The deliberate results distortion problem in the road construction materials laboratory and its disposal

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Abstract. Article considers the issue of asphalt concrete mixtures quality control necessity and analyses the road construction materials laboratory activity with detection description of an unacceptable random or a large systematic (shift) errors. In the process of producing asphalt concrete mixtures, there are many different factors that can influence their quality. In particular, such as: an inevitable change in raw materials properties, which is associated, among other things, with mineral components heterogeneity, for example, in grain size composition, moisture. There may be deviations in materials dosage, temperature variations and various other indicators, it is also necessary to consider subjective factor on performers part. Economic conditions for laboratory tests results distorting include: interest lack in maintaining information reliability and further strict control. There may also be a certain incentive for employee that determines appropriate behavior. Such incentives can both interest employee in providing reliable data, and can direct his actions towards a conscious distortion of information received. At the present stage of laboratory testing level development of building materials, an important role in making management decisions is played by reliability and objectivity of information received. However, in road construction, laboratory test results distortion is quite large and plays an important role in industry. To increase results reliability of testing materials, recommendations are given for strengthening internal control in organizations, as well as external control by customer organization and / or regulatory authorities to ensure test results reliability.

1. Introduction

Nowadays information objectivity and reliability play an important role in making management decisions. Quality control system in industry needs significant adjustments, since there are real problems associated with this factor.

Work organization of any laboratory is an ergatic system, in which much depends on performer behavior, which is the main key link in such a system. Proceeding from this, “human factor” plays a significant role, since the performer is responsible for quality and timeliness of work, which determines image and profit of organization [1].

In construction sector, situation cannot always be under control, this is due to delay in obtaining test results, which is an objective reason for decrease in their reliability. This situation applies to many building materials, which is associated with time allotted for routine tests, which, as a rule, significantly exceeds the time required to establish quality parameters and decide on material use.
There is also impossibility of using negative feedback, which provides, if necessary, correction implementation [2].

2. Problem statement

There are mistakes that are made by contractor during laboratory tests, they can be unintentional and deliberate. The latter are most often due to corresponding motivation aimed at deliberate action, which is associated with data distortion of laboratory workbook. Private conversations with laboratory staff showed that their leaders outlined criteria in which tests were to be carried out, including under dismissal threat. Consequently, there is a fairly definite motivation on the part of such organizations leaders.

At the same time, employees realize that it is impossible to correct situation due to untimely incoming information. Uselessness in tests carried out pushes ordinary employees of organizations, for example, to actually refuse in some cases from relevant tests actual conduct, thereby turning them exclusively into a virtual project.

To carry out bitumen incoming quality control in accordance with current regulatory documents, it takes up to 4 hours, according to GOST 22245-90 “Viscous road oil bitumen. Technical conditions”. But, there are different situations, such as bitumen binder delivery to an asphalt concrete plant (ACP) in accordance with supply contract, in which there is a clause related to plant's obligations to discharge bitumen within one hour (in some cases, two hours) in order to release bitumen truck. Moreover, it is not uncommon for bitumen to bypass intermediate tanks and go into technological process. Thus, ACP first drains bitumen, releases bitumen truck, then after a few hours plant's laboratory [3] has opportunity to assess bitumen binder quality.

3. Research questions

Reasoning In all cases, bitumen properties assessment is carried out with a delay in relation to its appearance in technological process at ACP, and if deviations are recorded, it is not possible to make corrections.

If test results are negative, then substandard bitumen cannot be used for asphalt concrete mixture preparation and there should not be such bitumen at ACP. For this, data are somewhat "edited" in laboratory's logbook, which in turn does not entail any costs for enterprise, except for laboratory worker "some inconvenience", which is expressed in struggle with professional conscience. But as a rule, the company's management motivates its employees.

At present, after appearance of such a concept as bitumen grade according to PG (in accordance with GOST R 58400.1-2019), situation has worsened due to longer time for determining this indicator. This time is 72 hours of determination. Therefore, it can be concluded that the ingress of substandard bitumen on the ACP and its becoming a component of the asphaltconcrete mixture is inevitable for them.

4. Purpose of Study

Consider and analyze results deliberate distortion problem in road building materials laboratory and options for their elimination.

5. Research methods

The article uses the following methods: analysis, synthesis, generalization and classification of obtained information, interviews of employees, comparison and observation.

The real way out in these conditions is to take control bitumen samples and carefully store them at customer, so that in conflict situation event, you can extract these samples, test them and find out the cause. Despite this, there is a problem: in the Soviet standards for testing bitumen, there were mandatory indications of method convergence and reproducibility, which made it possible to objectively assess differences in the results obtained, including between results obtained in laboratory and results obtained during testing control sample, but now in editions of the standards GOST 33142-
2014 “Public automobile roads. Viscous oil road bitumens. Method for determining softening point. Method “Ring and Ball”" and GOST 11506-73" Petroleum bitumens. Method for determining softening point of ring and ball”, approved in recent years, this section has been transformed into a phrase that does not allow drawing conclusions:

Measurements accuracy is ensured by:
- compliance with requirements of this standard;
- carrying out a periodic assessment of measuring instruments metrological characteristics;
- carrying out periodic certification of equipment.

The person conducting measurements must be familiar with requirements of this standard."

The same situation arises in case of asphalt concrete, when quality control existing methods of asphalt concrete mixtures in accordance with the current standard make it possible to obtain quality control result not earlier than 12 hours from moment the mixture was shipped to consumer, which fundamentally suppresses possibility of operational control and timely correction of composition in event of necessity.

In accordance with this, by time information on asphalt concrete mixture quality is received, the latter has already been laid into structure and it is no longer possible to fix anything without pavement disassembling.

As a result, currently carried out quality control of asphalt concrete mixtures is often carried out formally, and data that are entered in laboratory's logbook cannot always be considered objective.

It is possible to reveal fact of asphalt concrete mixture properties indicators deviation from standard values only in sampling cores (cuttings) process from road surface at facility, but probability of this is negligible when assessing cores (cuttings) indicators in three places per 7000m². At the same time, results will be influenced by laying and compaction technology [4]. In addition, it is not always possible to say with certainty from which batch asphalt mixture was laid at a given coring location. In this regard, it can also be noted that, in fact, only average density and water saturation are subject to assessment, since all other indicators are determined on re-molded samples, and re-molding process can also significantly affect the test results.

Control carried out in this case allows only to record substandard material presence.

6. Research findings

Thus, examples considered indicate that there is no way to quickly assess material quality, as a result, a possible correction of data obtained occurs.

It is recommended that internal controls be strengthened within organization to improve material test results reliability. But due to the fact that questions related to test results possible distortion during their recording in laboratory's working log, as a rule, are motivated by organization management, which leads to doubt in ensuring results reliability of monitoring these studies.

In this regard, it is possible to ensure test results reliability through external control implementation by customer organization and / or regulatory authorities. But in this case, facts revealing likelihood of test results distortion is unlikely, since it is practically impossible to prove this fact.

Intentional mistakes made by performer are committed, since it is practically impossible to prove the fact of test result distortion when entering it into laboratory log. Contractor is confident in his own impunity, given that laboratory tests results, as a rule, are fully characterized by dialectics laws, including that “you cannot enter the same water twice” or, accordingly, you cannot get the same results. In any case, it is often not possible to double-check test result, especially when it comes to destructive tests (strength, frost resistance, etc.). In addition, there is innocence presumption principle, which also protects performer to some extent.

In this case, material or other benefits can be considered as motivation, in which “human factor” is triggered due to performer deliberate actions.
7. Conclusion

Laboratory that controls road building materials quality must provide a reliable representation of products quality, which is necessary for making appropriate organizational and technical decisions.

Effectiveness of any construction organization, one way or another, depends on provision and use of reliable information. However, this condition is not always met due to various circumstances, for example, delay in obtaining test results and problems elimination for enterprises. Therefore, inaccurate information may arise at information processing and data transformation stage.

Information received quality can significantly affect the management decision-making process.

As practice shows, vast majority of deliberate falsification cases occur at the stage of compiling primary documents, collecting and registering data.

Counterfeiting main goals include overstating raw materials quality indicators and finished products in order to embellish organization's activities results, including concealing the fact of using or releasing substandard products. In this case, the main way of results distorting is associated with entering any "corrected" results into laboratory's work log.

Reliable information distortion is carried out by performer under organizational reasons influence.

At many asphalt concrete plants, where experienced laboratory assistants work, true results are saved and analyzed accordingly [4].

So, in many laboratories of asphalt concrete plants, they use accelerated methods for assessing physical and mechanical indicators. In this case, various techniques or some of their modifications are used, for example, recommendations for accelerated determination of average density, water saturation, and swelling of asphalt concrete, and others [5]. Due to fact that these methods do not have an official status, obtained results using them are purely indicative. However, in a number of laboratories, data obtained during accelerated tests are recorded in workbook as acceptance certificates. In some laboratories, in addition to accelerated ones, tests are additionally carried out according to a standard method. In this case, received data is recorded, as a rule, in different journals, respectively, in "black" and "white".

It should be noted that in Russian legislation (clause 2 of Article 18.19 of the Code of Administrative Offenses of the Russian Federation), liability is provided only for inaccurate test results provision of products subject to mandatory confirmation of conformity, which in no way applies to asphalt mixtures production, subject to exclusively voluntary confirmation of conformity. Responsibility for product quality control results distortion is not provided at all. This in turn gives rise to impunity in this matter.

In connection with the above, in order to ensure asphalt concrete durability, as well as optimal funds spending, a different system of road building materials and works quality control is needed.

Quality control at the stage of their preparation at an asphalt concrete plant plays a significant role in ensuring asphalt concrete mixtures and asphalt concrete quality. Deviations from material regulatory properties, admitted at the production stage, cannot be eliminated at construction and installation work stage. Timely operational information about produced asphalt concrete mixture parameters provides in most cases a real opportunity to avoid road surfaces premature destruction.

Thus, operability based on the current regulatory documents does not have ability to quickly and influence one of the main means of asphalt concrete pavements production - asphalt concrete mixture quality [6].

Rapid methods of determining asphalt concrete physical and mechanical characteristics are required to promptly prevent rejects.

Such methods were proposed in the middle of last century, but were not implemented in current regulatory and technical documents development.

Official reason for this is correlation lack between standard and accelerated test methods.

However, here the question arises: any test method is, to one degree or another, conditional. Including asphalt concrete strength values, determined according to standardized method, are in no way taken into account in road structure calculation, and in this regard, to assert that asphalt concrete
ultimate strength at 20 or 50 °C, determined according to standardized method, is "true" value hardly qualified.

At the same time, it should be noted that value obtained is "significantly delayed" by time when this information is really needed, when, if necessary, it would be possible to intervene in production process and correct something or prevent substandard products appearance.

In this regard, it would be more logical to apply methodology described in Information Letter No. 91 of the SoyuzdorNII "Accelerated Test Methods of Road-Building Materials" in 1957, in which it was said that accelerated test methods could be applied provided that central laboratory a preliminary check of asphalt concrete physical and mechanical properties was carried out in accordance with technical conditions (non-accelerated methods) requirements. At the same time, it was indicated that indicators compliance with accelerated methods of determination and conventional ones should be checked.

Currently, there is a methodology for finding correspondence between different test methods (GOST R ISO 5725-1-2002 - GOST R ISO 5725-6-2002. Accuracy (correctness and precision) of methods and measurement results), including when testing heterogeneous materials, a typical representative of which is an asphalt concrete mixture.

It should be noted that accelerated method should be universal and should not depend on asphalt concrete composition, raw materials quality, temperature and test method.

Express method for determining properties must meet the following requirements:
- result obtaining in the shortest possible time (within 1-2 hours) after asphalt concrete mixture production;
- ensuring required test results accuracy and stability (reproducibility and repeatability in relation to standard method);
- possibility of implementing proposed methods on the basis of equipment available in laboratory.

For an objective method assessment, it is necessary to have information about processes that occur in asphalt concrete at the early stages of formation, including during cooling.

In connection with the above, it is possible to outline the main ways to ensure test results reliability. These are events such as:
- Accelerated test methods introduction;
- control samples selection by customer;
- participation in interlaboratory comparison tests;
- building control charts.

To remedy this situation, it is necessary to massively develop and implement accelerated test methods that could provide necessary information prompt receipt. These express methods are designed to help improve products quality [7]. So, in MADI, in the Shared Use Center, an express method for assessing bituminous binder properties has been developed, which provides an opportunity to quickly assess product quality.

However, in many laboratories, employees "introduce" their own test methods, which allow obtaining necessary information about properties parameters of asphalt concrete mixtures in the shortest possible time, which provides a real opportunity, if necessary, to make any adjustments to production process. In some laboratories, freshly formed samples are subjected to accelerated cooling in cold water or a refrigerator, or they organize samples testing while they are still hot.

In any case, performers pursue a good goal associated with obtaining operational information about properties parameters of asphalt concrete and adjusting them if necessary. However, question arises about feasibility of "inventing" its own test methods, while in the Belarus Republic back in 2008 the state standard of Belarus STB 1536-2008 “Asphalt concrete road, airfield and asphalt concrete mixtures. Express - Test Methods” was approved, which regulates accelerated testing possibility of asphalt concrete mixtures.

The methods regulated by this standard are not indisputable, may need to be adjusted accordingly, but they exist and have an official status. In this regard, apparently, it would be advisable to use them, instead of using "home-grown" methods.
When conducting tests, parallel samples should also be taken, which should be kept at the Customer and, in case of any conflict situation, carry out tests. This approach disciplines performer and encourages him not to follow deliberate distortion path of test results. Thus, control sample availability at the Customer provides a real opportunity to ensure test results reliability, for example: when, in case of tests without warning at a construction site, products quality significantly increased [8].

GOST 5725 states that for a number of materials there is no such thing as a "standard", and this fully applies to road construction materials (GOST R ISO 5725-1-2002 - GOST R ISO 5725-6-2002). In this regard, it is possible to assess asphalt concrete quality only in process of carrying out interlaboratory comparison tests. All laboratories are strongly encouraged to participate in interlaboratory comparison programs. Without participation in such programs, laboratory cannot regularly check correctness of its work. This, along with regular reproducibility evaluations, is absolutely essential to ensure high quality results. One of the simplest methods of such control is to compare arithmetic mean and standard deviation obtained in this laboratory with corresponding indicators of other ISI participants using the same instruments and test methods [9].

Control cards are currently widely used without fail in medicine, mechanical engineering, pharmaceuticals and other industries: almost everywhere, except in the construction industry. Control maps, for all their simplicity of construction, are extremely essential. First of all, because of its visibility. If the laboratory has a work log that records the results of the relevant tests from day to day, it is often not possible to make an analysis. All that is possible is to highlight abnormal values which should be already marked by the performer. It is impossible to identify any regularities in the change of the indicator values, such as systematic error, drift, shift or random error. Built control card makes possible to assess the quality of this analytical series based on detection rules of unacceptable random and beginning large systematic (shift) errors. [10].

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