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ADVANCED PAVEMENTS TESTING

WHITEPAPER

PAVELAB 50

The case for automated asphalt extraction

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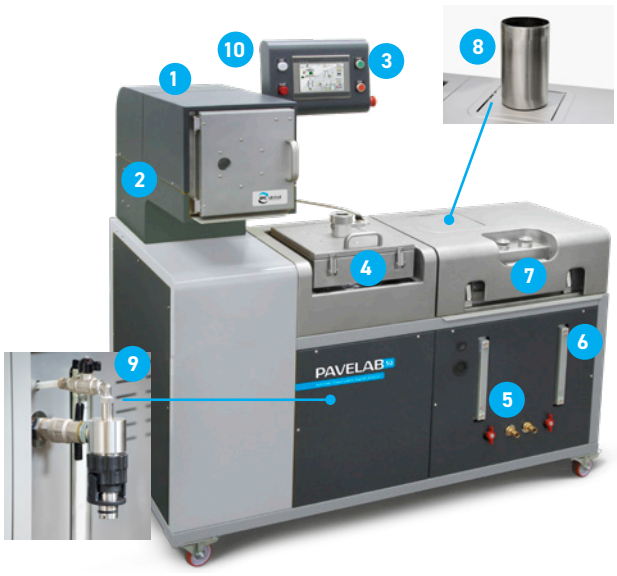
The automated asphalt extraction is an innovative, efficient, quick and safe solvent-based extraction of asphalt binder from asphalt mixtures, to characterize and control the quality of asphalt mixtures by measuring asphalt content and studying the aggregate gradations.

This method is used for Quality Control and Quality Assurance, acceptance criteria, and research activities.

The PaveAnalyzer is designed to automatically extract asphalt binder from loose asphalt mixtures in a closed system while being exposed to almost zero emissions coming from the extraction process.

This system includes an extraction chamber, a high speed centrifuge, a solvent recycler and aggregate dryer all in one unit minimizing the footprint needed to perform extractions and the overall cost of the setup.



1. Washing Chamber
2. Drying Heater
3. Control Interface
4. Centrifuge
5. Asphalt Solution Tank
6. Clean Solvent Tank
7. Condensation Chiller
8. Measuring Balance
9. Sampling attachment for binder recovery
10. Ultrasonic Wave Device

Figure 1 The Components of PaveAnalyzer

Pavelab50 PaveAnalyzer benefits

This equipment is clean, safe, quick, accurate and a cost-effective alternative to traditional extraction methods that offer the following advantages:

- Extracts asphalt binder through heating, solvent,and ultrasonic waves and measures asphalt content accurately while providing high repeatability between different replicates
- Recycles the extraction solvent for future uses, minimizing chemical waste.
- Collects all fines passing 75 microns (Sieve #200) or 63 microns using high speed centrifuge.
- Produces dry washed aggregates ready forwashed gradations, minimizing the time spent onwashing and drying the aggregates. Effective drying is completed through heating and ultra-sonic wave pulses that agitate the solvent particles. The full process is typically in less than one hour.
- Allows the operator to collect asphalt sample for binder recovery to study the properties of asphaltbinder.

Such technology allows Quality Control and Assurance managers and researchers to quickly and accurately evaluate the composition of their asphalt mixtures and eventually the performance in the field.

The performance of this equipment was evaluated by comparing the asphalt content measured by the PaveAnalyzer and the Reflux for four materials including 4.75mm NMAS Polymerized leveling binder, 9.5mm NMAS N70 mixture, Fine fractionated reclaimed asphalt pavement (FRAP) and course FRAP. The study also looked at the repeatability of field collected asphalt mixtures by measuring asphalt binder content and fines collected in the high speed centrifuge. Figure 2 demonstrates the results of the study.

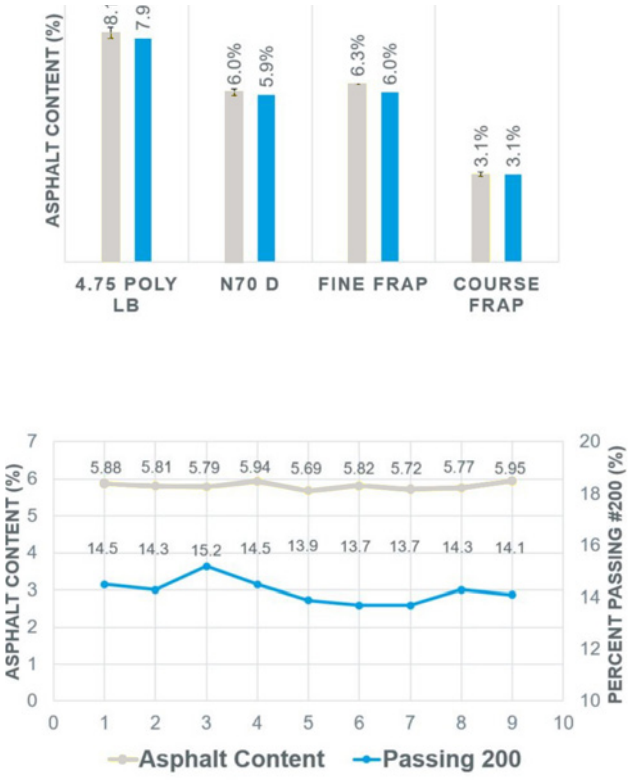


Figure 2a

Shows minimal variation (0 to 0.3%) in asphalt binder content measured by both the PaveAnalyzer and the Reflux with an average standard deviation of 0.07 and a coefficient of variation of less than 1.4%. The low variation is referred to the automation of the process, which standardizes the procedure and eliminates any source of labor error. It is important to note that asphalt content measured by the PaveAnalyzer is consistently higher than that measured by the reflux. This could be referred to the higher efficiency of the PaveAnalyzer in extracting the binder from asphalt mixtures.

Figura 2b

Presents the variation of asphalt content by studying multiple replicates of the same material that were collected from the field. The measured asphalt content varied from 5.95% to 5.69% with an average of 5.82%, standard deviation of 0.09, and coefficient of variation of 1.5%. This proves the low variability within a large sample of replicates from the same material, which make the PaveAnalyzer a good equipment to quickly and accurately monitor the quality of asphalt mixture during construction, and correct for asphalt binder content and/or aggregates if needed.

Figure 2 Performance of Pavelab50 PaveAnalyzer (a) Comparison between the Pavelab50 PaveAnalyzer and the Reflux (b) Repeatability of the Asphalt Binder Content and Fines using the Pavelab50 PaveAnalyzer

The impact of different operators was studied utilizing two different PaveAnalyzer units and three different operators.

This part of the study included three different materials: recycled asphalt shingles (RAS), 25mm NMAS, and 9.5mm NMAS mixtures. Both asphalt binder content and amount of fines passing sieve #200 were studied. The results are demonstrated in Figure 3. Minimal variation was noticed (0.1%) between different operators for the three materials dueto the full automation of the process. The operator is not involved in the actual extraction of asphalt binder, which reduces any variability due to human error.

This advantage is very important, especially if you are comparing samples between QC and QA labs, or comparing results with the client or transportation agency.

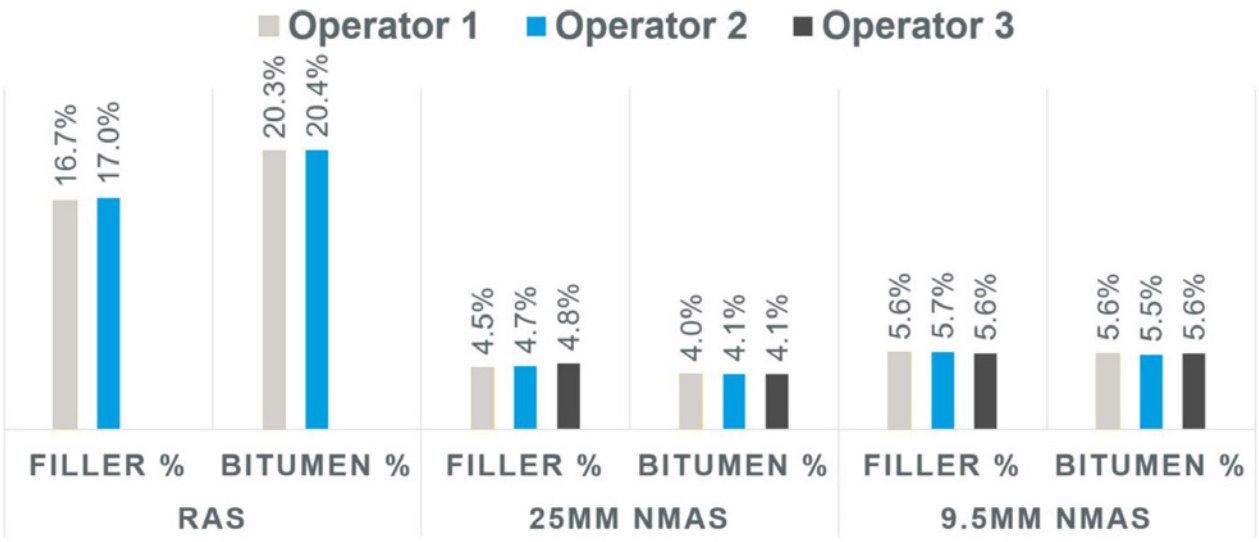


Figure 3 The Impact of Operator Error on Asphalt Binder Content and Percentage of Fines

An environmental analysis was conducted to check the amount of emissions emitted during extraction. A known volume of air was drawn through specially prepared sampling tube that contains two sections of coconut shell charcoal (SKC 226-09 tube). Methylene Chloride was tested using PaveAnalyzer. The investigation of the exposure of workers to solvent fumes involved the PaveAnalyzer, regular centrifuge, and the results were to compared to OSHA 8-hr TWA-PEL limit of 25 ppm. During the study, the worker was exposed to methylene chloride at a concentration of 28.8 ppm using the centrifuge, which exceeds the aforementioned OSHA limit. Using PaveAnalyzer reduced the exposure toonly 4.79 ppm.

This significant reduction in fume emissions ensures a safe environment for the lab operators while no hood is needed to perform extraction.

Exposure to Methylene Chloride
Centrifuge = 28 ppm
OSHA 8-hr = 25 ppm
Pavelab50 = <5 ppm

The aggregates gradations were also examined to ensure that the automated extraction is offering comparable results to standard methods and not causing aggregate degradation during rotation inside the washing chamber. Figure 4 presents sieve analyses conducted for aggregates of the same material after extraction using Reflux (one sample) and PaveAnalyzer (three samples). It is clear that the PaveAnalyzer does not alter the gradations by degrading the aggregates in the washing chamber.

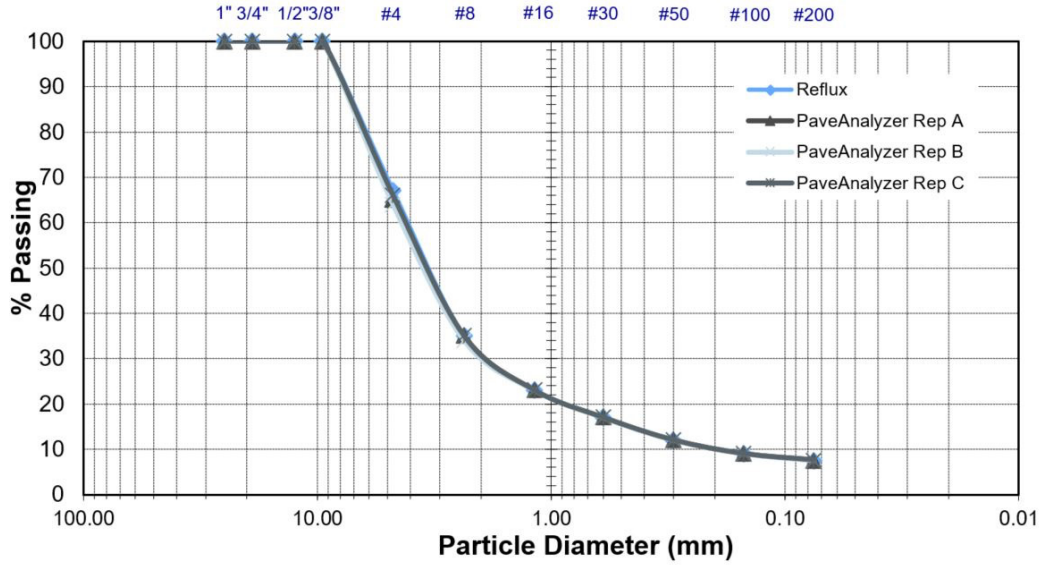


Figure 4 Comparison between Aggregate Gradations after Extraction Using Reflux and PaveAnalyzer

Based on the extensive examination that was performed to evaluate the performance and operation of the PaveAnalyzer, it is clear that this equipment is an effective tool that helps QC/QA manager to expedite the process of measuring asphalt content accurately, safely, and efficiently while minimizing the amount of time spent by the operator. It is a cost effective option as it is an all-in-one closed system extractor, high-speed centrifuge, solvent recycler, and aggregate dryer that minimizes the overall footprint and any cost needed for ventilation hood or cabinets.

It is an automated operation that eliminates operator error, and utilizes the labor time efficiently to only perform the actual calculation of asphalt binder content. There is no need for the operator to be around the equipment during the extraction process. The results of the performance evaluation show that the PaveAnalyzer offer comparable results for asphalt content and amount of fines to traditional methods. In addition, it provides accurate aggregate gradations while not degrading the aggregates during the extraction process.

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