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28–30 April 2014, Split, Croatia

## Road and Rail Infrastructure III

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## VIASPHALT BT<sup>®</sup>, THE MASTIC ASPHALT “LOW” AND “VERY LOW” TEMPERATURE

Jean-Etienne Urbain

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### Abstract

Mastic asphalt is a common material mainly use for waterproofing works (bridge decks), for pedestrian paths, car parks but also for road wearing courses. This material needs high temperatures in order to aloud correct laying conditions. The European REACH regulation (Registration Evaluation and Authorization of Chemicals) started to be implemented in Europe in 2007. The application to bitumen on the 1st of December 2010 had a critical effect of the development of warm solutions for mastic asphalts. Starting with experimental products, the French companies had to move to industrial solutions by producing and laying mastic asphalts under the temperature of 200°C. This temperature corresponds to the maximum temperature to use the bitumen, as it was defined by the producers. Characteristics of the products are defined according to the standard EN 13108-6. In this context the Eurovia Group developed a range of mastic asphalt products corresponding to the 2 new types (between 180°C and 200°C and under 180°C). The technic is very innovative and based on the use of a single additive which is renewable and which is very easily implemented on the plant. These new mastic asphalts are produced around 170 / 180 °C and are laid on the jobsite between 160°C and 180°C. This is a real drop by comparison with traditional mastic asphalt which are produced and laid around 220°C to 240°C. The aim of the presentation is to detail the formulation process, the performances and the follow up of these new products as well as their implementations in France, Czech Republic and CROATIA by the company TEGRA.

*Keywords: warm asphalt, health care, condition of laying, European regulation, innovation*

### 1 Introduction

The current mastic asphalt is defined by the following way. It is a mixture of chippings, sand, filler and bitumen the proportions of which are adjusted in order to obtain the flowing characteristic. Currently the mastic asphalts represent 220,000 tons laid on the French territory [1] and 1 million tons in Europe. The common proportions for a road mastic asphalt are:

- Chippings           30%;
- Sand                34%;
- Filler               28%;
- Bitumen            8%.

In general, the components are mixed in the plant with the quick mixer, and then they stay, for homogenization, in the pug mill during some hours. The mastic asphalt is then transported on the jobsite by trucks called transport mastic asphalt pug mills, thermo regulated, horizontal and vertical and with a capacity of 8 to 20 tons. The laying is, the most of the time, carried out manually by taking the mastic asphalt in wooden buckets and by laying it with a wooden squeegee (trowel).

For the jobsites that need an application on a continuous big surface, mechanized means are used. There are specific pavers (pendulum beam) front fed by a mobile plug mill. For a long time, the mastic asphalts are laid in the following sectors: waterproofing, footpath, industrial soil and roads. The production and the laying of mastic asphalts were carried out traditionally with temperatures reaching 240 to 250°C.

As for the asphalt concretes, one of the main research axes regarding these products is the decrease of their production and laying temperature. The field of mastic asphalt suffered a profound and quick modification in 2010 following to the coming into force of a new regulation. The implementation of this new regulation called REACH [2] began in June 2007. The application with bitumen on 1st December 2010 had an accelerating effect on the elaboration of the warm mixes. At the experimental stage, the companies were forced to move to the industrial stage while producing and laying the products at a maximum temperature of 200°C. This temperature corresponds to the maximum temperature of the use of the binder defined by the bitumen producers. The bitumen of direct distillation with the CAS number (unique registration number at the data bank of chemical abstract service) 8052-42-4 had the deadline of registration at the ECHA [3] on 30/11/2010. This registration in REACH, expressed on behalf of the Oil Companies by Europeans Unions EUROBITUME and CONCAWE, indicates via safety data sheets, the conditions of use and the use defined by the producers of bitumen, particularly the maximum temperatures to not exceed regarding health and safety rules. The safety data sheet of the bitumen commonly used for mastic asphalt systematically indicates a heating temperature up to 200°C or the temperature of the flash point reduced by 30°C, that means 190°C or 200°C depending on the source of bitumen.

The consequence of the bitumen registration in REACH was a production and laying of a mastic asphalt at temperatures below 200°C. In March 2012 the French "Office des Asphaltes" which is the Union of mastic asphalt Industries in France decides to define again the terminology of mastic asphalts while creating 3 classes of mastic asphalt from its general definition:

- traditional mastic asphalt: mastic asphalt, produced, transported and laid at a temperature above 200°C;
- low temperature mastic asphalt (BT): mastic asphalt, produced, transported and laid at a temperature between 180°C and 200°C;
- very low temperature mastic asphalt (TBT): mastic asphalt, produced, transported and laid at temperatures below 180°C.

In the 3 cases the mixing characteristics are defined by the standard NF EN 13108-6.

## 2 EUROVIA – the VIASPHALT® BT

### 2.1 Development and characteristics

For more than 10 years Eurovia has worked to decrease the temperatures of mastic asphalts. This step and the associated researches meet the environmental and health policies of the group. The research center of Eurovia elaborated a process allowing to decrease very significantly the production and laying temperatures of these mastic asphalts for the most common applications. This temperature lowering has numerous advantages, on the technical level (important decrease of the shrinkage phenomenon), economical (low extra costs), environmental and health level (energy consumption and almost no more fumes while applying).

The process is extremely innovative by its simplicity (unique additive), by the renewable character of the additive (in comparison to those currently used in the profession), by a production mode easily transposable in the batch plants. The decrease of the temperature between 60°C and 70°C allow to produce the mastic asphalts at 170°C / 180°C. Regarding the nomenclature of the office of mastic asphalts Eurovia carries out in the majority of the cases mastic

asphalts TBT. The process is subject to a trademark in Europe and in a number of countries all over the world. It contributed to the new product, the VIASPHALT® BT.

The principle is based on the use of an additive allowing to liquefy the mastic asphalt and to modify the pseudo viscosity of the mixture aggregates / bitumen at high temperatures (> 100°C) without changing the performances of the mastic asphalt below 80°C, or to improve them for certain ones.

This additive coming from the agro-resource, thus renewable is characterized by a melting point of 90°C. Its production simplicity makes the supply reliable and regular, furthermore its packaging in thermo fusible bags or big bags and its handling is simple. Before 2010, several experimental jobsites were carried out in France in order to validate the process, to make sustainable innovation.

## 2.2 VIASPHALT BT®, key benefits

### 2.2.1 Mix design

The mix design is the same as for hot mixes, as a part of bitumen is replaced by an additive. The process is then simple but keeps all known difficulties of the mastic asphalt mix design, workability; shear resistance (Fig.1). In the majority of the cases, the elaboration in the laboratory is not only the feasibility; validation and industrial adjustment are consequently necessary.



Figure 1 Machine to measure the indentation according to the standards EN 12697-20 and EN 12697-21

### 2.2.2 Technical characteristics

They are maintained or improved for certain regarding the traditional mastic asphalt. A particular characteristic of VIASPHALT BT is its lower shrinkage sensitivity. This one measured in the laboratory following the operation mode used in France allows us to verify this excellent behaviour, as shown on Table 1.

**Table 1** Comparative shrinkage measurements

	Traditional mastic asphalt (footpath)	Viasphalt® BT (footpath)
Shrinkage [mm]	0.20	0.07

### 2.2.3 Economical

Whatever the process used to decrease the temperature of mastic asphalts, systematically there is an extra cost non-negligible. With an increase of 15% in comparison to the traditional mastic asphalt, the VIASPHALT® BT is very competitive on the market of the low temperature mastic asphalt.

Note that the reduction of energy consumption in production does not present an economical advantage, as this one is largely absorbed by the cost of the additive. This is a very important point for the development of the process, adding of the additive is carried out by a thermo fusible bag or by an automated system in the asked quantity (see Fig. 2). The production is possible on every batch plant without changing significantly the production conditions



**Figure 2** Automated feeding of the additive (Plant CIFA Mityr-Mory, France)

## 3 Situation in 2013, EUROVIA, France and abroad

In France, the production of mastic asphalts BT and TBT covers at least 80% of the tonnages carried out by the companies that are members of the office of the mastic asphalts. Since December 2010, Eurovia has laid low temperature mastic asphalts for the quasi totality of its mastic asphalt activity. (~98%). There are still some jobsites carried out with hot mixes on request of the client. These jobsites concern generally the waterproofing on bridges, sector in which the mastic asphalts BT show satisfied results. However there are still some reticences on behalf of certain clients because of a lack of technical information. The same for the most jobsites with clear or colored mastic asphalts based on a clear binder that are still carried out with the traditional process.

In other countries mainly in Europe, there are less feedback and communications on the use and development of these new mastic asphalts. Eurovia distributes its process within its subsidiaries. The first jobsites were carried out in the Czech Republic, in Prague in 2012. In order to develop this process in the Czech Republic in the subsidiary EUROVIA CZ, the company had to use all its know-how from France on low temperature mastic asphalts. Thus, the first step of this technology transfer was to choose carefully the components and to establish

a mix design with the cooperation between the laboratories of Mérignac and Prague. The second step was to launch a first satisfactory industrial production (see Fig.3).



Figure 3 Resurfacing TRAMWAY (PRAGUE 2012)

In 2013, the subsidiary TEGRA in Croatia carried out its first experimentation. A similar deployment was undertaken by entities of the company to take full advantage of the experience gained in France. The application fields sighted by the Croatian subsidiary are bicycle paths or footpaths, roads with light traffic and parking spaces in commercial areas. The same requirements regarding indentation are expected in Croatia. However, the technical export is complex, the regulation REACH is not always followed and the extra cost of production seems sometimes too high in comparison to the traditional mastic asphalts.

#### 4 Technical report after two years of production

In the region of Paris, since 01/12/2010, Eurovia has produced and laid about 45,000 tons of “warm” mastic asphalt. Regarding the terminology of the office of mastic asphalts of March 2012, the big majority was carried out in TBT that means below 180°C. For the transport, the horizontal and vertical pug mills are now systematically calibrated in order to guarantee the announced temperatures. Furthermore the maximum heating temperature is fixed at 190°C, there is no action possible on the temperature to catch up a lack of workability and there is no scope of action to adapt production, transport and laying hazards.

The conditions of production, storage and putting in pug mills and transport became very precise and very qualified. The complexity caused by the decrease of the temperature and the important increase of the viscosity of the binder asked important industrial follow-up. One discovers then a difficulty to maintain the indentation level of the production up to the last ton of the pug mill, hence the difficulty to produce daily regular mastic asphalts. Difficulties that are the same in the past for traditional mastic asphalts but force of habit they were less often followed by all players of the mastic asphalts.

The traditional mastic asphalt afforded some flexibilities of use for its viscosity managed by the temperatures higher than 200°C and mechanical resistances favored by the oxidation of the bitumen at a high temperature. The warm mastic asphalts kept these performances by the use of an adapted additive but the technology is more complex. On the 45,000 produced tons, beyond the follow-up of CE marking, 10% of the production and laying were subject to a high level control in the laboratory and on the jobsite (workability, indentation, complete analyses). The efforts of the follow-up, the adjustments allow today to guarantee the mastic asphalts BT or TBT responding on different fundamental criteria; indentation, workability, aspect and the laying facility, compliance with thicknesses, all, in an urban environment with a quasi-

disappearance of fumes (see Fig.4). With a temperature lowering by 60°C the fumes quantity is divided by a factor of 32.



Figure 4 Jobsite VIASPHALT BT in Paris and temperature measurement

## 5 Health and environmental reports

The environmental report is very positive. Since 2010, Eurovia followed the impact of this production of low temperature mastic asphalt on atmospheric emissions. The main production plant of the group provided all figures, tonnage and energy consumption. The evaluations of the data in 2011 and 2012 were compared to 2010 (about 90% of hot mastic asphalt production). The results are the following:

- the reduction of the registered energy consumption on the level of dryer is 41% when producing low temperature mastic asphalts;
- the impacts on the emissions of greenhouse gas are about – 17 %;
- the VIASPHALT BT creates a progress of a health point of view; the following observations are systematic:
  - decrease or elimination of fumes during application;
  - much less odor;
  - application comfort;
  - important reduction of the inconvenience for the residents.

## 6 Perspectives

For Eurovia the perspectives are multiple. The first one is to follow its process, to develop it to further improve the whole production chain, from production to laying. Then, facing the slow evolution of the profession of mastic asphalt and its working conditions, EUROVIA would like to increase its action in the field of work hardness. Increase the activity of “low temperature asphalt” in Europe is an aim. This is an ambitious program highly depending on the behaviors and ways that will be implemented in the European Community. Overcome the administrative barriers will be more complex than the technical issue.

## References

- [1] Figures from “Office des Asphaltes” which is the Union of mastic asphalt industries in France
- [2] REACH means Registration Evaluation and Authorization of Chemicals
- [3] ECHA means European Chemicals Agency