

CONFERENCE PAPER 10

2nd International Conference on Asphalt 4.0

The Transformative Influence of Digitalization on Laboratory and Quality Control Activities in the Asphalt Industry

#ICA4point0

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ABSTRACT

In the realm of the asphalt industry, laboratory work plays a pivotal role in ensuring the quality and performance of the materials used in road construction. Traditionally, this laboratory work has been divided into three main parts: mix design, production control, and field control after paving. However, a critical examination of current practices reveals that the industry, in many aspects, still operates with methods that can be best described as “Stone Age.”

This archaic approach has led to an ineffective workflow, which was once tolerable due to the simplicity of the tasks and the elementary nature of laboratory equipment. However, the landscape of the asphalt industry has evolved significantly over the years. Today, we find ourselves working with complex equipment, intricate testing methods, and a growing need for the exchange of information among various stakeholders. To meet these evolving challenges, intelligent digitalization emerges as the key to unlocking unprecedented efficiencies and advancements.

1. THE THREE PILLARS OF LABORATORY WORK IN THE ASPHALT INDUSTRY

1.1 Mix Design

Mix design is the foundational step in the creation of asphalt formulations that meet the required performance criteria. Historically, this process involved manual calculations and limited data analysis.

Digitalization in mix design enables:

Advanced Simulation: Digital tools allow engineers to simulate various mixtures and assess their performance characteristics with precision.

Data-Driven Decision-Making: Real-time data collection and analysis streamline the mix design process, enabling rapid adjustments to formulations.

1.2 Production Control

Ensuring consistent quality during asphalt production is vital to the longevity and safety of road infrastructure.

Digitalization in production control brings forth:

Automation: Automation of key processes minimizes human errors and enhances the consistency of asphalt production.

Remote Monitoring: Real-time monitoring of production facilities allows for immediate response to deviations from quality standards.

1.3 Field Control after paving

Once asphalt is laid on roads, it's crucial to monitor its performance in real-world conditions.

Digitalization in field control offers:

IoT Integration: Incorporating sensors and IoT devices within the asphalt layer allows for continuous monitoring of temperature, stress, and strain, providing valuable insights into performance.

Predictive Maintenance: Digital tools enable the prediction of maintenance needs, reducing downtime and enhancing road safety by addressing issues before they become critical.

1.4 Additional benefits

In addition following benefits are the positive effect of digitalization:

- Improve the accuracy and repeatability of laboratory testing
- Facilitate the sharing of data between different laboratories and stakeholders
- Reduce costs and improve the overall efficiency of the asphalt industry

2. THE NECESSITY OF DIGITALIZATION

The call for digitalization is not merely a trend but a necessity in the modern asphalt industry. Here's how it can revolutionize the sector:

Enhanced Efficiency

Digitizing labor-intensive processes, such as data entry and analysis, liberates laboratory professionals to focus on more complex tasks, leading to substantial gains in overall efficiency.

Improved Quality Assurance

Digitalization provides real-time feedback mechanisms, allowing for immediate corrective actions in case of deviations from quality standards. This results in consistently higher-quality asphalt used in construction.

Seamless Collaboration

The seamless exchange of information between laboratories, construction sites, and regulatory bodies becomes the norm through digital platforms. This fosters collaboration, knowledge sharing, and transparency, ultimately driving industry-wide improvements.

Sustainable Practices

Digital tools enable the optimization of asphalt mixtures, leading to more sustainable road construction practices. This includes the use of recycled materials, reduced energy consumption, and a smaller environmental footprint.

2.1 Specific examples

Here are a few specific examples of how digitalization is already being used to transform laboratory and quality control activities in the asphalt industry:

- Asphalt plants are using digital sensors to collect real-time data on the temperature, composition, and other properties of asphalt mixtures. This data is then used to control the production process and ensure that the asphalt meets quality standards.
- Laboratories are using digital tools to automate the testing of asphalt samples. This includes the use of robots to perform repetitive tasks, such as weighing and mixing samples.
- Road construction companies are using digital tools to monitor the performance of asphalt pavements in real time, including the use of sensors embedded in the pavement to measure temperature, stress, and strain.

3. CONCLUSIONS

In conclusion, the influence of digitalization on laboratory and quality control activities within the asphalt industry is poised to be transformational. By shedding the constraints of antiquated methods and embracing the possibilities of intelligent digitalization, the industry is on the brink of achieving new heights of efficiency, quality, and sustainability.

As we embark on this technological journey, we are not just building roads; we are paving the way for safer, longer-lasting, and environmentally conscious road infrastructure that will serve generations to come.