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NEW EXPERIENCES WITH FOAMED BITUMEN ASPHALTS IN HUNGARIAN ROAD BUILDING

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Abstract

The use of low temperature (LT) asphalt products can result in a significant decrease of temperature required for asphalt production. This reduces energy costs and consumption. Moreover, safety during asphalt production and laying improves because the amount of potentially harmful vapours and aerosols decreases. Temperature decrease, in addition to the above, reduces the short-term ageing of bitumen in the asphalt production process, and ultimately has a positive impact on the durability of pavements.

COLAS Group in Hungary considers propagating the use of low temperature sorts of asphalt in road construction in Hungary as a high priority innovation task

Between 2012 and 2014, COLAS Group equipped its asphalt mixers with units from different manufacturers, capable of producing foamed bitumen, at four COLAS Group mixing plants in Hungary.

This was followed by several test production runs and course laying with asphalt mixes containing foamed bitumen. Some of the foam asphalt mixes were produced and laid at low temperatures. The other part of the mixes were produced at conventional temperature and were layed after 2 – 2.5 hours of transport. The test asphalt mixtures were made with 50/70 and 10/40-65 modified bitumen also containing 10-20% RA.

We compared the compactability of foamed bitumen mixtures produced with four different foaming kits. We produced Marshall specimens at various compaction temperatures, tested the bulk densities of the specimens, then represented the bulk densities subject to the compaction temperature. We established the following:

- the Marshall bulk density (better compactability) of foamed bitumen asphalt mixes is higher for all asphalt types compared to the normal bitumen mixtures,
- higher Marshall bulk density of foamed bitumen asphalt mixes can be achieved both in normal (50/70) and modified bitumen mixtures (25/55-65,10/40-65),
- better compactability of foamed bitumen asphalt mixes is independent of the type of the foaming kit. It works for all types of foaming kits.

Keywords: foamed bitumen, foamed asphalt, LT asphalt; energy consumption; environmental protection; CO_2 reduction.

1. INTRODUCTION

The asphalt industry has constantly been on the lookout for opportunities to reduce energy consumption and greenhouse gas emissions in order to have its share in solving environmental protection issues. Low temperature asphalt production does not just contribute global environmental protection, but also reduces asphalt production costs. At the moment, the following methods are available to decrease the mixing temperature of asphalts: viscosity modifying mineral additives (e.g. zeolite), viscosity modifying organic additives (Fischer-Topsch waxes, fatty acid amides, montan waxes), viscosity modifying binders [1] and foaming [2].

It is a high priority on the innovation agenda of COLAS Group Hungary to promote the application of low temperature asphalt products in Hungarian road construction. COLAS Group Hungary has dealt with LT asphalt mixes since 2008. Between 2008-2010, we constructed several road sections using the fatty acid amide additive produced by COLAS Ireland. These test sections brought positive results, nevertheless, despite the nearly 30 % energy saving the relatively higher acquisition cost of the additives makes the price of LT asphalt mix in Hungary higher than that of normal asphalt mixes [3].

2. FOAMING KITS IN COLAS HUNGARY

In 2012, COLAS Group Hungary installed a foaming kit on the Ammann UNIGLOBE 240 mixing plant (batch plant, fix telepítésű) located in the vicinity of Budapest (Dunaharaszti). The foaming kit is Swiss production.

In 2013, we installed a foaming kit produced in Germany in our Benninghoven TBA 180 U mixing plant (batch plant, fixed installation) in Felsőzsolca, Northeast Hungary.

In 2014, we installed Colas foaming kits in our Benninghoven TBU 160 mixing plant (batch plant, fixed installation) in Táplánypuszta, West Hungary and Benninghoven TBA 240 U mixing plant (batch plant) that currently is in operation at a motorway project in the Great Plain.

The properties of the foaming kits are illustrated in Table 1.

Table 1. Type of foaming kits in Colas Hungary

Mixing plant	Type of kit	System of kit	Year of operation since
Dunaharaszti	Swiss production	Bitumen pump	2012

Felsőzsolca	German production	Bitumen pump	2013
Táplánypuszta	Colas	Bitumen pump Modified gravitation	2014
Szolnok	Colas	Gravitation	2014

Figure 1 presents the locations of fixed installation Colas mixing plants with foaming kits in the map of Hungary. Foamed bitumen asphalt mixes may be produced at normal and low temperature as well. Foamed bitumen asphalt mixes produced at normal temperature have longer workability, therefore, the foamed bitumen asphalt mixes produced at the three mixing plants can practically cover the whole territory of Hungary.

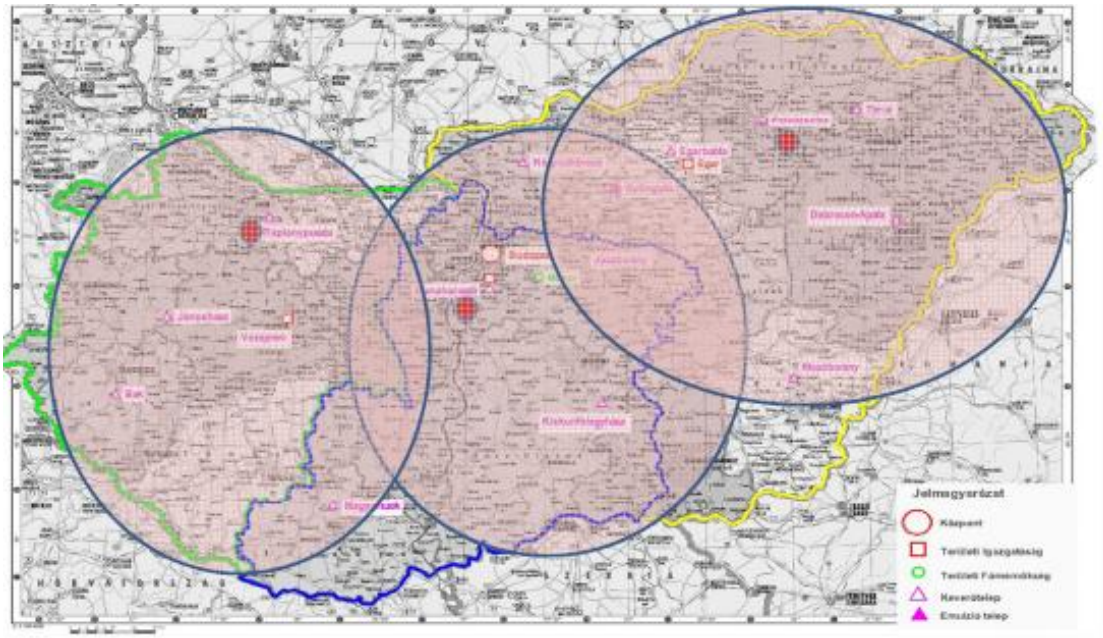

Figure 1. Action radius of Mixing Plants with foaming

The foamed bitumen asphalt mix quantities produced at the Dunaharaszti and Felsőzsolca mixing plants in 2014 are presented in Table 2.

Table 2. Foamed asphalt mixes in 2014

Asphalt plant	Asphalt production in tons	Foamed production in tons	Foamed production, %
Dunaharaszti	101 739	30 026	30
Felsőzsolca	131 223	95 927	73
Total	232 962	125 953	54

3. COMPACTION TRIAL TESTS

We laid several trial sections after the installation of the first foaming kit in 2012.

During the trial operations, we built in low temperature asphalt in Budapest, near our mixing plant, while we laid the asphalt that was produced at normal temperature after 2-2.5 hours of transport. The asphalt mixes produced were wearing and binder course mixes of different particle sizes designed for various traffic loads. We used normal 50/70 and hard modified 10/40-65 bitumen to produce the mixes. All mixes contained 10-20 % of RA. We dosed 2.5 % water in proportion to the total bitumen amount for foaming in the asphalt mixes. We applied 29 s wet mixing time for all asphalt mixes. We had not problems with foaming bitumen even in the case of hard modified bitumen.The composition of the asphalt mixes produced satisfied the factory production control requirements. The compaction and pavement void values of foamed bitumen asphalt courses satisfied the requirements for WMA courses. When working with foamed bitumen LT asphalt mixes, we obtained a temperature reduction of 50-70 ^{o}C in the case of aggregates and that of 35-40 ^{o}C in the case of the finished asphalt mix compared to the conventional production temperatures. When working with foamed bitumen asphalt mixes at normal temperature can be transported the asphalt mixes about 200 km distances from mixing plant without changing the quality of asphalt mixes [4].

After the foaming kits of diverse production were put into operation, it was necessary to verify whether the new equipments would operate as efficiently as the foaming kit installed in the Dunaharaszti mixing plant. In other words, we checked if better compaction can in fact be achieved with foamed asphalt mixes produced on said equipment.

For this reason, in the laboratory we produced Marshall test specimens according to EN 12697-30 [5] by 2 x 50 hits at various temperatures of the foamed asphalt mixes produced at various mixing plants and monitored compaction by the bulk density (acc. EN 12697-6 B method) [6] change of Marshall test specimens. As reference, we also tested normal (not foamed bitumen) asphalt mixes of the same composition. The characteristics of the tested asphalt mixes are illustrated in Table 3.

Table 3. Characteristics of tested asphalt mixes

Asphalt plant	Foaming kit	Type of Asphalt mix	Type of bitumen	Water content in bitumen
Dunaharaszti	Swiss	AC 11 (mF) wearing	25/55-65	2,5 %
Felsőzsolca	German	AC 11 wearing	50/70	2,5 %
Szolnok	French	AC 22 (F) binder	50/70	2,5 %
Táplánypuszta	modified French	AC 22 (mNM) binder	10/40-65	3,3 %

Marshall bulk densities are represented in view of the compaction temperature (compaction curves). The compaction curves of foamed bitumen asphalt mixes compared with those of the reference mixes are illustrated in Figures 2-5.

The figures demonstrate that the Marshall bulk densities of foamed bitumen asphalt mixes are invariable higher than the Marshall bulk densities of the reference mixes. This means that foamed bitumen asphalt mixes are always better compacted than reference asphalt mixes.

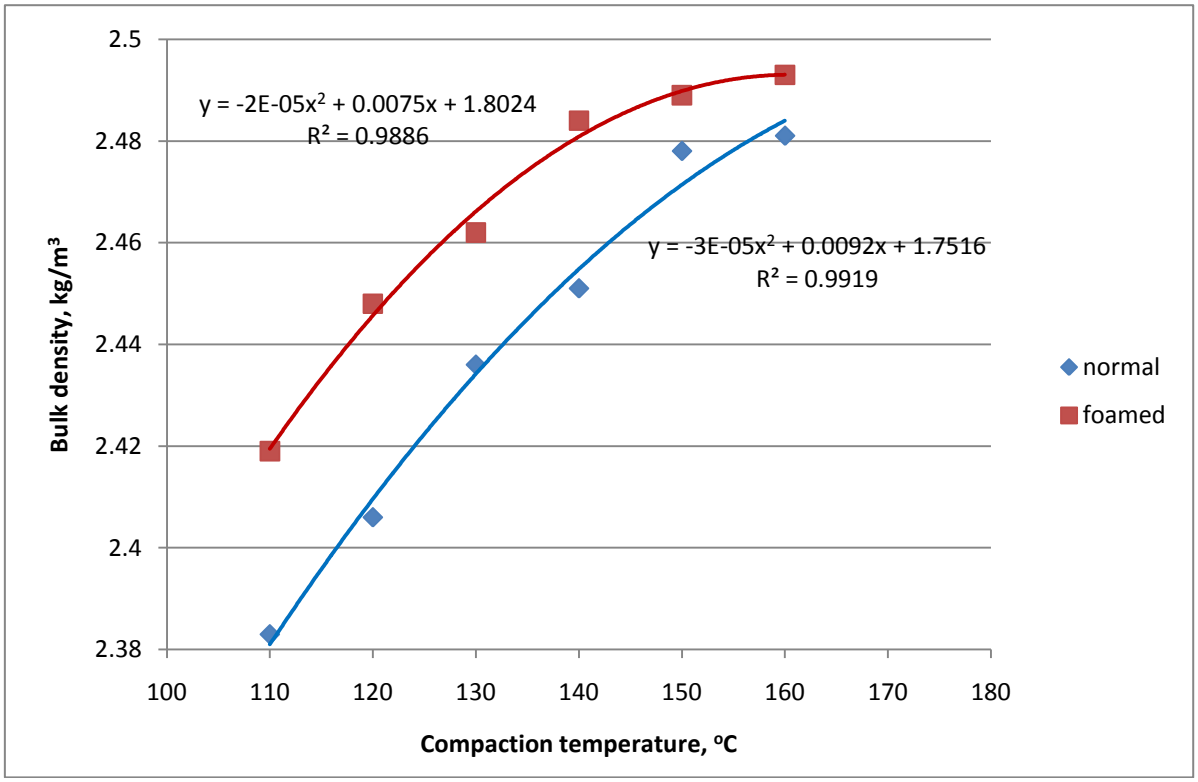

Figure 2. AC 11 (m F)wearing 25/55-65 type, Dunaharaszti mixing plant

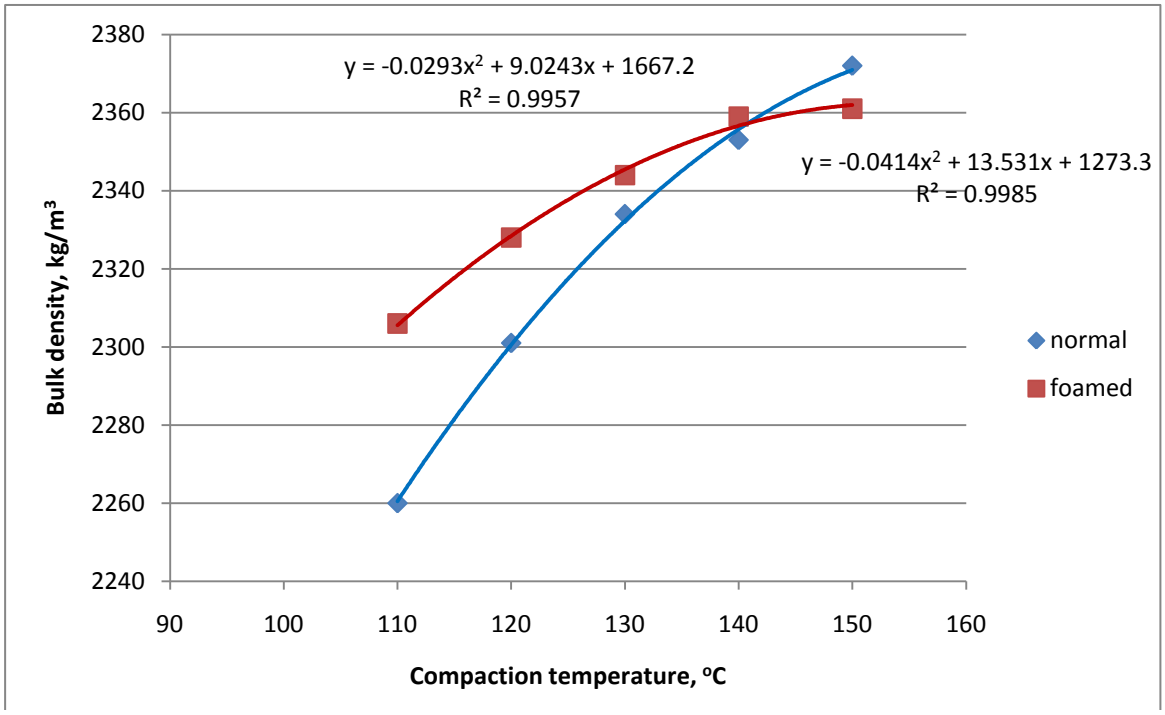

Figure 3. AC 11 wearing 50/70 type, Felsőzsolca mixing plant

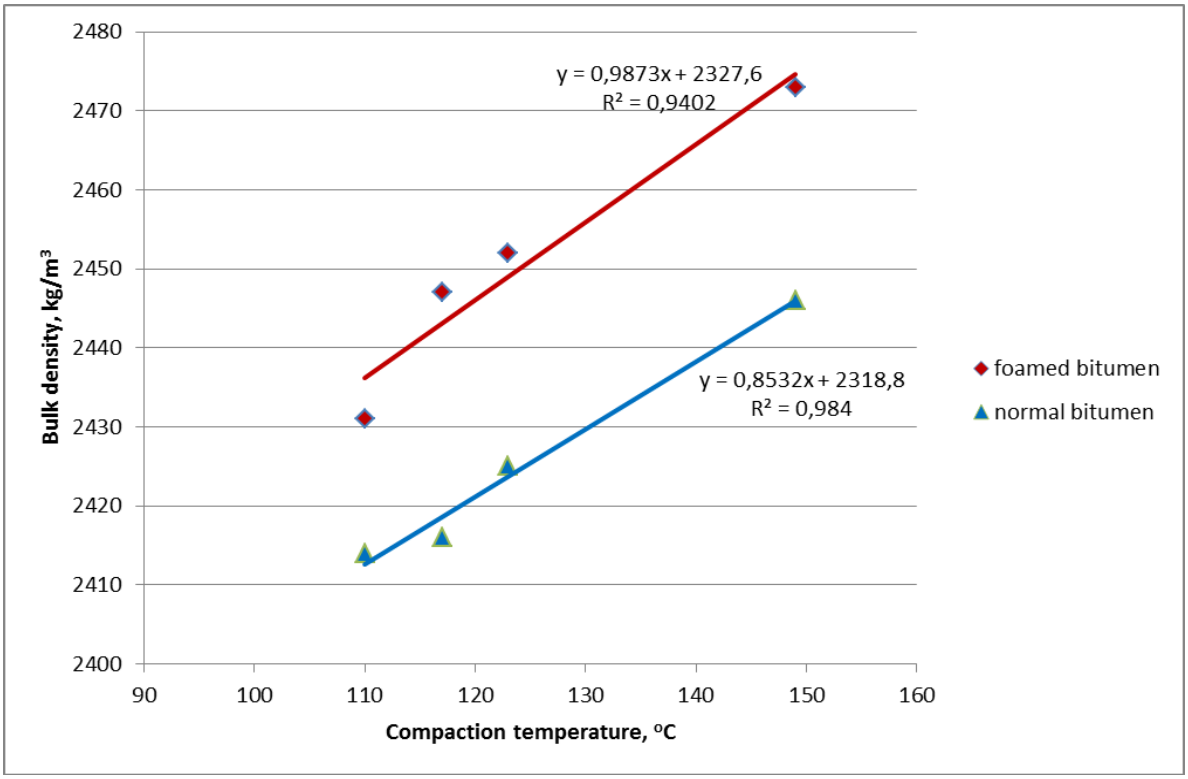

Figure 4. AC 22 (F) binder 50/70 type, Szolnok mixing plant

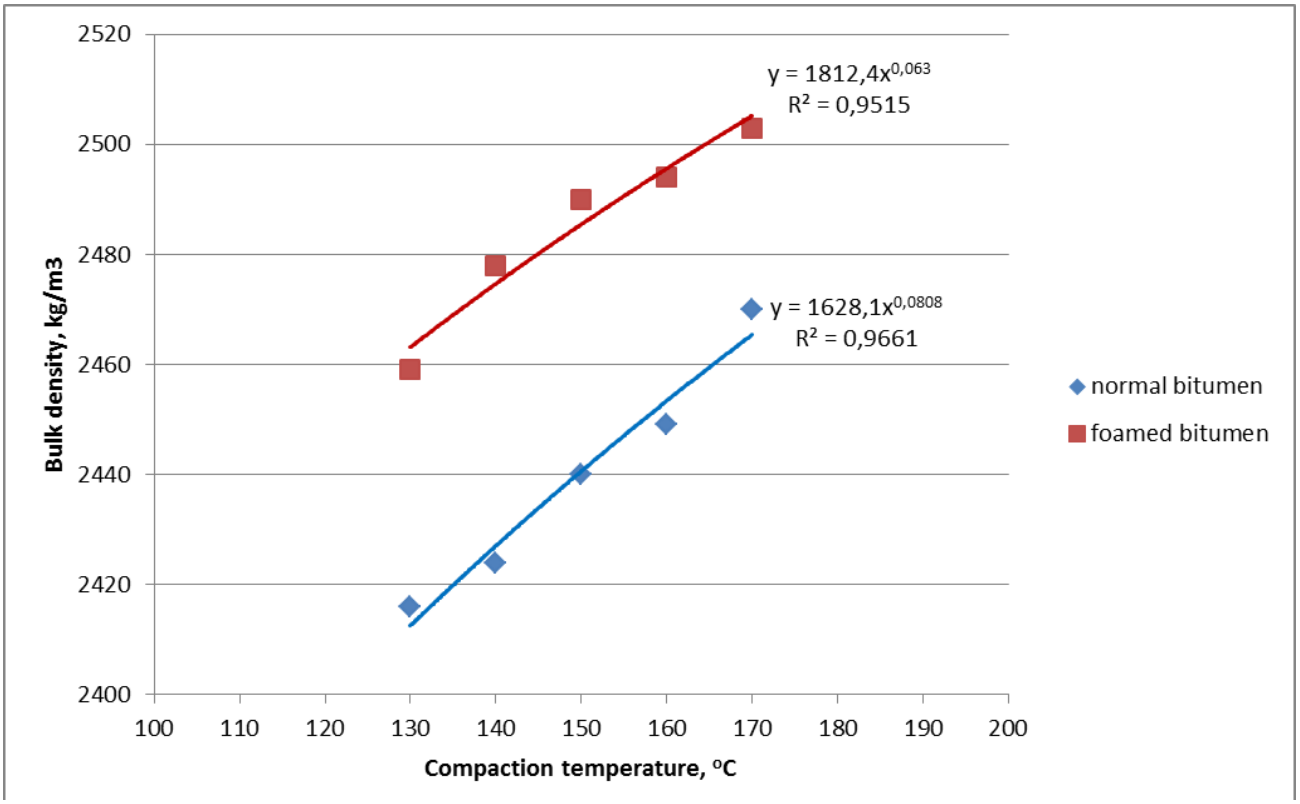

Figure 5. AC 22 (mNM) binder 10/40-65 type, Táplánypuszta mixing plant

4. CONCLUSIONS

COLAS Group Hungary has dealt with LT asphalt mixes since 2008. Between 2008-2010, we made several road sections using the fatty acid amide additive produced by COLAS Ireland. These test sections brought positive results, nevertheless, despite the nearly 30 % energy saving the relatively higher acquisition cost of the additives makes the price of LT asphalt mix in Hungary higher than that of normal asphalt mixes (3).

We installed the first foaming kit at our Dunaharaszti mixing plant in 2012, then based on the positive production and building experience gathered there, we continued to install foaming kits at our Felsőzsolca mixing plant in 2013, followed by installations at the Táplánypuszta and Szolnok mixing plants in 2014. The foaming kits were produced by different companies. The price of the foaming kits was a key factor for the procurement of the equipment.

Foamed bitumen asphalt mix production at two of our mixing plants amounted to some 50% of the total production in 2014. The production of foamed bitumen asphalt mixes at said four mixing plants and the building of

mixes have become routine. The better compactability of foam bitumen asphalt mixes is perceptible and can also be monitored by isotopic density measurements during laying. On the other hand, laboratory tests can provide the best exact methods to monitor the compactability of foamed bitumen asphalt mixes.

We subjected the foamed bitumen asphalt mixes of various composition, containing different bitumen types and produced at four mixing plants to Marshall compaction at a variety of compaction temperatures. We performed the same tests on the reference mixes (containing normal bitumen). We represented the Marshall bulk densities in view of the compaction temperatures. The comparison of the resulting compaction curves leads to show that

- the Marshall bulk density (better compactability) of foamed bitumen asphalt mixes is higher for all asphalt types compared to the normal bitumen mixtures,
- higher Marshall bulk density of foamed bitumen asphalt mixes can be achieved both in normal (50/70) and modified bitumen mixtures (25/55-65,10/40-65),
- better compactability of foamed bitumen asphalt mixes is independent of the type of the foaming kit. It works for all types of foaming kits.

Based on the favourable experience gained with bitumen foaming, COLAS Group Hungary will increase its foamed bitumen asphalt mix production in the future. Low temperature production enables energy saving, reduces greenhouse gas impacts and provides for the health protection of employees. Production at normal temperature, on the other hand, does not produce saving by reducing the mixing temperature, but in this case it doesn't be established mixing plant by working place, so it can be saved e.g.. set up cost of mixing plant.

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