2008 "Measurement uncertainty. Part 3" was carried out according to the normative document.

As we know, uncertainty calculation consists of the following several steps.

- Uncertainty assessment;
- Determination of type A uncertainty;
- Determination of type B uncertainty
- Calculation of extended uncertainty;
- Final uncertainty.

In classical metrology, the measurement error was usually expressed by the boundaries of the confidence interval calculated on the basis of the dispersion of the measurement results, the largest and smallest values of the interval in which the desired (true) value of the measurement result is located with a given probability, i.e., the measurement error were evaluated directly from the results of these measurements, namely, from the variance of the results. At the same time, the components of the "error" from the "errors" of the certified value of the standard sample or the calibration dependence were not taken into account.

During the research work, 5 measurements were made and the following values were obtained: 34; 35; 36; 38; 40 °C. (Fig. 1)

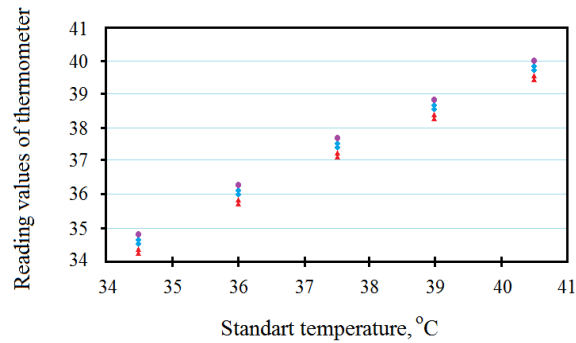


Figure 1: Temperature measurements result

We find the average value of the temperature according to the formula 1:

$$\bar{x} = \frac{1}{ni} \sum_{i=1}^n x_i \quad (1)$$

Next, we calculate the standard deviation of the arithmetic mean using the following equation (Formula 2):

$$S = \sqrt{\frac{1}{(n_i - 1) \cdot n} \sum_{i=1}^n (x_i - \bar{x}_i)^2} \quad (2)$$

We calculate the type A uncertainty during the temperature measurement performed in the above sequence.

Calculating type B uncertainty, however, requires a different process. We must take into account all the factors affecting the measurement operation at this time.

In order to evaluate the type B uncertainty during the performed process, we used the basic reduced error limits of the 0.02% standard known from the technical documentation. Then the absolute error will have a uniform distribution within the range of ± 0.5 °C.

The standard uncertainty of type B is calculated by the following formula 3:

$$U_{B1} = \frac{X_{B1}}{\sqrt{3}} = \frac{0,5}{1,732} = 0,2886 \text{ °C} \quad (3)$$

The standard uncertainty of the calibrator resolution is calculated using the uniform distribution formula 4.

$$U_{B2} = \frac{X_{B2}}{\sqrt{12}} \quad (4)$$



Where X_{B2} is the unit of the last digit of the calibrated sensor reading (Formula 5).

$$U_{B2} = \frac{X_{B2}}{\sqrt{12}} = \frac{0,1}{3,4641} = 0,02886 \text{ } ^\circ\text{C} \quad (5)$$

Next, we calculate the standard total uncertainty through the input quantity uncertainty contributions (Formula 6):

$$u_c = \sqrt{u_A^2 + u_{B1}^2 + u_{B2}^2} \quad (6)$$

The expanded uncertainty is calculated using the following formula 7:

$$U = k \cdot u_c \quad (7)$$

Contribution of the uncertainty of each input quantity x ; to the uncertainty of the measured quantity (total uncertainty) is calculated as follows formula 8:

$$u_i(y) = c_i \cdot u(X_i) \quad (8)$$

The measurement uncertainty budget for 5649 R-type thermocouple calibration is given in the table 1.

Table 1. The measurement uncertainty budget for 5649 R-type thermocouple

Parameter	Value
Estimation of input quantity, $^\circ\text{C}$	500
Output value, $^\circ\text{C}$	501
Standard uncertainty, $^\circ\text{C}$	0,02886
Standard total uncertainty, $^\circ\text{C}$	0,021
Distribution	normal
Effective number of degrees of freedom	1
Contribution to uncertainty, $^\circ\text{C}$	0,023
Extended uncertainty	0,043

Thus, the expanded uncertainty at the 500 $^\circ\text{C}$ calibration point was 0.0043 $^\circ\text{C}$.

According to ISO/IEC 17025:2017, the laboratory must estimate the measurement uncertainty for all calibrations, including its own equipment.

In the previous version of the standard, there was no requirement to calibrate their own equipment, which created major problems for the metrological service, as it would be necessary to develop calibration procedures for its own equipment. Accordingly, the next challenge is whether



the metrology service staff has sufficient competence to do it, how and when to do it, and to develop its calibration methods, as well as to calculate and estimate measurement uncertainties. In European countries, this problem was solved by the introduction of departments for the development of calibration methods depending on the types of measurements (optical, geometric, electrical, etc.). [10]

The requirements to ensure the reliability of measurement results are as follows: the laboratory must have a procedure to control the reliability of its results. The data obtained should be recorded to identify trends and where possible statistical methods should be used to analyze the results. A plan for such monitoring should be developed and analyzed. Monitoring refers to both internal and external audits, and the plan refers to actions to be taken by laboratory personnel if monitoring is performed.

In this work, we tried to theoretically substantiate two important points in the procedure for estimating the uncertainty of the temperature measurement in the interval, which arises due to the presence of verification uncertainties in the calibration points. First, it was proved that if the total correlated uncertainties exceed the uncorrelated ones, it is possible to use linear interpolation to obtain the uncertainties in the interval. Secondly, it was shown that in order to express the uncertainty of the temperature difference measured by two thermometers calibrated with the same equipment, it is necessary to take into account the correlation, which will reduce the total uncertainty of the difference several times. In addition, it is possible to use a simplified formula, excluding all correlated uncertainties. The uncertainty of the difference in the interval can be calculated by linear interpolation of uncorrelated total uncertainties between calibration points.

Conclusions

The problem of obtaining information from the listed sources is also related to their incompatibility with the realities of the Republic of Azerbaijan. By the data of previous measurements, we mean the data specified in the calibration certificate, but if we consider that this certificate was obtained from an organization that is not accredited for the right to perform calibration, the data on measurement uncertainty cannot be considered reliable. If we take into account the resources obtained through practical or theoretical means, then the problem of loss of time and resources for the metrological service arises. Information about measurement uncertainties, if of foreign origin, is very rarely found in the passports or operating instructions of the measuring instrument. Such information is available, but the manufacturer usually does not provide any information on measurement uncertainty. It is not entirely clear which reference books the ambiguities refer to. Most likely, these reference books are available in foreign practice for calibration of measuring instruments, but not in the Republic of Azerbaijan.

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ADVANTAGES OF INTRODUCING AN INTEGRATED MANAGEMENT SYSTEM IN EDUCATION

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ABSTRACT

Education is a fundamental need of every member society, therefore, every citizen should be concerned the quality of education provided by providers of educational services. But while the results may not always be guaranteed and yet educational institutions can play a decisive role in ensuring the expected quality in education. These problems can be solved by the Integrated Management System in Education (IMS). This is a guide for improving the management of the enterprise, created on the basis of international management experience. What can we get from IMS and why are we introducing it into the education system? IMS integrates management systems based on the requirements of international and national standards. We also consider the algorithm for the implementation and development of the IMS at EI. This process includes three subsequent steps: preliminary, preliminary and main. With ISO certification, we can: improve our education system; enhance the reputation of your school; promote equal opportunities for all students, regardless of their religion, ethnic or cultural background, gender, ability/disability, etc. ISO certifications for the education industry help school systems to navigate a complex and competitive environment, also help customers in the industry by implementing education industry standards.

Keywords: education, management system, standards digitalization.

Introduction

The quality of education has a significant impact on the socio-economic development of society. The development of education in Azerbaijan is one of the priorities of the state policy.

Over the years, there have been quite a few changes in all sectors, including in the field of education. For a long time, Azerbaijan, like other post-Soviet Republics, worked and received education according to one single scheme and formula. But after the collapse of the USSR, Azerbaijan began to create a new model of quality education, both in general education schools and in the country's higher educational institutions. But time does not stand still and our country strives for everything new and progressive.

In the late 1990s, private international universities and schools began to appear in Azerbaijan. Parents chose the school and universities at will, in accordance with plans for the future. The society was divided into three subgroups - a private school/university, a public education or a school/university with an international curriculum. The Turkish curriculum has become the leader in the education market. For some time, everyone was happy, the choice was not small.

Everything is new and in demand, but the time has come for the first graduates of the new curriculum. And a new picture of non-compatibility and non-demand has emerged. There came a period of Performance in the educational field. And it was at this point that we got a little confused. Naturally, it is very difficult to solve such multi-way problems with a large number of unknowns in a short period of time. But today this difficult task with a large number of unknowns



has become solvable, because we have begun to see more clearly what we want from education for the quality future of our children and our country.

The improvement of the quality of life is the basis of public policy in developed countries, including Azerbaijan. The ideas oriented to the creation of quality management systems are the components of the provision of a high level of quality of products and services. That is, high quality is guaranteed not from product certification, but through the introduction of quality management systems.

Education is a fundamental need of every member of society; therefore, every citizen should be concerned about the quality of education provided by providers of educational services. But while the results may not always be guaranteed, educational institutions can play a decisive role in ensuring the expected quality of education.

These problems can be solved by the Integrated Management System in Education (IMS).[1],[2] On the example of the positive results of the leading companies in the world, which in the basis of their management, use the algorithm of the IMS. What can we get from the IMS and why do we implement it in the education system? IMS combines management systems based on the requirements of international and national standards: Fig.1.

- ISO 9000 (quality);
- ISO 14001 (environmental protection);
- OHSAS 18000 (occupational health and safety), and some others [3]

This is a guide for improving the management of the enterprise, created on the basis of international management experience.

Although the quality management system has some shortcomings, quite a few enterprises have declared certification of quality systems, or intend to do so in the near future.

Recognizing the importance of quality education for all, ISO developed ISO 21001, the first ever standard for an education management system.

It aims to improve the outcomes and quality of educational institutions for the particular attention and expectations of those who use their services.

6 specific marks of ISO 21001 are planned to be marked, which include but are not limited to:

- mission, vision, goals and action plans;
- inclusive and equitable education for all;
- more personalized learning and response to special education needs;
- sequential processes and assessment tools;
- models for improvement;
- increasing the authority of the educational organization. ISO 21001 is designed to fully standardize the education business, from goals to methods to adjustments.

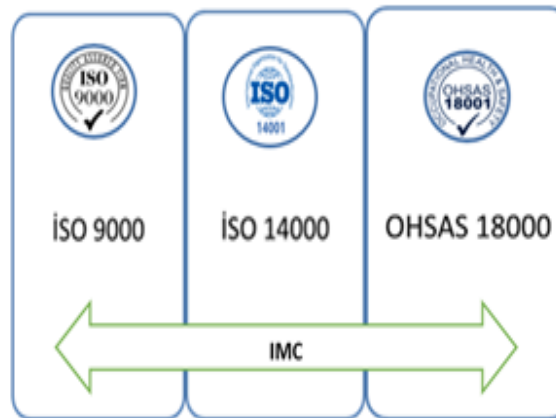
In addition, ISO technical committee ISO/TC 232 is developing standards that describe the requirements for learning services provided outside of formal education, such as ISO 29993, which covers all types of lifelong learning, including vocational education and in-company training. The International Organization for Standardization (ISO) has put forward countless sets of standards that benefit business and industry operations. However, ISO's work is not limited to these areas. It can also be useful in other areas that we don't see as often, such as education.

The business is a consumer or purchaser of OS. He must evaluate quality in terms of obtaining the maximum benefit from the funds spent on training. But there is a difficulty here, due to the fact that the costs are known at the moment, and the effectiveness of their investment will appear only



over time. And since the activity of an enterprise depends on the influence of many other factors, it is almost impossible to unambiguously assess the role of training in terms of value. In this regard, the interest of businesses in training their employees depends primarily on the requirements of the law.

An educational institution is an organization that provides educational institutions, that is, their manufacturer and seller. It considers quality as a way to achieve competitive success.



The state, representing the interests of the whole society, should be vitally interested in the high quality of educational institutions since well-educated citizens form the basis of the country's intellectual capital. The state is neither a buyer nor a seller of OS. Even in the system of higher education, by providing state-funded places for students, it plays the role of an investor rather than expecting a return on invested funds.

Quality is a very multifaceted and ambiguous characteristic of products, services, management systems, etc. Fig.2. In the OS system, quality, on the one hand, is the main characteristic, and on the other hand, it has a number of features:

- It is impossible to objectively assess the quality of EI using measurable instrumental methods and verifiable indicators. And this is one of the conditions for the functioning of modern management systems. The various approaches currently in use are based on expert evaluation or on the results of questionnaires;
- There are too many factors that affect the quality of EI.[4] There are too many factors that influence the quality of EI. They are staffing of an EI organization of all levels and specialties, material and technical support, availability of demanded programs, classrooms and training workshops, multimedia various communications, the level of students' training, and many others. Moreover, some of these factors are variable, some of them are interrelated, and some of them do not depend on the organization that provides EI;
- Many experts consider that the most important criterion for the quality of educational institutions is the existence of a quality management system (QMS) certificate. But this opinion is valid only if the QMS is really developed, implemented and successfully functioning. The main reason is the unwillingness and inability of management to change the nature of management from linear-functional to process-based, which is the basis of modern management systems.

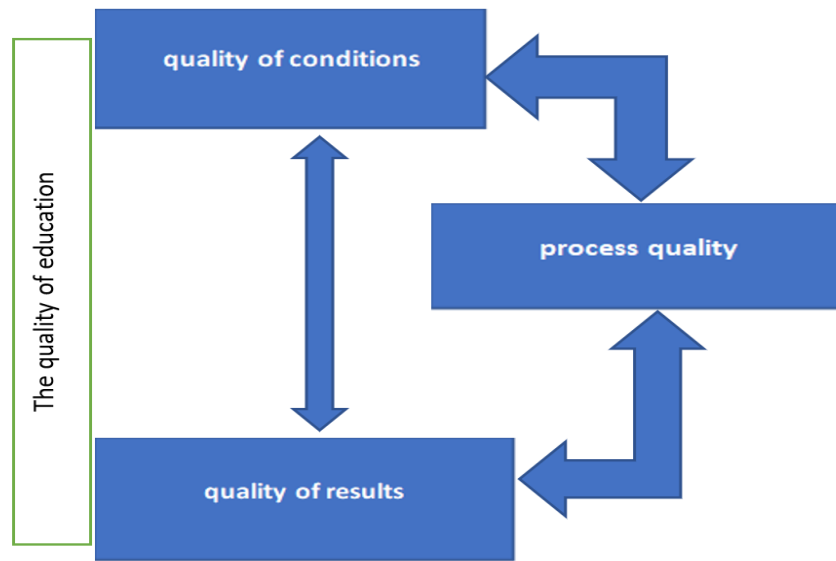


Figure 2: Linking the quality of education - with the characteristics of products services, management system, etc

I would also like to note that ISO 21001 sets guidelines for many organizations related to how education is carried out and how students should be approached and managed, it is certain that over time the standards will lead to a more uniform educational ecosystem. This does not mean that all institutions and teachers should be the same or even teach the same. Specific problems should be dealt with in a similar manner so that one student facing difficulty in a given environment is not less likely to overcome the problem than another student facing the same situation in another institution.

Quality supply problem in higher education

The expansion and deepening of the Bologna Process in higher education in Azerbaijan is directly related to the quality of its foundation. Some experts believe that the Bologna Declaration does not reflect a method for accurately defining the problem of quality of education, despite the fact that at the conference of ministers of education in Paris, quality was the main issue every time. Subsequent dynamics have shown that the higher education system offers three levels of quality: the high school, the country and Europe as a whole. The primary responsibility for quality in higher education lies in the use of mutually acceptable criteria and methods. The challenge is to keep the following in mind when ensuring quality.

Considering the degree of responsibility and interest of the university and the organization interested in the issue;

Evaluation of the program and the work of the university, as well as the evaluation of external peer reviews, as well as student participation in the evaluation and printing of results;

Considering the perfection of the system of accreditation procedures and the accuracy of the certification mechanism;

The level of international cooperation, participation in international networking and network cooperation;



Preparation and publication of training manuals, textbooks;

Level of contact with students, level of use of new teaching methods, encouragement of free work with students, and so on.

At the European level, the Berlin Conference, together with the European Association of Universities, the European Students' Union and the European Network for Quality Assurance in Higher Education, offers guidelines for establishing a common concept, procedure and methodology. These guidelines include the introduction of accreditation and the development of a quality assurance system for foreign experimentation in certain universities.

The quality of higher education is explained a number of reasons. In Europe, the government does not actively intervene in the work of higher education institutions and is outside the process of regulating the higher education system. In many European national education systems, there has been interference in the process of entering and leaving the academic process in the last 10 years.

It is necessary to develop a methodology for designing education so that one of the most important indicators of education is the result of education. In other words, to evaluate the effectiveness of education is planned (curriculum content, duration of training, etc.), not the process of implementation, but the result of education, knowledge, worldview, employment, free education and self-education process based on such criteria as their ability to implement. In this case, the focus is on the educational process (educational programs, student success - 33), and it should be aimed at improving the level of professional and personal training. Finally, in the organization and implementation of the quality of higher education, the mutual recognition of diplomas and degrees, as well as the comparison of the documents submitted, that it can be done, that it can be reliable, that the staff is competitive in the labor market and that they can reflect the process of declining training, have the right professional training and habits, etc. combine and other aspects, such as this. Provision of manifested qualities, on the other hand, is directly connected with the organization of curriculum in higher education institution, regulation of relations between teachers and students, organization of its ability for educational learning and formation of free learning skills, in other words, the development of personnel able to continue competing in the educational sector market depends on it. In general, the quality of education is characterized by indicators that reflect the real educational results of social and personal expectations to which it refers. The concept of education is usually reflected in two main forms, such as the result (education) and the learning process. In both cases, the factors affecting education are governing bodies, educational institutions, educational programs, students, and teachers. And assessing the quality of education requires adding to the list of bidders and those who benefit from the educational service, mainly individuals, production, society and government, education is a system. It is necessary to assess and evaluate what. That is, it is important to define the object and the criteria for evaluation. If the objects and subjects of evaluation are defined, then it covers the entire education system and its elements.

Evaluation, on the other hand, is done by government agencies. On this basis, 34 different options arise. Experience shows that there are two forms of assessment, mainly internal and external. Internal assessment is primarily self-evaluation and mutual evaluation of teachers and students, internal quality monitoring, internal evaluation of educational programs is an internal evaluation of the educational institution. The application of the evaluation methods shown has led to the elimination of deficiencies and factors that negatively affect quality in higher education institutions, which they can. For example, during the academic year, faculty evaluation opportunities for students include seminars, lab evaluations, checks ("Passed Completely") during



discharge, during the submission of certain assignments, and so on. Finally, there are final examinations and performance reviews (if verbal or written, in the form of a test). Student assessments of instructors, on the other hand, are based on responses to surveys administered at least twice during the semester and on the results of individual faculty students' opinions of what an instructor might be like. In many cases, a faculty member's personal qualities may call into question the outcome of this evaluation. Therefore, attitudes toward students must be objectively governed by full internal discipline.

During the educational process, a democratic environment should be created in which students can inform themselves and the organizers of the educational process about their relationship with the teacher (inform him). In this case, measures can be taken to regulate the relationship between the teacher and the teacher. In general, the issue of self-esteem and self-control is one of the most discussed issues in the world. Methodological guidelines and recommendations do not yet exist. However, this is necessary during the period of introduction of continuous education. Internal monitoring can be carried out 2-3 times during a regular semester. The survey is conducted between students and a professor-teacher team. Each survey includes 10 to 12 questions. The goal is to fully cover the educational process. The goal is to evaluate each subject, textbook and learning materials, as well as the condition of the classroom, library, canteen, and so on. In other words, it is aimed at assessing the performance of all institutions that perform the functions of educational institutions. Since we are talking about teachers and students, it is in their interest to appreciate each other. It will be more effective if specific evaluation criteria are applied for each question. Results are generally timely for each faculty, governing body and service.

Internal curriculum assessment standards have been prepared by the Ministry of Education of Azerbaijan, and elective and vocational science education for higher education institutions is recommended to be included in the curricula. Education, on the other hand, primarily attracts educators and professionals. However, if education is to be universal, it will be aimed at defining the structure and content of education. There is a great need, as we say, for the development of standards for higher professional education. At least those who work in this process - employers, entrepreneurs, civic organizations, and so 36 Internal evaluations of 36 educational institutions are more applicable to institutions of higher education. Improving the efficiency of the educational process and the effectiveness of the governing body is a major factor.

According to the report prepared for the prose: - mission, purpose, - structure, content, duration and requirements of the Educational program, - the main goal of the direction of research, the results of scientific schools, - creation of quality system, - student body, success rate, assessment of the possession of the curriculum, their achievements, their success in the labor market and in continuing education, - main financial indicators of the management body and their provision, etc. should be taken into account. Assessment of individual achievement will address the Process in two forms:

(1) Final State Attestation.

(2) Evaluation of the quality of education (faculty). Despite the fact that there are many wishes for their work, they are still evaluated only by attestation.

The ISO governing body evaluates public institutions that are subjects of higher education. Other institutions of interest, teaching and educational institutions do not participate in the process of evaluating its work. 37 In conclusion, it should be noted that evaluating the work of an educational institution, identifying and improving the criteria for its quality, increasing its productivity, is unique to achieving high results. At the same time, it requires a rejection of



formalism, maximum objectivity and impartiality. In this sense, the human factor always comes first.

Conclusions

In the detention report, which is currently in Azerbaijan Institute for Standardization of Processes of All Educational Institutions in with the ISO requirement to ensure compliance with the quality of work in the field education. Also measurement and development algorithm ISM in OS. This process includes three subsequent steps: preliminary, preliminary and main.

By obtaining the ISO certificate, we will be able to:

- Improve your education system
- Hang in the glory of an educational institution
- Coexist with the existence of opportunities for all students, regardless of their affiliation, ethnicity or religion cultural background, gender, ability/disability.
- Provide individual training and selective response for all students.
- Stimulate excellence and innovation
- Make education more secondary (physical or online modifications).

ISO certifications for the education industry help schools systems to navigate in a complex and competitive environment, also help customers in the industry by implementing education industry standards.

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THE IMPORTANCE OF CHOOSING EFFECTIVE ADVERTISING IN THE PREVENTION AND PREDICTION OF HARMFUL HABITS AND SUICIDAL PROBLEMS IN THE EDUCATIONAL ENVIRONMENT

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ABSTRACT

Harmful habits are behaviors that are considered to have a negative impact on many people's health and prevent them from getting the benefit of their opportunities to achieve their goals throughout their life. There is a plethora of data about the most well-known individuals around the world who later died as a consequence of drug addiction. It is essential that those who end their lives by giving up a healthy lifestyle and accepting harmful habits realize the physical differences among health and illness in order to stop young people from taking this path. Obviously, those who elect this path do not read understanding and knowledge articles or watch commercials on suicide issues, but others who wish to assist such victims should be aware of them. The instructional model needs considerable support for young people who are prone to destructive habits and suicidal expressions since the sufferers of bad behaviors are serious patients. It's necessary to remain far from the surroundings wherever these tools are used, and if necessary, contact a specialist. It's necessary to not enable these deadly suggestions to destroy human life before the method has concentrated and addiction has begun. These habits not solely damage a human health, however conjointly stop them from achieving their goals and victimization their opportunities.

Keywords: Harmful habits, suicide, prevention, advertising, social networks, anonymous qualified helpers, individual characteristics, psychological services, gender, religion.

Introduction

Health is a condition that ensures normal functioning of a person in physical, psychological and social life. Health is a harmonious combination of physical, psychological and mental state. Every person who wants to live a healthy lifestyle should follow many steps. These rules include proper nutrition, constant strengthening of the body, compliance with hygiene rules, proper regulation of work and rest, and avoidance of harmful habits. A healthy person can give appropriate responses to environmental reactions. Unlike other living beings, man has the ability to change the environment around him and live according to this environment.

Diseases and effects caused by bad habits disrupt the internal environment of the body and create conditions for the development of various diseases. At this time, the body's resistance decreases, and the effect of psychogenic factors on the course of the disease increases. Harmful habits, which are the exact opposite of a healthy lifestyle and are the basis of an unhealthy lifestyle, seriously damage not only the person himself, but also his family, the environment and the society in which he lives. The form and number of these habits are increasing and showing their negative effects on human society. Drinking alcohol and drugs, smoking are dangerous and widespread forms of harmful habits. These habits make a person's entire activity dependent on himself. The dangerous feature of harmful habits is that a



person becomes dependent on these tools, and a person cannot live without them. It is very difficult to get rid of these means and return to normal life. More dangerous are alcoholic beverages, drugs, toxic and psychotropic substances that have a lethal effect on the human body. A person who takes these drugs for fun does not realize that he is ultimately destroying his life.

Drug use destroys not only a person's health, but also his social and financial life. Psychotropic drugs, along with creating addiction in the body, damage individual organs, and then it is impossible to restore these organs with treatment. After a long time of use, a person becomes addicted to these tools without being dependent on himself. It should be noted that if harmful habits are cyclical, they eventually turn into diseases such as alcoholism, drug addiction, and drug addiction. The World Health Organization has compiled a list of dangerously addictive substances in the human body.

- alcohol-barbiturate-type substances - ethyl alcohol, barbiturates, sedative meprobamate, chloral hydrate, etc.;
- amphetamine-type substances - amphetamine, phenmetrazine;
- cocaine-type substances - cocaine and coca leaves;
- hallucinogenic substances - glyceride, mescaline;
- cat type substances – *Catha ectulis* Forsk;
- opiate-type substances - morphine, heroin, codeine, meperidine;
- ether type solvents - toluene, acetone, tetrachloromethane;

These substances, with the exception of ethereal solvents, are often used for therapeutic purposes and are addictive. In recent years, artificially produced drugs have become available, which have many times stronger effects than known drugs and are more unique [1].

Cigarette addiction also creates a serious addiction in the body. Nicotine and a number of toxic substances contained in cigarettes have a complex effect on the body and cause various diseases. Tobacco affects the central nervous system as a weak stimulant and antidepressant. 2-3 packs of cigarettes per day have a psychotic effect on the human body more than drugs. This effect is more dangerous at a young age, fogs the brain, and changes a person's behavior. Smoking addiction causes many diseases - lung cancer, gastric ulcer, myocardial infarction, hypertension, etc. causes diseases.

Actual statement of problem

Despite varied social advertisements concerning dangerous habits and their harmful finish, these habits have become a world unwellness of society. Degradation of temperament happens in those that area unit created sick by these habits. Drug use typically begins in adolescence. the explanations for victimization these tools area unit various:

- lack of sense of responsibility, internal discipline;
- the absence of a goal that someone has set for himself, the absence of a way of motivation;
- loss of certainty and confidence within the future;
- the teenager's lack of positive relationships together with his family, friends, schoolmates;
- basic cognitive process within the feeling of "forgetting" the issues of harmful substances.

Family and college should work along to stop these tools from getting into the lives of teenagers. it's necessary to create teenagers perceive however vital a healthy life-style is, taking into consideration their age characteristics and individual characteristics. As simple because it is to begin victimization harmful substances, it's terribly tough to cure addiction to those substances.



it's necessary to remain far from the surroundings wherever these tools area unit used, and if necessary, contact a specialist. it's necessary to not enable these deadly suggests that to destroy human life before the method has concentrated and addiction has begun. These habits not solely damage a human health, however conjointly stop them from achieving their goals and victimizationtheir opportunities [5].

Alcoholism happens once alcoholic drinks area unit taken for an extended time. Since alcohol-containing medication area unit neuro depressants, they weigh down the availability of atomic number 8 to the central systema nervosum. This, in turn, inhibits the activity of the brain, the coordination of movement and speech is disturbed. The brain ceases to perform logically, attention is distracted, and someone cannot be answerable for his actions. Alcoholism causes vas and canal diseases, particularly liver cirrhosis of the liver. Alcohol includes a venomous result on sex cells, disrupts the perform of endocrine glands. suprarenal gland pathology ends up in weakening of metabolism within the body and premature aging of the body. It has been scientifically established that the consumption of drinks with a little quantity of alcohol reduces the operating capability of someone by 5-10%. those that drink alcohol frequently on their days off have a 24-30% lower productivity. individuals engaged in mental work, World Health Organization have to be compelled to perform precise operations, seriously harm their work by drinking alcohol. It's known that the lifetime of alcoholics is 15-20 years but the lifetime of traditional individuals.

Hippocrates, the founding father of ancient drugs, noted that brain disorder, several medical specialty diseases, and schizophrenic psychosis occur thanks to the fault of oldsters World Health Organization took alcohol throughout the conception amount. The protection of human life isn't solely the task of life science, as a result of within the times their area unit several social and psychological reasons that directly have an effect on someone and that they area unit increasing. alland sundry ought to attempt to defend his health and observe preventive needs so as to take care of traditional life activities. For this, advertisements that cowl harmful habits and directly have an effect on the human brain ought to be enforced in universities.

One among the foremost serious issues facing human society is suicide. Suicide (Latin "sui cadre" to kill oneself) may be a deliberate act to finish one's own life severally and voluntarily. In fact, even considering death is tough for someone. Biologically, a healthy human brain doesn't settle for that it'll die someday. though he is aware of that everybody can die, together with himself, he doesn't deeply believe his own death. typically, there are cases of suicide over one thing that may be solved. Why do individuals kill and is it doable to stop these suicides? He sees that their area unit such a big amount of suicide cases around America, however by activity this subject and not giving it to the discussion of the society, we tend to do additional harm. Figure 1.

At present, suicide isn't a rare development in our life, it's been taking its place among the demographic events for an extended time. Contrary to the ostensibly innate instinct of saving all told living things, suicide has long occupied the thinking of the many researchers. Long before the science of suicide emerged as a life science, suicide was studied by philosophers, chroniclers, and historians [4].



Figure 1. Advertisements showing types of harmful habits and ways of getting rid of them

About one million suicides occur worldwide each year, and therefore the range of suicide tries has increased by concerning ten times in recent years. Suicides between the ages of fifteen and thirty-five area unit the second leading reason behind death once road accidents. Statistics show that the bulk of individuals World Health Organization die as a result of suicide failed to look for psychiatrically and psychological services for facilitate throughout their time period. Suicide, contrary to the saving instinct of all living things, has been studied by several researchers for an extended time. Long before suicidology emerged as a life science, suicide was studied by philosophers, chroniclers, and historians. From past to the current, philosophy has given nice importance to the matter of the acutely aware finish of life.

The subject "Suicide may be a social drawback of society" has relevancy, as a result of suicide is one among the eternal issues of humanity, it'll exist as a development throughout the time that man is on earth. the matter of suicide, in line with researchers, may be a utterly social science development. Suicide may be a advanced drawback, and therefore the study of this drawback began within the field of philosophy. Albert Camus believed that "there may be a extremely serious philosophical drawback, the matter of suicide. Deciding whether or not life is price living or not is respondent the basic question of philosophy. Everything else is secondary."

Suicides have taken their place among the events of the demographic chain for an extended time, however the matter of finding the optimum varieties of human behavior, the matter of suicide, is already within the minds of individuals. in line with social science studies, factors like climate, season, place of residence, age, gender, religion, economic normal of living, and political state of affairs have an effect on the entire range of suicide cases.

Since September ten, 2003, the globe Suicide bar Day has been celebrated so as to push suicide bar activities everywhere the globe. these days is widely known below the initiative of the International Association for the bar of Suicides, the support of the globe Health Organization and therefore the auspices of the international organization. in line with statistics provided by the globe Health Organization, within the third millennium, additional deaths were caused by suicide than by all wars and targeted killings. Taking into consideration the Covid nineteen pandemic,



studies area unit being conducted at the globe level to assume seriously concerning suicides and take necessary measures.

There are suicides all the time. There are a unit centers for obtaining out of important things in several countries of the globe. Suicides area unit most typical among adolescents and teenagers, thus it's acceptable to possess a district coping with these problems in youth organizations in faculties and universities.

Humanity doesn't gain something by activity the difficulties of life, in fact, the present issues ought to be investigated with full openness, then the responses ought to be shown. within the family, oldsters will share their kids' issues by establishing a friendly and trusting relationship with their children. Often, there's such advanced and tough surroundings within the family and society that someone doesn't have the physical and non-secular strength to face and fight. this can be the case all told countries of the globe, if their area unit individuals and life, there's conjointly competition and struggle. These problems ought to be seriously analyzed in social networks, the socio-psychological and social science basis of harmful habits and self-destructive events ought to be mentioned. Studies on the self-destructive behavior of adolescents in developed countries became a significant drawback. within the us and lots of European countries, adolescent suicide is one among the highest 5 causes of death among adolescents. in line with the results of studies, it's appalling that the present range of deaths among adolescents is second solely to suicide. As a rule, suicide tries begin at the age of thirteen. Suicides before the age of 12-13 area unit rare. From the age of 14-15, self-destructive activity will increase sharply and reaches a most at the age of 16-20. Suicidal behavior in adolescents is principally a transition amount drawback, that is caused by neuro-hormonal processes and body reaction states. Therefore, several suicides and suicide try area unit studied as "adolescence and youth crises". At this age, teenagers don't have the expertise to unravel the issues they face, they can't kindle facilitate from their families and relatives.

There is a unit terribly serious reason for this. Families themselves don't acumen to be friends with their kids, they are doing not have enough info for this. Education conjointly plays an enormous role here. If oldsters' area unit educated, they acumen to treat their kids on an individual basis. generally, we tend to bump into such cases that the precise suicide is beyond any doubt caused by the parent's treatment of the kid. in line with analysis, seventy fifth of individuals World Health Organization conceive to kill specific their self-destructive intentions in a way or another. Rarely, self-destructive intellection happens suddenly. nearly most of those individuals need to consult psychologists and doctors. generally, their opinions area unit unheeded, if they hear such individuals and share their pain, they most likely will not kill. Because, throughout a sincere language, the signs of planned suicide seem or the symptoms of depression seem. Such individuals board despair on the one hand, and hope for salvation on the opposite hand. it's doable to assist somebody World Health Organization needs to kill with straightforward words of support. If this can be not done, suicide won't be prevented. Therefore, it's important to grasp the signs of planned suicide. The fate of someone is said to the variability of events arising from the course of life. Every day, each second, we tend to create a selection in one direction or another, so leading the ways of our lives in one direction or another. It ought to be noted that their area unit parts of determinism in our life. we tend to cannot confirm ahead wherever, during which family and country we tend to area unit born, during which social level, during which health we tend to area unit born. Assessment of the role of biological factors in human life is additionally important. there's conjointly info concerning the role of heredity within the tendency to kill [3].



Suicidal behavior in kids and adolescents is one among the varieties of behavior and differs from the self-destructive behavior of adults by sure parts.

Description of suicide prevention among teenagers

A "call for help" is determined in ninetyth of suicide cases in adolescence, solely 100% of adolescents need to commit real suicide.

The most typical causes of unsafe behavior in teenagers:

- feeling of not being understood, resentment, loneliness, feeling of alienation;
- feeling jealous of parental love, love towards different youngsters within the family;
- death of idolized ones, divorce, dangerous behavior of oldsters at home;
- guilt, shame, regret, pride hurt, ridicule, humiliation;
- worry of penalization, feeling of not apologizing;
- love failures, secretion sexual changes throughout puberty;
- feeling of revenge, anger, protest, threat, warning;
- the will to draw in attention, arouse sympathy, avoid unpleasant consequences and tough situations;
- sympathy or imitation of friends, book or moving picture heroes [1].

Suicidal behavior has modified thanks to the informatization of contemporary society. With the event of the net, the rise within the variety of individuals preferring virtual communication ends up in the disruption of human relationships in real world and therefore the emergence of depression. In times of crisis, a juvenile cannot satisfy the will to seek out associate interlocutor and discuss their issues, and that they will become victims of internet sites that promote suicide. It ought to be noted that "Suicide clubs" have existed since ancient times: in Ancient Egypt throughout the time of queen, in Federal Republic of Germany in 1819, in national capital in 1824, within the us at the start of the twentieth century, etc. however communities of virtual suicide supporters disagree from their ancient predecessors in their sizable amount and insufficiency. Geolocation and free access for individuals of any age on these sites is additionally a technique of attraction. the matter of virtual suicide exists everywhere the planet, beside the event of the net, the culture of virtual suicide has "emerged and formed". once learning the activities of those sites, it's determined that almost all of the guest's area unit children. Formally, these teams' area unit closed, however to induce info, you only ought to subscribe or write the cluster. the amount from the start of unsafe thoughts to the decide to carry them out is termed the presuicidal period; the individual is during a state of depressive have an effect on, his thoughts regarding suicide become stronger, his discontent with living conditions will increase.

This is often shown by the materials announce by the participants of virtual suicide clubs on their personal pages in social networks, they write that they're depressed and suffer from loneliness. Such a mood may be a fertile ground for a suicide proposal and offers a significant impetus to the event of a depressive mood, that is characteristic of the pre-suicide amount. Figure 2.



Figure 2. Advertisements promoting suicide prevention

Relatives or families of a depressed juvenile will browse this info on his personal page on the social network. In nowadays, voluntary organizations produce social networks and forestall suicide the maximum amount as attainable within the pre-suicide stage. The worst factor is that if the attractiveness is addressed to members of virtual suicide clubs, then the person doesn't suppose it: his alternative is confirmed and they begin to supply a fast and reliable technique of suicide. info regarding suicide ways and locations is straightforward to seek out on the net. All this makes it clear to the young man that society doesn't veto suicide, that he's superfluous. The content of virtual suicide clubs aims to draw in as several members as attainable. The danger of an individual's open access to such info is highlighted by the advice of the planet Health Organization. those who state the advantages of suicide within the virtual world increase the boundaries of non-public and public life and therefore the vulnerability of someone. Cyber mobbing, that facilitates the method of manipulation with the assistance of contemporary means that of communication, is strictly applied.

Cybermobbing is dole out within the info house through info and communication channels and means that. as well as through e-mail, instant electronic communication programs on social networks (Instant Messenger), in addition as on video portals (YouTube, Vimeo, etc.) or through a portable. The perpetrators of those acts of bullying typically act anonymously so the victim doesn't apprehend UN agency the acts of violence area unit returning from.

Cybermobbing or cyberbullying (Cyberbullying) characterizes actions or behaviors dole out by teams or people against a victim UN agency cannot defend himself. Defamation, insults, blackmail, and therefore the posting of obscene videos on the net haven't any geographical limits and may continue for a protracted time. it's unfeasible to forestall the dissemination of data during this content. At this point, crime is committed against someone, these days schoolchildren aged 11-16 area unit victims of crime, however adults may be victims of cyberbullying.

Cybercide is suicide iatrogenic by technology, like the synchronal suicide of many individuals when meeting on the net. victimization the net will result in suicide and, as a result, the amount of bierkellers. those who do not know one another get along and meet on the net and so get along



during a sure place and kill along. Additionally, to committing suicide on the net, there also are cases wherever users connected to the net kill through a digital camera in real time. In response to the mentioned and different similar cases, the question of the influence of the net on suicide has begun to be actively mentioned. On a sensible level, research project on bierkellers remains in its infancy, and empirical proof that the net contributes to suicide rates is presently tokenish. One in all the primary cyber suicides began in 1997 in Israel, once 19-year-old soldier Eran Ateret expressed his need to kill on-line associated asked for elaborated directions on the way to bed with an M16 rifle. When receiving this instruction, he died. When this sensational event, SAHAR, a non-profit association was fashioned in Israel, whose goal is to forestall suicide by making associate anonymous, confidential on-line setting. Anonymous qualified helpers during this on-line setting provide support to individuals in crisis. In 2005, following a rise in cyber suicides, the police created a special unit of six cops to assist those who confessed on-line to kill. An infatuated section contacts forum moderators UN agency area unit asked to follow informed reports of unsafe users. Regarding two hundred cases area unit detected per annum, that prevents dozens of suicides. World expertise shows that the foremost effective thanks to stop net-related suicides isn't to carry Internet suppliers and social network directors responsible, however to collaborate with them. This is often confirmed by the thriving implementation of the program developed in Israel in 2005. Volunteer teams of the SAHAR Foundation (SAHAR) try and hash out to assist those who state their issues on-line.

Within the 1st year of the program, quite 100 suicides have already been prevented. This effective technique has been studied and is presently utilized in Federal Republic of Germany, Scandinavian country and France.

The fight against cyber-suicides ought to begin from rising the standard of lifetime of the population, as a result of "cyber-suicide is simply one in all the symptoms of society's issues and it reflects its condition sort of a measuring system." Communication on the net will result in suicide, however the explanations for the increasing dynamics of the number of suicides among children ought to be wanted not within the virtual house, however within the globe.

Aid of this method, one is able to do their objectives. You ought to attempt to be a robust individual for this. Moreover, strength may be a quality that has to be attained, similar to the other. Suicide isn't associate option; instead, one ought to maximize use of their potential.

Conclusion

The Internet can serve two functions as a source of poorly managed information, including information that really is harmful and illegal. There are forums and groups on the Internet where young people become more and more popular in their suicides, and virtual reality enables supporters of youth culture who idealize death to come altogether. The ever-present lethal infection of suicide is disseminated by technological advances, as stated by psychologist Alexander Thostov [2, p. 64]. Cyberbullying and cybercide are activities that are spread through the Internet. It's critical to understand that using the Internet, a person's associated with depressive symptoms can be easily established and strengthened. Because the person who feels more alone in the virtual world than they do in fact. Because he will carry on playing the virtual game after committed suicide and become a hero online, for him, even death is merely some other episode in the game! Modern media, however, can have a positive impact on society and the individual, including decreasing suicidal ideation and preventing suicide (virtual psychological support services). The success of other societies in combat cyber suicides indicates that providing online



support to those contemplating suicide is more effective than using repressive methods to remove dangerous sites.

Since man is just so powerful, he can overcome anything. But confidence in one's own capabilities is essential. This can be done in a variety of ways utilizing psychology and psychoanalysis. Inoculation's healing benefits on patients (including healthy ones) were established by French psychiatrist Emile Kuye as early as 1921. Very few people are aware of the power of instillation in contemporary psychology. With the aid of this technique, one can achieve their objectives. You should strive to be a strong individual for this. Moreover, strength is a quality that must be earned, just like any other. Suicide is not an option; instead, one should maximize use of their potential.

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ISSUES OF TECHNOLOGICAL OPTIMIZATION OF CENTRALIZED COMBUSTION OF ASSOCIATED HYDROCARBON GAS FROM SOURCES WITH DIFFERENT CONCENTRATIONS OF METHANE

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ABSTRACT

A method for technological optimization of centralized combustion of associated hydrocarbon gas from sources with different methane concentrations is proposed. A technological scheme for the centralized combustion of hydrocarbon gas from sources with different concentrations of CH₄ has been drawn up. An optimization problem was formulated and solved, the solution of which, under a certain restrictive condition, made it possible to obtain the optimal relationship between the concentration of CH₄ in associated gas and wind speed. As a result of the optimization carried out, the optimal procedure for the functioning of the developed technological scheme for the centralized combustion of the associated gas was recommended. To determine the conditions for achieving the maximum functional efficiency of the proposed technological scheme, an optimization problem was compiled and solved, the solution of which, under a certain restrictive condition, made it possible to obtain the optimal relationship between the concentration of CH₄ in associated gas and wind speed. As a result of the optimization carried out, the optimal procedure for the functioning of the proposed technological scheme for the centralized combustion of associated gas from various sources was developed.

Keywords: Harmful habits, suicide, prevention, advertising, social networks, anonymous, qualified helpers, individual characteristics, psychological services, gender, religion.

Introduction

As noted in [1], due to the lack of detailed information on the combusted hydrocarbon gas volumes in the areas of production, storage and hydrocarbon processing, satellite tools are the most informative regarding the implementation of control over the global scale of gas flaring. According to the estimates of various international and governmental agencies, the Russian Federation is one of the main countries in terms of the amount of associated hydrocarbon gas flared. The total volume of flared gas in the Russian Federation according to [1] is 23 billion cubic meters, of which 19 billion cubic meters belong to the oil and gas industry, which is about 15% of the entire global scale of gas flaring on the planet.

Historically, the first work on satellite monitoring of gas flares was carried out on the basis of data obtained using the DMSP [2,3] and TIROS-N [4] programs. In the Russian Federation, similar studies were carried out on the basis of data obtained from spectroradiometers in MODIS [5].

According to NOAA (USA), in 2015, 13,605 gas flares located in 88 countries were detected by satellites [6]. According to the estimates given in [6], about 140 billion cubic meters of gas are burned per year, and as a result, 300 million tons of CO₂ are emitted into the atmosphere, as well as a large amount of aerosols and various small harmful gases, which generally stimulate the process of climate warming on the planet. In [7], a method for estimating the volume of



combusted hydrocarbon gas in flares was described, based on data obtained from the VIIRS spectroradiometer installed on the Suomi-NPP satellite [8, 9]. Let us briefly outline the theoretical foundations of this technique, which is based on the regression relationship between the flare power determined by satellite means and the volume of flared gas. This regression relationship looks like:

$$V=0.0247 \cdot W, \quad (1)$$

where: - volume of flared gas, in cubic meters; W is the power of the gas flare in megawatts.

According to Stefan Boltzmann's law

$$W=\sigma T^4 S, \quad (2)$$

where: - temperature in K; S is the surface area of the source; Stefan-Boltzmann σ -constant.

As was shown in [10], there is a non-linear relationship between the W and S indicators in the form

$$W=\sigma T^4 S^{0.7}. \quad (3)$$

It is well known that the completeness of combustion of hydrocarbon gas in flares is of particular importance, because, during incomplete combustion, a significant amount of such gases as CH_4 , NO_x , SO_4 , etc. is emitted into the atmosphere [11,12].

Issues of the negative impact of incomplete combustion of associated gas in flares were considered in [13-16]. According to [16], the efficiency of hydrocarbon gas combustion in flares can reach 98% or more. According to [17, 18], combustion efficiency depends on the stability of combustion conditions, which in turn depends on the energy content of the combusted gas and wind speed.

As indicated in [19], a technique and a corresponding special software tool were developed for calculating the efficiency of gas combustion, which was based on the results obtained in [17]. In this work, CO and NOx emission factors were calculated based on the UNIPCC [20] and USEPA [21] recommendations.

Summary of the current methodology for calculating the efficiency of hydrocarbon gas combustion.

Let us briefly outline the technique developed in [17].

According to [19], in order to accurately calculate the efficiency of hydrocarbon gas combustion, the moisture content in this gas should be taken into account. In this case, the concentration of water vapor formed during gas combustion is calculated by the Raolts formula

$$W = \frac{P_w}{P_0} \cdot \frac{H(\%)}{100}, \quad (1)$$

where P_w - is the water vapor pressure (kPa);

P_0 – barometric pressure (kPa);

H is humidity, in%.

Water vapor pressure according to [18] is defined as

$$P_w(kPa) = \exp \left[16.262 - \frac{-3799.89}{T(^{\circ}C) + 226.36} \right], \quad (2)$$

where $T(^{\circ}C)$ – is the temperature in Celsius.



After determining the concentration of water vapor, the moisture concentrations are calculated in such gas components as CH₄, CO₂, etc. Next, the molar mass of the gas mixture and the lower value of the heating index (LHV) are calculated. According to [19], methane

$$LHV_{CH_4} = 50.009 \frac{MJ}{kg} \cdot \quad (3)$$

where CH₄ is the concentration of CH₄; m are the molar masses of CH₄ and gas.

According to [17], taking into account (1)-(4), the overall efficiency of hydrocarbon gas combustion can be calculated by the formula

$$X = \frac{V_b \left(\frac{M}{ceK} \right)}{V_{gas} \left(\frac{M}{ceK} \right) \cdot g \left(\frac{M}{ceK} \right) \cdot D(M)^{\frac{1}{3}}} \cdot \quad (4)$$

where V_b is the wind speed; V_{gas} is the gas supply rate; D is the pipe diameter.

It was shown in [17] that on the basis of expression (5) it is possible to obtain the following expression for estimating the efficiency of hydrocarbon gas combustion.

$$E = 1 - \left(0.00166 \left[\exp(0.387 \cdot X_1) \right] \cdot \frac{LHV_{CH_4} \left(\frac{MJ}{kg} \right)}{LHV_{намаг} \left(\frac{MJ}{kg} \right)} \right) \cdot \quad (5)$$

Taking into account expressions (5) and (6), we have developed a special technique for optimizing gas combustion conditions to achieve the highest combustion efficiency.

Suggested method

Taking into account formulas (5) and (6), we obtain

$$E = 1 - \left(0.00166 \left[\exp \left[0.387 \cdot \frac{V_b \left(\frac{M}{C} \right)}{V_{gas} \left(\frac{M}{C} \right) \cdot g \left(\frac{M}{C^2} \right) \cdot D(M)^{\frac{1}{3}}} \right] \right] \cdot \frac{LHV_{CH_4} \left(\frac{MJ}{kg} \right)}{LHV_{gas} \left(\frac{MJ}{kg} \right)} \right) \quad (6)$$

Taking the indicators in (4):

$$m(CH_4); LHV_{CH_4}; m_{gas} \quad (7)$$

as well as indicators in [17]:

V_{gas}, g, D, LHVCH₄ as constant values, expression (7), taking into account (4), we rewrite as

$$E = 1 - \frac{a_1}{C_{CH_4}} \left[\exp(a_2 V_b) \right], \quad (8)$$

where

$$a_1 = \frac{0.00166 \cdot LHV_{CH_4} \cdot m_{gas}}{m(CH_4) \cdot LHV_{CH_4}}, \quad (9)$$

$$a_2 = \frac{0.387}{V_{gas} \cdot g \cdot D^{\frac{1}{3}}} \cdot \quad (10)$$

According to the proposed method, the associated gas flaring facility under consideration serves several sources of such gas with different methane content. The technological scheme of the proposed method for organizing the centralized combustion of associated gas is shown in fig. 1.

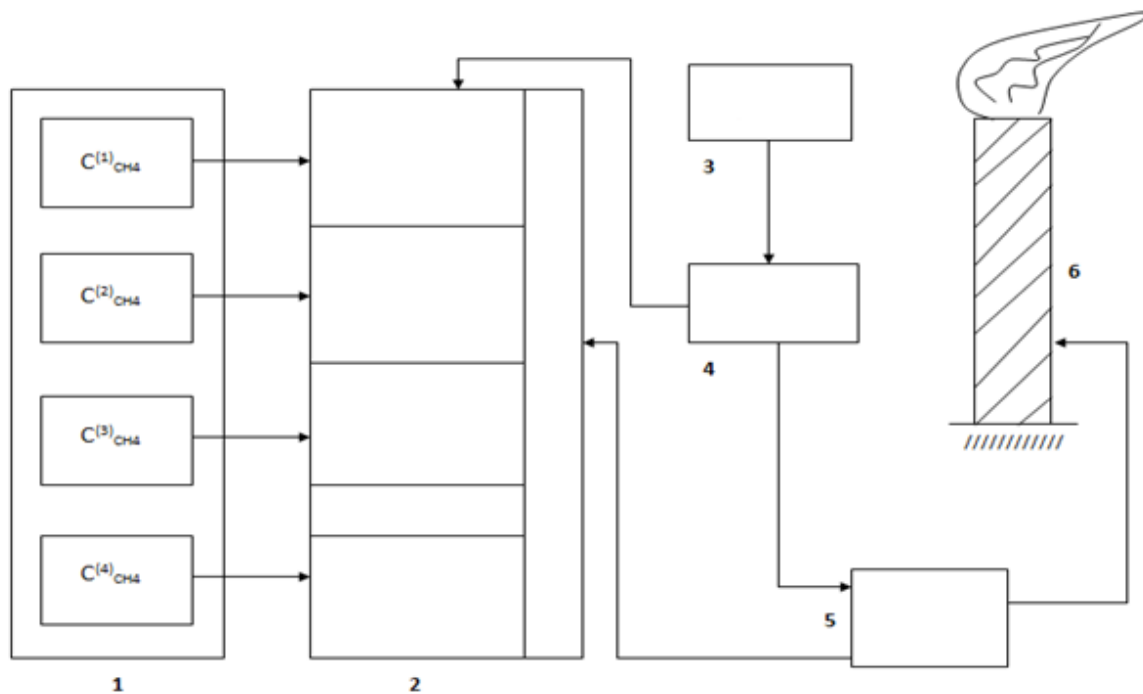


Figure 1. The proposed technological scheme for burning associated gas from different sources, taking into account the magnitude of the wind speed.

The numbers indicate: 1 - many sources of associated gas; 2 – associated gas accumulators with controlled output; 3 – wind speed meter; 4 - control system; 5 - block for supplying gas to the pipe; 6 – gas flaring pipe.

The general principle of the proposed methodology and the corresponding technological scheme of associated gas flaring is based on expression (8), according to which, in order to maintain an average high value of E, with an increase in Vb, compensatory control of the CCH4 value should be carried out by supplying a mixture from one or another source of associated gas to the pipe. Therefore, it is important to find the optimal procedure for selecting associated gas sources, which achieve the maximum efficiency of gas combustion.

Sharing laser power and solar panels on drones Optimization of the proposed technological scheme for flaring associated gas from various sources.

Let us assume that for centralized combustion of associated gas produced in equal volumes at different sources, all sources are divided into n number of groups. CH4 concentrations in associated gases included in these groups make up an ordered set



$$C_{CH_4} = \{C_{CH_4}^{(i)}\}, \quad i = \overline{1, n}. \quad (11)$$

where

$$C_{CH_4}^{(i)} = C_{CH_4}^{(i-1)} + \Delta C_{CH_4}; \quad \Delta C_{CH_4} = const; \quad C_{CH_4}^{(0)} = 0. \quad (12)$$

In this case, conditionally accepting, we compose the following optimization functional

$$F = \int_{C_{CH_4}^{(min)}}^{C_{CH_4}^{(max)}} \left[1 - \frac{a_1}{C_{CH_4}} \left[\exp(a_2 V_b(C_{CH_4})) \right] \right] dC_{CH_4} \quad (13)$$

where $V_b(C_{CH_4})$ is the input communication (control) function, the optimal form of which should provide maximum F .

In the general case, problem (13) does not have a general solution, and to calculate the solution, taking into account the narrowing of the class of possible solutions, we assume that the sought-for optimal function must satisfy the condition

$$\int_{C_{CH_4}^{(min)}}^{C_{CH_4}^{(max)}} V_b(C_{CH_4}) dC_{CH_4} = C; \quad C = const. \quad (14)$$

Taking into account expressions (13) and (14), we form the target functional of unconditional variational optimization

$$F_0 = \int_{C_{CH_4}^{(min)}}^{C_{CH_4}^{(max)}} \left[1 - \frac{a_1}{C_{CH_4}} \left[\exp(a_2 V_b(C_{CH_4})) \right] \right] dC_{CH_4} + \lambda \left[\int_{C_{CH_4}^{(min)}}^{C_{CH_4}^{(max)}} V_b(C_{CH_4}) dC_{CH_4} - C \right] \quad (15)$$

where λ is the Lagrange multiplier.

The solution to the optimization problem (15) according to [12] must satisfy the condition

$$\frac{d \left\{ \left[1 - \frac{a_1}{C_{CH_4}} \cdot \exp(a_2 V_b(C_{CH_4})) \right] + \lambda [V_b(C_{CH_4}) - C] \right\}}{d[V_b(C_{CH_4})]} = 0. \quad (16)$$

To simplify the mathematical calculations, we take

$$C_{CH_4}^{(min)} = 0. \quad (17)$$

Taking into account (16) and (17), the solution of the problem is obtained in the form

$$V_b(C_{CH_4}) = \frac{1}{a_2} \ln \frac{\lambda \cdot C_{CH_4}}{a_1 \cdot a_2}, \quad (18)$$



where λ - can be determined by substituting (18) into the integral (14) and calculating taking into account the given value C .

Thus, solution (18) provides the extremum of the objective functional (15). To determine the type of extremum, it suffices to take the second derivative of the integrand in (15) with respect to the desired function and make sure that it has a negative sign, i.e. extremum is the maximum. Therefore, in the optimal case, in the proposed centralized combustion process scheme, a logarithmic relationship between V_b and C_{CH_4} should be provided by measuring V_b and supplying gas from the corresponding source to the pipe.

Conclusions

Thus, based on the results of well-known studies of the dependence of the efficiency of burning associated hydrocarbon gas in flares on wind speed, methane concentration in associated gas, and other indicators. A technological scheme is proposed for centralized combustion of associated gas from various sources, where the concentration of CH_4 in them is different. To determine the conditions for achieving the maximum functional efficiency of the proposed technological scheme, an optimization problem was compiled and solved, the solution of which, under a certain restrictive condition, made it possible to obtain the optimal relationship between the concentration of CH_4 in associated gas and wind speed. As a result of the optimization carried out, the optimal procedure for the functioning of the proposed technological scheme for the centralized combustion of associated gas from various sources was developed.

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SURFACE TEMPERATURE REDUCTION METHODS BRAKE PAIR FRICTION

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ABSTRACT

One of the promising industries is oil engineering, the main task of which is the creation of drilling equipment of increased reliability and durability. A band- block brake (LKT) is one of the main units of hoisting and transport machines and equipment widely used in the oil, gas, mining industry, construction and transport. LCT, which has a number of advantages, differs sharply from other types of brakes. We have rich oil and gas deposits in the republic, which are located in deep and hard-to-reach places. During braking, all factors and parameter values, depending on their interconnected action on each other, change to a large extent, which further complicates the friction process. It is also known that, depending on the materials used, the design of the brake and the operating conditions, there is a sharp change in the friction parameters, especially in braking devices operating under heavy loads. Considering the complexity of the nature of the braking process, the deep analysis shows that, along with the interrelated action of various factors, depending on the design, materials of friction pairs and operating conditions of a given brake, the main dominant factor may be the temperature factor that occurs on the friction surface during the braking process.

Keywords: Thermal spots, nozzles, friction, retenax material, temperature, brake pairs, cooling, loading, band-block brake, brake pulley friction surface.

Introduction

The conducted experimental studies show that without forced cooling, high temperatures arise on the friction surface of brake pairs, which causes a sharp decrease in the quality of the friction surface and, in general, negatively affects the efficiency and reliability of the braking process. To reduce the temperature of the friction surface during braking and create a favorable working condition for the brake, researchers have proposed various methods and designs for forced cooling of the friction surface of brake pairs. In view of the imperfection and inefficiency of the proposed methods and structures for the full cooling of the friction surface of brake pairs, they have almost not found their application in a band- block brake to date. Therefore, it became necessary to develop a new method and design of a system for forced cooling of the friction surface of the brake pairs of a band-shoe brake, which, when used, would enable efficient cooling during braking. For this purpose, a new design of the forced cooling of the friction surface of the brake pairs of the band- block brake during braking was protected by a patent [1, 2, 4]. A technique has also been developed for testing a new design on a following test was carried out with the measurement of the temperature of the friction surface through the experimental

installation of a band- block brake. The proposed design of the cooling system for a band-shoe brake has an air-cooling device and is designed for uniform cooling around the entire perimeter of the friction surface of the brake pulley after each shoe during the braking process. To do this, compressed air is supplied to the slots formed between the pulley, the brake band and the pads from 2 sides along the width of the brake pulley, in a checkerboard pattern so that after cooling it is possible for air to escape in front of the nozzles. The proposed design is shown in (Fig. 1). It contains a brake pulley 1, a brake band 2, brake pads 3, mounted on carriages 4, an air-cooling device with a main pipeline 5, fixed clamps 6 on the brake housing from the side of the tape, with distributing nozzles 7 placed on them on both sides. The design of the cooling system of the band-shoe brake works as follows. Compressed air is supplied to the main pipeline, from here to the friction surface of the pulley, through dispensing nozzles placed along the width of the tape on both sides between the shoes in the slot on the pipeline.

Bodies of the brake pairs in the following order: on both sides of the brake pulley and in the middle part of the block without and with the use of cooling from one and 2- x sides.

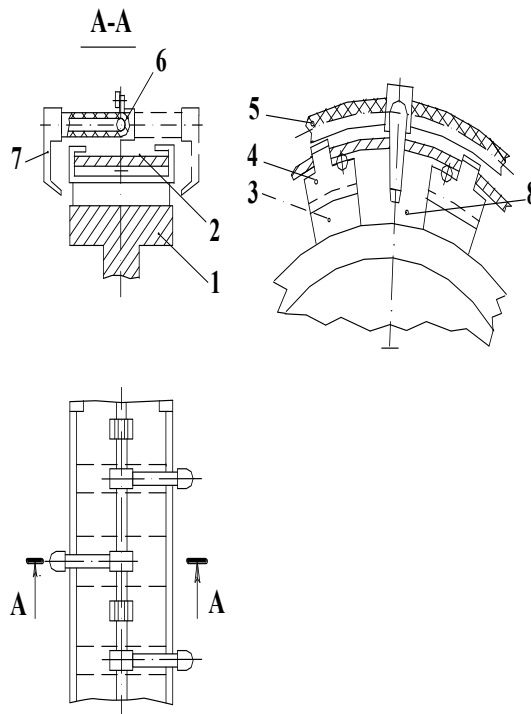


Figure 1: The device for cooling the friction surface is tape- block brake

When this compressed air is sent to the slot 8, with the possibility of exit after cooling in both ends of the tape 2 hot air. Slots for compressed air inlet and hot air outlet were formed between the pads around the brake pulley (1), created on both sides of the carriage (4) with pads (3), the surface of the pulley and the belt. In front of all nozzles, one side of the slots was left open [4, 10].

Tools to reduce friction surface temperature at local levels.

To install thermal sensors that determine the temperature of the friction surface of the band-shoe brake, on the brake pulley at the ends on both sides, at a distance of 0.5 mm from the friction surface, pre-drill to determine the effectiveness of the proposed cooling system on the installation of a band.

The measurement of the temperature of the friction surface during braking is carried out using temperature sensors that were prepared in advance. Then, using the calibration graph (Fig. 2), the value of the temperature of the friction surface of the rim of the brake pulley is determined along the width. For this, a certain cycle of operation was first chosen and its mode was worked out, which consists of the time spent on the braking process and the time between braking processes.

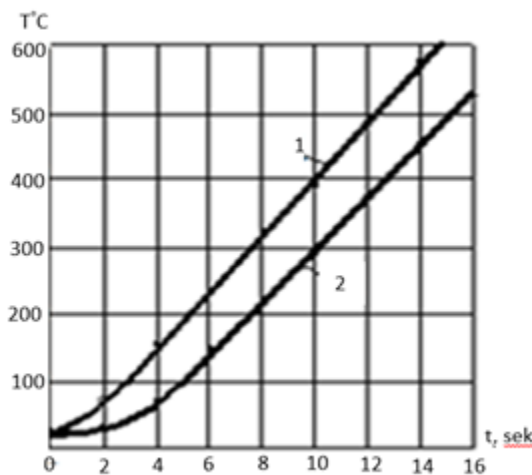


Figure 2. Calibration schedule brake pulley temperature depending on process time braking (1-on friction surface; 2-in depth)

The worked cycle of work was achieved by repeated repetition of braking and its values for all cases were taken to be the same. Measurement of the temperature of the friction surface is carried out according to the developed method, in the following three directions. 1. Measuring the friction surface temperature of the brake pulley without forced cooling. 2. Measurement of the temperature of the friction surface of the pulley with forced cooling on one side. 3. Measurement of the temperature of the friction surface of the pulley with forced cooling on both sides. During the experiment, the ambient temperature was 8-10° C. At the beginning, the friction surface temperature of the brake pulley in the selected mode was measured without cooling. Then, without changing the mode of operation of the brake, the temperature of the friction surface of the brake pulley was measured from both sides with cooling after each pad from one and both sides.

To do this, compressed air is supplied to the pipeline, from there compressed air is directed to the dispensing nozzles placed on the pipeline and through them in a checkerboard pattern along the width of the tape, from one and both sides between the pads in the slot on the surface of the brake pulley after each pad. The slots are formed between the pulley, the belt and the blocks fixed on the carriages, and one side of the slot in front of each nozzles with the possibility of hot air outlet was left open [8, 12].

The results of the experiment, cooling the friction surface of brake pairs, are shown in (Fig. 3.). The nature of the temperature change during the braking process, depending on the time of increase, and cooling relative to the previous positions is shown by thin lines in (Fig. 3.).

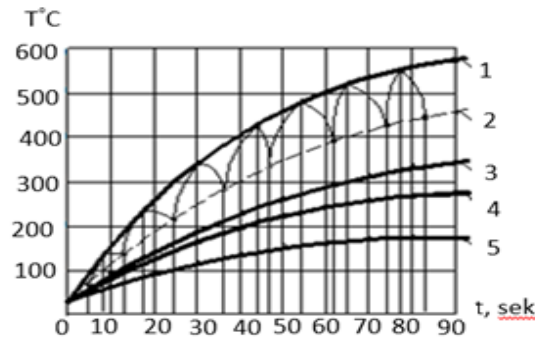


Figure 3. Graph of the dependence of the temperature of the friction surface of the pulley on time: 1 - during braking, without cooling of the friction surface; 2 - during cooling, without cooling the friction surface; 3 - at the outlet, with one side of the friction surface cooling; 4 - at the inlet, with one side of the friction surface cooling; 5 - with bilateral cooling of the friction surface

From these graphs it can be seen that with one-sided cooling of the friction surface of the brake pulley, the width at the inlet and outlet of the compressed air has a different temperature, and compared to without cooling, it turns out to be significantly lower. This is explained by the fact that with one-sided cooling of the friction surface of the brake pulley, compressed air removes heat from one side of the friction surface at the inlet, increases its value and displaces it in a warm form to the outlet in the other direction. With double-sided cooling, the friction surface of the brake pulley heats up much less than in previous cases and does not have a temperature gradient across the width, since the friction surface of the brake pulley is uniformly cooled around the entire perimeter after each pad in a checkerboard pattern. It should be noted that with this method of cooling, the friction surfaces of the brake pairs are simultaneously also cleaned of wear product [10].

The table shows that as the speed of the brake shaft and the load of the pulley increase, the temperature of the friction surface increases and reaches 630°C. Subsequently, with an increase in temperature, when it reaches the limit of 800-900°C, there is a significant change in the quality of the friction surface and, subsequently, the braking efficiency decreases sharply [10, 11].

Table 1. The results of measurements of the temperature of the friction surface through brake pulley body.

Flywheel load N,H	Brake shaft speed min, ⁻¹				
	20	40	63	80	100
Brake pulley friction surface temperature, T ⁰ C					
20	52	110	170	190	210
30	70	130	210	270	370



40	85	165	270	350	450
50	95	190	350	480	530
60	105	315	380	520	630

Table 2. The results of measurements of the temperature of the friction surface through brake pad bodies.

Flywheel load N,H	Brake shaft speed min. ⁻¹				
	20	40	63	80	100
	Friction surface temperature of brake pads, T ⁰ C				
200	40	100	155	175	195
300	60	122	195	245	335
400	75	155	255	325	415
500	88	175	330	455	495
600	95	200	360	490	600

At the same time, it was found that the number of microcracks on the friction surface of the brake pulley increases, and the first signs of thermal spots appear. And on the surface of the block, cracks also increase and there are places where particles of retenax material are pulled out. On the friction surface of the brake pulley along the entire perimeter, especially in the middle part, the cracks were *1000-3000 μm in length and *20 μm in width (Fig. 3.4). On the surface of the pads, the sizes of cracks were large compared to the brake pulley and amounted to *3000-5000 microns in length and *2000-3000 microns in width. At high loads that occur in heavily loaded friction units, such as a draw works band-shoe brake, from the braking process, the temperature on the friction surface rises sharply, which leads to strong heating of the elements of the friction pair. And this affects the change in frictional properties, the quality of the friction surface: the geometric and physical-mechanical properties of the surface layer, and also creates the necessary conditions for the formation of micro and macrocracks, thermal spots on the working friction surface of the brake pulley. The presence of thermal spots on the friction surface of the brake pulley, due to their deepening, further increases the discreteness of the process of contacting the surfaces of brake pairs, which leads to a direct change in the actual contact area and the pressure of the pads on the brake pulley rim. As can be seen, at high speeds of the brake shaft and the presence of a large load, a high temperature can occur on the friction surface of the band-shoe brake, which, of course, has a significant impact on the parameters characterizing the quality of the friction surface: geometric and physical-mechanical properties of the surface layer. This creates conditions for changing the hardness of the surface layer of the brake pulley, which causes the formation of thermal spots and adversely affects the magnitude and stability of the coefficient of friction [8].



Figure 4. Brake pulley friction surface with microcracks and partial thermal spots.

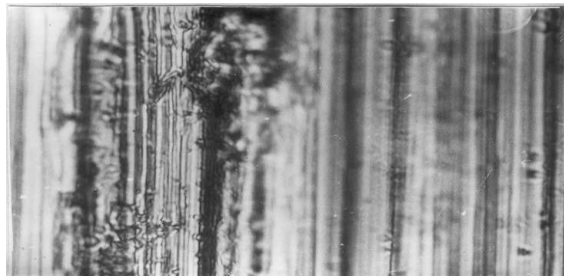


Figure 5. Brake pulley friction surface with adhering particles from the pad material Retenaks FK-24A.

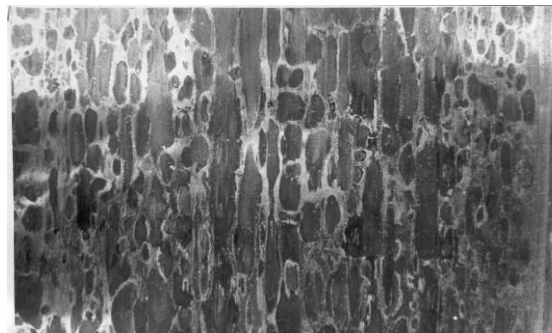


Figure 6. The surface of the brake pulley of the band-shoe brake of the draw works, worked out in severe conditions.

Conclusions

1. The review of the work shows that with the advent of the band-shoe brake in various industries, for a long time the main problem was to ensure the rational distribution of pad pressure on the pulley rim, to find ways to improve the efficiency and reliability of the braking process. One of the disadvantages of this design is the instability of existing and emerging parameters and changes in their values.
2. Direct fastening of the pads to the brake band leads to an uneven distribution of pad pressure on the pulley rim and creates additional problematic tasks. These important problems are solved with the use of forced cooling of the friction surface on the new design of the band-shoe brake, where the pressure of the shoes on the pulley rim is evenly distributed.



3. Comprehensive experimental studies carried out with different modes on a new constructions, under the action of interrelated basic parameters, show that this the design provides not only uniform distribution of temperature, pad pressure on the pulley rim, uniform wear of all pads; efficient and rational cooling friction surfaces, but also stripping

4. Guided by the results of the conducted research and the position of the theory of "dry" friction, theoretical foundations have been established on the mechanism of formation of thermal spots and cracks on friction surfaces of the brake pulley and pads. Consistently and in detail formation of thermal spots, the process of adhesion and setting of friction surfaces brake pairs. Their physical structure is explained.

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CALCULATING THE UNCERTAINTY OF MULTI-FUNCTIONAL EQUIPMENT AND PREPARATION OF THE UNCERTAINTY BUDGET

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ABSTRACT

Measuring uncertainty is not easy to calculate. Due to the large number of factors and parameters affecting the process during uncertainty assessment of complex objects, it is necessary to perform a correct assessment. In automated processes and automatically controlled systems, the factors affecting the measurement result are different. Engineers have trouble estimating uncertainty. Therefore, it is necessary to disclose an exclusive six-step process to calculate the measurement uncertainty and put together these instructions. Learn how to calculate measurement uncertainty in six easy-to-use steps. Also, what information is needed to calculate the uncertainty, how to obtain the uncertainty capability, and how to use calculations to obtain an overestimation or underestimation of the uncertainty. In addition, you can get some exclusive tips to help you calculate uncertainty like a pro with the help of the extract. Both production equipment and production systems can never be completely described or predicted. It is a contradiction for an engineer to get an accurate measurement and get the process right. Even if the engineer performs the measurement at a very high level, there will still be additional effects on the measurement result and the measurement process. Accordingly, this article can be used to estimate uncertainty.

Keywords: Uncertainty, uncertainty calculation, distribution, budget, standard deviation, A and B type of uncertainty, expanded and combined uncertainty.

Introduction

With scientific and technical progress in the field of measurement, the calculation of uncertainty, one of the new terms, added several innovations and advantages to the calculation results in the scientific field. Calculating errors and determining their impact on measurement results does not provide accurate results. For this reason, it is necessary to calculate the uncertainty in the measurement process and add (subtract) to the measurement result. In this section, let's clarify the nature of uncertainty and the issues of calculating its types. The term uncertainty should not be confused with error. As we know, the error is the difference between the measured quantity and the actual value. However, it can have both positive and negative effects on the measurement result under the guise of uncertainty.

The uncertainty is divided into 2 main types. Type A uncertainty and type B uncertainty. Let's look at the broad explanation of these types. A type of uncertainty is one that can be recognized by statistical analysis.

- Mean value of measurements;
- Standard Deviation;



- Distribution around the mean

There are different methods used to calculate A type uncertainty.

- Repeatability test (single);
- Repeatability test (multiple).

An example of a repeatability test can be performed by making repeated measurements at 10 points.

Type B uncertainty can be collected from the data statistically. It can be determined by means but the process is different from Type A uncertainty measurements.

- Type B uncertainty is related to the presence of systematics.

There is various source of data that you use to assess B Type uncertainty.

- Reports;
- Calibration certificates;
- Articles;
- Manuals;
- Engineers' notes;
- Datasheets;
- Excel files;
- Conference materials;
- Experimental results.

Since multiple sources of information are used throughout the measurement process, type B uncertainty can come from multiple datasheets. Thus, when assessing type B uncertainty, experts can use couple different methods

When type A uncertainty is calculated and added to the measurement result, it is possible to reduce the effect of random errors. Systematic errors can be avoided when type B uncertainty is calculated and added to the measurement result. When calculating the standard uncertainty, 67.8 percent and 95 percent when calculating the expanded uncertainty are obtained.

Normal distribution (also called Gaussian distribution) is used to evaluate uncertainty. Normal distribution is a symmetrical form around the mean value. Six main types of distribution are used in science. Normal distribution is preferred when estimating uncertainty.

- Normal;
- Uniform;
- U Shaped
- Log normal;
- Triangle;
- Quadratic.

The rectangular distribution is more commonly used by engineers to estimate uncertainty. Because all results have same probability to happen.

U shaped distribution means head points of the range are most likely to happen.

Triangular distribution is used when there is insufficient data, that's why it is called dangerous distribution. For example: As a result of experiment engineers get 3 different points of temperature. Which means high, low and average points. In this situation we must use Triangle distribution formula.

Log normal type of distribution has been created in the base of logarithmic functions



As a reference of ISO 17025 required to determine source of the uncertainty from the calibration and testing laboratories. All main source of uncertainty must take into account during the assessment of process. Laboratories which performing calibration and testing services must to evaluate uncertainty and add it to the result. If assessment of uncertainty is not available because of the testing methods then engineers must use practical principles and practical experience. The result of the uncertainty if is not required by the customer then the laboratory has an ability like to archive this material.

- Who needs measurement uncertainty?

The customer needs this value, together with the measurement result, to make the right decision.

- Why should the laboratory report the uncertainty of measurement?

Customers need this value to make the legal decision. When examining compliance with limits, the uncertainty of the outcome is important.

The requirements define the highest allowable uncertainty.

- How is measurement uncertainty used?

Results from different laboratories or at different times in the same laboratory decide whether there is a difference (variance over time) between the obtained results.

Uncertainty is mainly characterized by the concept of risk. From the point of view of probability, the uncertainty of calculations is divided into 3 places.

- Complete uncertainty;
- Complete certainty;
- Partial uncertainty.

As a result of non-calculation of uncertainty, we can show the following negative effects:

- Financial expenses;
- Time Wasting;
- Low accuracy;
- Negative feedback;
- Wrong result;
- Unavailable reputation;
- Low reproductivity.

The following are the unintended effects that affect the operation of the laboratory.

- Different types of accident;
- The equipment failure;
- Hazardous area;
- Unsafe work space;
- Dangerous data;
- Injured workers;

Uncertainty should be calculated to reduce and eliminate such effects.

Calculation of the uncertainty for the multi-functional equipment.

As a first step, average evaluation should be carried out. The method (Multiple repeatability) used when determining type, A uncertainty is based on 10 different measurement points and the average is calculated. By the given below formula (1):



$$\sigma = \frac{(x_1 + x_2 + x_n)}{n}, \quad (1)$$

where ...

σ – Mean (average)

x_n – Reading number n

n – Total number of data

Standard deviation formula is utilized for to find out data that is collapsed. Standard deviation generally is calculated for the determine A type uncertainty in the result of this process we can get approximately 68 percent probability (2):

$$SD = \sqrt{\frac{(x_1 - x_n)^2}{n}}, \quad (2)$$

where ...

SD – Standard Deviation

x_1 – 1st reading

x_n – Mean

n – Total number of data

After the estimating standard deviation, it is possible to get uncertainty by given formula. (3)

$$u = \sqrt{\frac{(x_i - \mu)^2}{n * (n - 1)}}, \quad (3)$$

where ...

u – A type uncertainty

x_i – Reading number i

μ - Standard deviation

Once all types uncertainties are determined, the combined uncertainty can be calculated. (4)

$$u_c = \sqrt{u_A^2 + u_B^2 + u_C^2 \dots}, \quad (4)$$

where ...

u_c – combined uncertainty

u_A – A type

u_B – B type

As a final part, expanded uncertainty can be calculated by simple mathematical form. (5)

$$u_e = u_c * k \quad (5)$$

k Coverage factor: The main purpose of the Engineer's Student Table is used to determine the relationship between the number of measurements and measurement errors.

The number of measurements is different, the factor is set according to infinite measurements from the table. When k = 1.98 is set, this is suitable for 95% confidence interval (Fig. 1).



Most of the time, $k=2$ is used by engineers, which gives a confidence ratio of 95.45%.

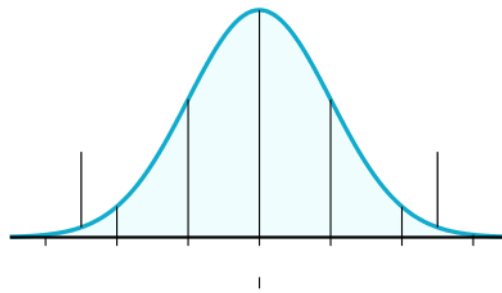


Figure 1. Normal distribution

When $k=3$ is accepted, the confidence coefficient is used as 99.78%. When $k=2.58$, 99% high result can be obtained. The uncertainty meets with a confidence ratio of 68%, where is $k=1$.

When the coverage factor is 3, it means a very high confidence interval. Accordingly, coverage factor 2 is accepted because our equipment does not work without errors.

On the base of JSGM 100:2008 the explanation of uncertainty has been proved. According to the documents uncertainty means doubt to measurements and it is named as the uncertainty of measurement.

At this point the main issue is defined like the comparison between the measuring uncertainty and measurement conception and they should not mix each other.

For example: Sometimes the concepts of standard deviation and uncertainty can be equated.

- Uncertainty is the measurement variance and can be added directly to the measurement result.
- Standard deviation, which is one of the parameters, is an interval with a confidence level. GUM specifies the steps for calculating uncertainty.

Budget for uncertainty.

6 easy steps should be preferred when you want to go into processing uncertainty assessment.

- Learn the measurement;
- Determine source of uncertainty;
- Find out Standard Deviation;
- Combined Uncertainty;
- Expanded Uncertainty;
- Budget for uncertainty (Excel version).

First of all, it is necessary to have enough information about the measurement. Measurements made by experts are less likely to cause errors. Resources must be available and properly selected during the process.

Secondly, sources that will cause uncertainty should be identified and evaluated. After determining the standard deviations, the Gaussian distribution should be constructed.

Excel, one of the Microsoft office programs, can be used to prepare the uncertainty budget. The wide range of functions in the Excel program will help engineers in all calculations. Before creating the budget, all the data should be collected and the measurement methodology should be



selected. The engineer must control the resources and then prepare the equipment, manuals and engineering records. Unlike single-function equipment, the uncertainty is calculated separately for each function of multi-function equipment. According to the standard and methodology, 10 times measurement is performed at 1 point. Readings of UUT from ten tests are recorded in Table 1.

Table 1. Readings of Unit Under Test (UUT).

Voltage DC		
Points	Reference Standard	UUT
1	5.0000	5.000
2	5.0000	4.999
3	5.0000	5.000
4	5.0000	4.999
5	5.0000	5.000
6	5.0000	5.000
7	5.0000	4.999
8	5.0000	5.000
9	5.0000	5.000
10	5.0000	4.999

A formula is used to determine the difference. (6)

$$D = RS(\text{readings}) - UUT(\text{readings}), \quad (6)$$

where ...

D - Difference

RS – Reference Standard

UUT – Unit Under Test

The obtained results are entered into Excel Table 2.

Table 2. Results of Difference for each point.

Difference
0.000
0.001
0.000
0.001
0.000
0.000
0.001
0.000



0.000
0.001

Standard deviation and uncertainty are pointed by using the mean, showed in Table 3.

Table 3. UN and SD.

Uncertainty	Standard Deviation
0.20000000	0.000516398
0.20004001	
0.20000000	
0.20004001	
0.20000000	
0.20000000	
0.20004001	
0.20000000	
0.20000000	
0.20004001	

In the result of calculation of A and B type engineers can get combined uncertainty, in Table 4.

Table 4. Types of uncertainty.

U _a	U _B	U _c
0.00016330	0.044741	0.001001

As a Final we can use all results and by using the we can find out expanded uncertainty, Table 5.

Table 5. Expanded uncertainty.

U _{exp}
0.00200179

Steps, that we used, can apply to all different functions of multi-function equipment. Result of uncertainty can be added and minuses from main results of equipment. Detailed template for the assessment of measurement uncertainty, Table 6.

Table 6. Quality control and data for measurement uncertainty.

Analytical procedure:	
Measurement interval and analytical.	
Measurement range:	Uncertainty accumulation Essential



1st	Percent
2nd	
3rd	
Short explanation of Analytical procedure.	
Related standard/ method.	
Customer demands for uncertainty?	

How to calculate the measurement uncertainty in the analytical report with the value. The logo of the company and the accreditation institution has been removed from template and the report does not contain the information normally requested by accreditation institutions.

Engineers must give relative or absolute values according to the client's needs that are recommended.

Conclusions

As a brand-new term uncertainty is applied to all field of measurement. Though there are a few methods which is used to get uncertainty, in this article is decided to create 6 easy step to calculate it. by using available program, the budget of uncertainty can be created.

Article makes it clear that what type of distribution is sufficient for evaluating uncertainty. Also, there are given formulas that are used to get result.

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Line Spacing	1.15	1.15	1.15	1.15	1.15



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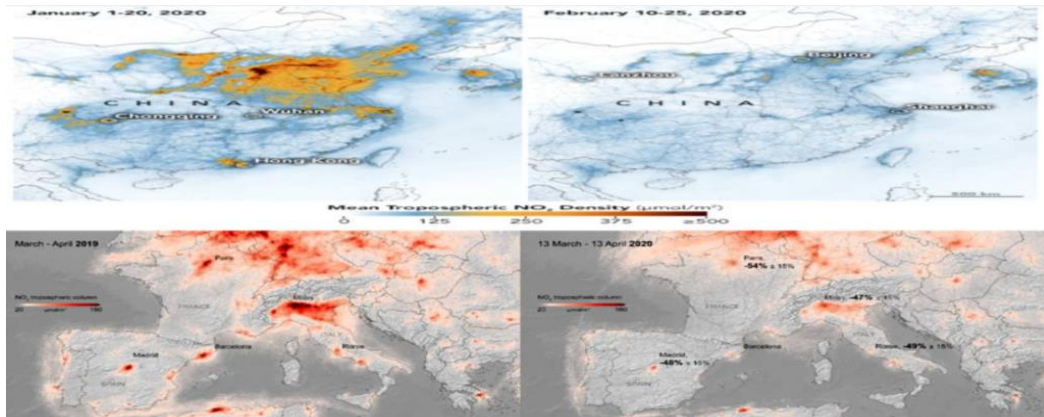


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3. Bahishti, “A New Multidisciplinary Journal; International Annals of Science”, Int. Ann. Sci., vol. 1, no. 1, pp. 1.1-1.2, Feb. 2017. <https://journals.aijr.in/index.php/ias/article/view/163>



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5. W. S. Author, "Title of paper," Name of Journal in italic, vol. x, no. x, pp. xxx-xxx, Abbrev. Month, year. Access online on 5 March 2018 at <https://www.aijr.in/about/publication-ethics/>
6. M. Ahmad, "Importance of Modeling and Simulation of Materials in Research", J. Mod. Sim. Mater., vol. 1, no. 1, pp. 1-2, Jan. 2018. DOI: <https://doi.org/10.21467/jmsm.1.1.1-2>

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