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Establishing workability asphalt mixtures

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Abstract. The article shows the need to improve repair technologies for bituminous pavements especially during the cold season. As a result of laboratory tests, it was found the need for other attempts. These are attempts on storable asphalt mixtures workability at various temperatures for the installation period, but also for the storage period. Through the laboratory tests was shown the complex interaction between mechanical behaviour of asphalt mixtures and variability factors acting on the road structure, this complex framework is determined by fundamental mechanical properties that influence long-term performance.

1. Introduction

To ensure the safe conduct of road traffic in any season is necessary to ensure continuity of maintenance and repair of pavement surface throughout the year.

Bituminous pavements degradation repair in the season, the time period between 15 October and 15 March with temperatures generally below 10 °C, when there are no precipitations filling with storable asphalt mixtures is recommended [1].

Holes filling of the bituminous street pavements are necessary for ensuring traffic safety and the prevention of holes development under the combined action of traffic and water [2].

2. Workability of storable asphalt mixtures workability

Workability is the property of asphalt mixtures which allows the production, handling, placing and compaction of asphalt mixtures with minimal energy consumption [3, 4].

This test method is used to generate information on potential characteristics handling, laying, compaction and performance of asphalt mixtures.

This test method is also used on storable asphalt mixtures for control improvement over storage of these materials, timing and method of packing, climate conditions of storage and application.

3. Measuring devices

Workability measuring device was designed in the road laboratory of the Faculty of Civil Science Engineering.

This device is composed of a mixer used to make building materials, mixer produced by Humboldt HL200, an electronic device manufactured by UNI-TREND Technology for measuring the electric intensity and a computer on which is installed the software for data interpretation recorded by electronic measuring device of the electric intensity, figure 1.

Figure 1. Workability measuring device.

HL200 mixer used is equipped with a timer that can be set during the mixing of mixture, a stirrer with transmission speeds that can provide 3 speeds of 107 198 and 361 rpm plus an addition lower speed necessary for liquid material composition of 53 rpm. Mixing vessel has a capacity of 20 litters and is made of aluminium.

Determination of the storable asphalt mixture workability is made as follows:

- storable asphalt mixture is placed in the mixing bowl;
- the mixing bowl is place in the mixer device.
- the machine ensured to carry out tests under normal safety conditions;
- the thermometer is placed to display mixture temperature during the determination;
- the speed and duration of mixing is established;
- the engine is turned on. When pallets are rotating the mixture from the vessel is opposing.
- the engine needs more power which leads to an increase of current intensity.
- the current intensity is measured with an amper measuring device and represents current intensity required for asphalt mixture mixing;
- measurement results are automatically transmitted to a computer and interpreted.

4. Workability of laboratory studied storable asphalt mixtures

In laboratory were studied four storable asphalt mixtures:

- control asphalt mixture (M0) without flow agent;
- storable asphalt mixtures with bitumen mixed with a flow agent (M1) – the flow agent used is an oil called STAROIL GL30;
- storable asphalt mixtures with bitumen mixed with a flow agent (M2) – the flow agent used is a solvent(white-spirt);
- storable asphalt mixtures RRD standard (M3).

To study the workability of M1, M2 and M3 storable asphalt mixtures comparisons have been made between these mixtures and control mixture (M0). The tests on M1, M2 and M3 mixtures aimed the same workability as the control mixture (without flow agent) at the laying time, at 120 ^{o}C (laying temperature of hot asphalt mixtures).

Were made three batches of each control mixture, 8 kg each, and were put in the mixing vessel. When the mixture temperature reached 120 ^{o} C, the first speed started (107 RPM) for 1 min registering values of intensity within 5 seconds. In the end was given three results for each batch of control

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mixture. The test was repeated at 110 °C, 100 °C and 90 °C registering three intensity values for the three temperatures.

In table 1 values have been calculated by averaging between each batch of the four temperatures.

Were made three batches, 8 kg each, for M1 mixture (Storable asphalt mixtures with bitumen mixed with a flow agent – the flow agent used is oil called STAROIL GL30) and for M2 mixture (Storable asphalt mixtures with bitumen mixed with a flow agent – the flow agent used is white-spirit). The two storable asphalt mixtures were tested at 20 °C, 15 °C, 10 °C, 5 °C, 0 °C, -5 °C, -10 °C.

Table 1. Values of the electric intensity for M0 mixture.

Batch	Electric intensity at 120 ° C, A	Electric intensity at 110 ° C, A	Electric intensity at 100 °C, A	Electric intensity at 90 °C, A
I	2.149	2.183	2.278	2.454
II	2.141	2.181	2.276	2.457
III	2.145	2.185	2.280	2.456
Average	2.145	2.183	2.278	2.456

In tables 2 and 3 values were calculated by averaging between the values obtained for each batch to determine the four temperatures, for M1 and M2 mixtures.

Table 2. Values of the electric intensity for M1 mixture.

Batch	I -10 ° C A	I -5 ° C A	I 0 ° C A	I 5 ° C A	I 10 ° C A	I 15 ° C A	I 20 ° C A
I	2.919	2.652	2.399	2.271	2.244	2.162	2.138
II	2.917	2.725	2.405	2.280	2.241	2.169	2.132
III	2.914	2.730	2.413	2.278	2.250	2.159	2.131
Average	2.917	2.702	2.406	2.276	2.245	2.163	2.134

Table 3. Values of the electric intensity for M2 mixture.

Batch	I -10 ° C A	I -5 ° C A	I 0 ° C A	I 5 ° C A	I 10 ° C A	I 15 ° C A	I 20 ° C A
I	3.121	2.986	2.621	2.371	2.291	2.219	2.182
II	3.130	3.002	2.625	2.365	2.287	2.228	2.186
III	3.112	2.995	2.617	2.367	2.274	2.221	2.177
Average	3.121	2.994	2.621	2.368	2.284	2.223	2.182

The storable asphalt mixtures RRD standard (M3), a storable asphalt mixture ready prepared and packaged in the bucket was warm up for reaching the desired temperature.

The storable asphalt mixtures RRD standard (M3) was tested at 20 °C, 15 °C, 10 °C, 5 °C, 0 °C, -5 °C, -10 °C.

In tables 4 values were calculated by averaging between the values obtained for each batch to determine the four temperatures

Table 4. Values of the electric intensity for M3 mixture.

Batch	I -10 ° C A	I -5 ° C A	I 0 ° C A	I 5 ° C A	I 10 ° C A	I 15 ° C A	I 20 ° C A
I	2.727	2.427	2.325	2.276	2.250	2.176	2.155
II	2.728	2.433	2.316	2.274	2.246	2.175	2.149
Average	2.728	2.430	2.321	2.275	2.248	2.176	2.152

In figure 2 is the workability variation of asphalt mixtures according to the temperature and the temperature range, considered optimal, that can be achieved under optimal laying and compacting conditions for each mixture type.

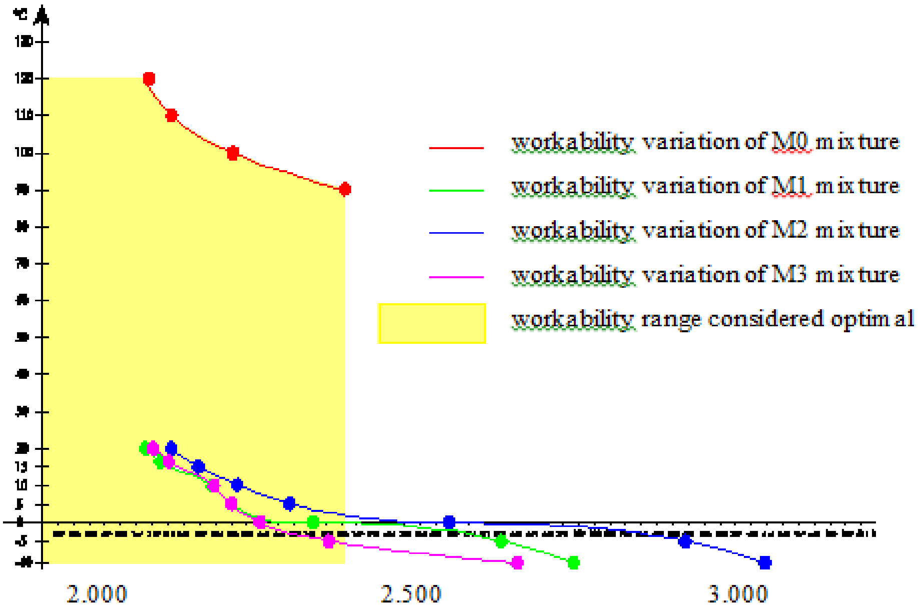

Figure 2. Storable asphalt mixtures workability variation according to the temperature.

5. Conclusions

Having established the storable asphalt mixtures workability in the temperature 10^0 C - 20^0 C range, were observed the following:

- M1 mixture meets the required workability for laying and compaction in optimal quality conditions, up to a temperature of 0 °C;
- M2 mixture meets the required workability for laying and compaction in optimal quality conditions, up to a temperature of 5 °C;
- M3 mixture meets the required workability for laying and compaction in optimal quality conditions, up to a temperature of -5 °C.

From a comparison of the three mixtures M1, M2 and M3 was found that although we have close granulometric curve, the difference is made by the flow agent. The flow agent for M3 mixture provides workability at low temperatures.

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