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Bitumen Stabilized Material Versus Hot Mix Asphalt

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1. INTRODUCTION

Environmentally friendly and economically efficient construction using alternative materials is increasingly important in the construction industry. This is especially true for the construction, maintenance and use of roads due to environmental as well as socio-political factors. Due to society's greater awareness of the impact on climate change, the pressure on public infrastructure managers and related stakeholders to take action also in the area that supports these green road construction technologies is increasing. Administrators are often faced with the question of how to carry out a "green public procurement", but we have prepared recommendations for this as well [1]. In some countries, it began to happen that they encountered a shortage of quality aggregates for asphalt mixtures. In addition, the prices of road construction materials have risen sharply over the past decade. Both economic and environmental factors are very much in favor of low-energy technologies in road construction, such as BSM technology.

2. DIFFERENCES BETWEEN BSM AND HMA

2.1 (Four) basic differences betwen BSM and HMA

Regarding the processing (preparation) of the materials used for the production of the mixture, they differ in two aspects - the temperature of the basic materials and the moisture content. The input materials for the production of BSM are at ambient temperature and contain water (natural moisture content), while the input materials for the production of HMA are heated to approximately 180 °C (as a result, all moisture is evaporated and removed). The produced BSM is therefore “cold” with a certain moisture content, while the HMA asphalt mixture is hot and without moisture.

Both mixtures usually contain approximately between 4 % and 8 % (inactive) filler. It is a mixture of (fine) stone grains smaller than 0.063 mm. The difference is in the properties of the used filler, because BSM also contains up to 1 % of active filler, cement or hydrated lime.

In the production of BSM, the foamed bitumen envelops and adheres mostly only to fine particles (larger grains remain unwrapped), whereas in the production of HMA, the hot bitumen envelops all the grains.

The differences presented above significantly affect the properties of the mixture and layer.

2.2 Mixture production

2.2.1 Production of hot mix asphalt (HMA)

Asphalt plant provides the highest level of confidence in the invariability of the properties of the produced mixture. Even if there is a deviation in the grain size of the input materials, this does not represent a significant deviation in the grain size of the produced mixture. The used fractions of stone grains are re-screened in the plant on vibrating screens and distributed according to their nominal size in the corresponding hot silos. The more silos of different grain sizes, the smaller will be the deviation of the total grain size of the produced mixture, which is essential for the physical and mechanical properties of the mixture or layer.

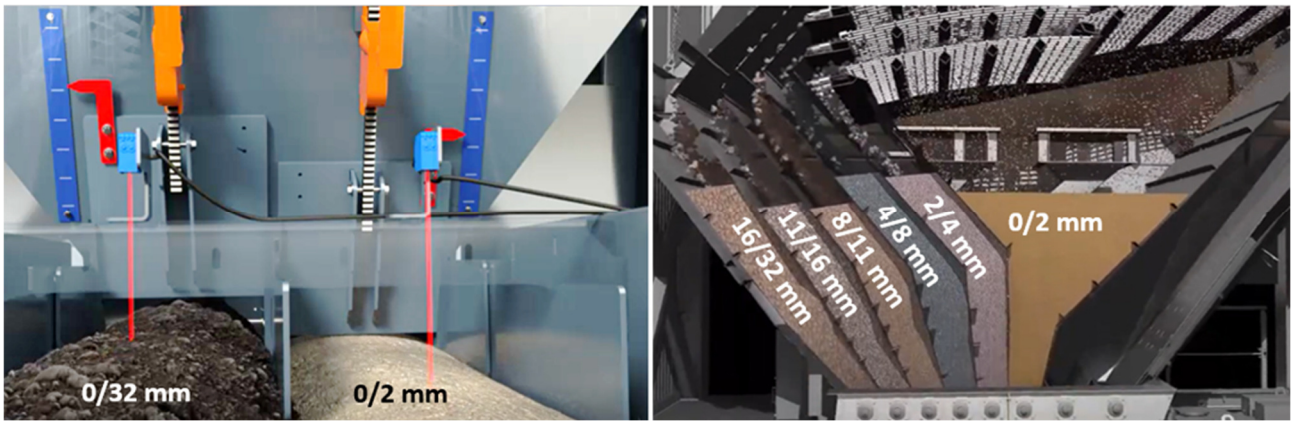

Figure 2: Mixture production in plant (left BSM, right HMA) [2], [3].

2.2.2 Production of stabilized mixture (BSM)

BSM can be produced in plant or in situ. Production at the plant is carried out according to the process of (simpler) continuous production. The incoming materials are continuously fed from two storage tanks or chambers into the mixer, where binder and water are added during mixing. If the granularity of the materials used is adequate and constant at all times, then the total granularity of the produced mixture is also adequate. However, there may be deviations in grain size in the input materials that must be detected and acted upon accordingly.

BSM contains water, which helps to achieve better homogenization of the mixture, facilitates mixing, serves as a lubricant in the thickening phase and activates the hydration process of the active filler. The mixtures used during production (at the place of installation or at the plant) contain a certain natural moisture content. The moisture content tends to remain relatively stable, but significant fluctuations can occur, particularly when work is conducted during or after the rainy season, leading to potential issues. Based on the determined natural moisture content, the proportion of added moisture must be corrected so that the mixture contains an appropriate total moisture content, which is between 70 % and 90 % of optimal moisture value according to Modified Proctor test.

In the literature [4] it is stated that the characteristics of at least six mixture samples should be sampled and investigated every day. In any case, the input materials and the produced mixture should be visually inspected at all times and the properties found should be evaluated against the expected properties, and appropriate corrections should be made to the settings if necessary. The person who is responsible for the quality of the work carried out must have the appropriate education and have as much experience as possible, because without a professional approach drastic errors can occur.

3. INCREASING LAYER STIFFNESS

One essential difference between BSM and HMA is the conditions for obtaining (early) stiffness of the embedded layer. In both cases, the time frames when the embedded layer will be able to bear traffic loads without causing major deformations are important. Understanding these differences is key to the successful implementation of construction projects, especially those that are built in half-closed roadways and the need to expose them to traffic as soon as possible is imperative.

3.1 Increasing the stiffness of the HMA layer

Stiffness increases with decreasing temperature in the embedded layer. The mixture begins to cool immediately after production, cooling continues during transport, incorporation, compaction and after compaction. The thicker the layer, the slower it cools. Adequate early stiffness of the layer is usually achieved when the temperature of the layer drops below approximately 30 °C [5]. It is achieved in a very short time, from a few minutes to a few hours [6], depending on the thickness of the layer and the temperature characteristics of the mixture and the surroundings.

Favorable conditions for obtaining early stiffness of the asphalt layer: as thin a layer as possible, cold layer under the installed layer; cloudy, windy, cold weather.

3.1 Increasing the stiffness of the BSM layer

When stabilizing with foamed bitumen (and active filler), densification achieves the immediate appearance of cohesion forces that create resistance to deformations, but adequate stiffness for carrying greater traffic loads is usually achieved only when the moisture content in the layer is low enough (to approximately 50 % of the optimal moisture value according to Proctor). Adequate initial stiffness can be achieved within a few hours to 24 hours. If, after installation, the layer is exposed to favorable weather conditions, the moisture content decreases more quickly and the layer consequently gains rigidity more quickly. The stiffness of the layer therefore increases with a decrease in the moisture content in the layer and with the influence of the cement hydration process. When bituminous emulsion is used, the achievement of adequate stiffness is slower than when foamed bitumen is used, due to the delay in the breakdown of the emulsion. The final stiffness of the BSM layer is reached in about three years [2].

Favorable conditions for obtaining the early stiffness of the BSM layer: low proportion of moisture in the layer, adequate proportion of cement in the mixture; sunny, windy, hot weather; low percentage of moisture in the atmosphere.

4. CONCLUSIONS

The deviations in the properties of HMA mixtures are smaller compared to the deviations in the properties of BSM, but with a professional approach they can be controlled to a large extent. That is why we need professional and experienced staff.

Due to significantly cheaper and faster execution of the works, this brings us great financial, time and environmental benefits.

5. REFERENCES

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