

Assessing the Potential and Possibilities for the Use of Warm Mix Asphalt in Latvia

Martins Zaumanis¹, Viktors Haritonovs², Guntis Brencis³, Juris Smirnovs⁴, ¹⁻⁴Riga Technical University

Abstract. Warm Mix Asphalt (WMA) production technologies allow lowering the production and paving temperature of the conventional Hot Mix Asphalt (HMA) by at least 20°C without compromising the performance of asphalt. This promises various benefits over HMA, for example, allows to reduce the energy consumption, thus lowering the greenhouse gas emissions, permits to extend the paving season, attain better compaction, provides longer haul distances etc. However, in order to reach widespread implementation of WMA, it is necessary to provide enough information to the decision makers on the benefits of this technology. This article presents an overview of different WMA products and production principles, benefits and drawbacks associated with the technologies. A total of fifteen products that were found to be used in Europe are reported in the paper. However, not all of the technologies are suitable for Latvia, because of the necessary financial investments, climate, local legal provisions and the industry traditions. Potentially most favourable technologies for Latvian conditions are analysed with the reference to local road specifications.

Key words: Warm Mix Asphalt (WMA), greenhouse gases

INTRODUCTION

WMA is a relatively new technology that allows significant lowering of the production and pavement temperature of conventional hot mix asphalt (HMA) without compromising the performance of pavement. The temperature reduction range varies depending on what WMA product is used, but the common classification of asphalt by the production temperature is presented in Figure 1.

WMA promises various benefits, e.g. reduced greenhouse gas emissions, lower energy consumption, improved working conditions, lower binder viscosity, better compaction, etc. These technological advantages of WMA allow to use it not only as a substitute for conventional HMA by applying the same asphalt specifications, but also to use it in circumstances, where usage of HMA would not be eligible. However, in order to reach widespread implementation of WMA, it is necessary to provide enough information to the decision makers on the benefits of this technology and ensure that the asphalt has the

same or better mechanical characteristics and long-term performance as the HMA.

The article is based on the Master Thesis by Martins Zaumanis at the Danish Technical University, published as a monograph [1].

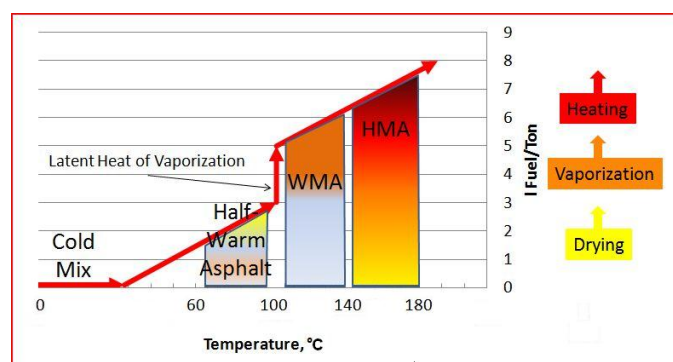


Fig. 1. Asphalt classification by production temperature [3]

WMA PRODUCTION TECHNOLOGIES

The existing WMA production technologies can be categorised in three groups:

1. Foaming technologies;
2. Organic or wax technologies;
3. Chemical additives.

The most widely used products available on the European market and their descriptions are listed in Table 1. The reported values of the production temperatures were not the same in all the literature reports, therefore the most commonly reported data or data supported by the production company are listed first and the data from a different research - afterwards. Differences in the reports may be caused by different factors, such as the production technology, type and the amount of additives used, mix design methods, climatic conditions, material use, etc. The amount of WMA additive usually depends on the materials used, their proportion and especially the grade and type of bitumen used.

TABLE 1
COMMON WMA TECHNOLOGIES IN EUROPE

Product	Company	Description	Reports from countries	Additive	Production temperature (or reduction ranges)
FOAMING TECHNOLOGY					
Low Energy Asphalt	LEACO	Water based Hot coarse aggregate mixed with wet sand	US; France, Spain, Italy	Yes, $\pm 0.5\%$ of bitumen weight of coating and adhesion additive	$\leq 100^\circ\text{C}^*$ [2; 3;4] 105-124°C [5]
WAM-Foam	Shell and Kolo-Veidekke	Foaming process using two binder grades	US, Norway	Antistripping agents could be added to soften binder	110-120°C*[6] 100-120°C [3] 62°C [5]
LEAB	BAM	Water based Mixing of aggregates below water vaporization	Netherlands	0.1% of bitumen weight of coating and adhesion additive	90°C [3]
LT Asphalt	Nynas	Water based Binder foaming + hydrophilic filler	Italy, Netherlands	0.5-1.0% of hygroscopic filler by mixture weight	90°C [3]
Aspha-Min	Eurovia	Water containing Zeolite	US; France, Germany	0.3% by mixture weight	(30°C)* [7; 8] (12°C) [5] (20-30°C) [9]
ORGANIC TECHNOLOGY					
Sasobit	Sasol	Fischer-Tropsch wax	US, EU, worldwide	2.5-3.0% of bitumen weight in Germany 1-1.5% of bitumen weight in US	(10-30)* [10] (20-30°C) [3] (18-54°C) [11] 130-150°C [9]
Asphaltan A Romonta N	Romonta GmbH	Montan wax for mastic asphalt	Germany	1.5-2.0% of bitumen weight	(20°C) [12]
Asphaltan B	Romonta GmbH	Rafined Montan wax with fatty acide amide for rolled asphalt	Germany	2-4% by mixture weight 2.5%by mixture weight	(20-30°C) [3]
Licomont BS 100	Clariant	Fatty acid amide	Germany	3% of bitumen weight	(20-30°C) [3]
3E LT or Ecoflex	Colas	proprietary	France	Yes, not specified	(30-40°C) [3]
CHEMICAL TECHNOLOGY					
Evotherm ET	Mead-Westvaco	Chemical bitumen emulsion	US, France, worldwide	In form of bitumen emulsion	(50-75°C)* [13] (37-54°C) [5] >93°C [14] 85-115°C [3]
Evotherm DAT	Mead-Westvaco	Chemical package plus water	US, France, worldwide	30% by weight of binder	(45-55°C)* [13] >93°C [14] 85-115°C [3]
CECABASE RT	CECA Arkema group	Chemical package	US, France	0.2-0.4% by mixture weight	120°C* [15] 101°C [5]
Rediset WMX	Akzo Nobel	Cationic surfactants and organic additive	US, Norway	1.5-2% of bitumen weight	($\geq 30^\circ\text{C}$)* [16] (16°C) [14] 126°C [5]
WarmMix L	Star Asphalt	Amide based chemical package	France, Italy, East. Europe	0,5% of bitumen weight	(30°C)* [17]
*Temperature range defined by the product supplier					

Foaming technology

Foaming technologies use small amounts of cold water injected into the hot binder or directly in the asphalt mixing chamber. The water rapidly evaporates and is encapsulated in the binder, producing large volume of foam. The foaming action in the binder temporally increases the volume of the binder and lowers the viscosity, which improves coating and

workability. In the foaming processes enough water must be added to cause foaming action without adding too much, so that stripping problems arise. To ensure this, most of the producers advise to use antistripping (adhesion, coating) additives to ensure that moisture susceptibility of an asphalt mixture is minimized. Liquid antistripping additives are recommended for WMA production processes [3; 14]. They

are added to the binder just before mixing with aggregates, typically 0.5% by weight of binder.

There are several foaming technologies available that could be sub-categorised into two groups: water based and water containing [18; 5].

Water containing technology uses finely powdered synthetic zeolite that has been hydro-thermally crystallized. It contains about 21 percent water of crystallization which is released when temperature is increased above 85°C. When the additive is added to the mixture simultaneously with the binder, water is released as a fine mist, which foams the binder. Controlled foaming effect of 6 to 7 hours of increased workability is reported [14; 3; 9].

Water based technologies use a foaming process which is created by injecting cold water into hot asphalt binder using special equipment or technology. The water rapidly evaporates, producing a large volume of foam, which slowly collapses [18; 5].

It is considered that these technologies are the most technically complex and require relatively large financial investments for plant modification. There are also some concerns on the moisture susceptibility and permanent rutting of asphalt produced by these technologies. These are pressing problems in Latvia even for HMA, therefore it is considered that thorough research and laboratory testing are necessary before implementing these technologies in Latvia.

Organic technology

Organic or wax additives are used to achieve the temperature reduction by reducing the viscosity of the binder at the production temperature. The processes show the decrease of viscosity above the melting point of the wax, making it possible to produce asphalt mixes at lower temperatures. After crystallisation, waxes tend to increase the stiffness of the binder and the resistance of asphalt to deformation. The type of wax must be selected carefully so that the melting point of the wax is higher than expected in service temperatures to minimize embrittlement of the asphalt at low temperatures [3; 5].

Different researches (for example [19; 11]) show that WMA that is produced using waxes often has better resistance to plastic deformation than the traditional HMA. This performance can be explained by the forming of the lattice structure in bitumen below the crystallisation point of wax. This process stiffens the binder and increases the resistance to permanent deformations of asphalt.

Waxes are also often used as additives to improve resistance to deformation and to improve workability of the mixture for the traditional HMA. Keeping in mind that there are considerable problems with the resistance to permanent deformations in Latvia it is considered that waxes may be successfully used for the production of WMA here.

Chemical additives

A variety of chemical packages are used for different products. They usually include a combination of emulsification agents, surfactants, polymers and additives to improve coating, mixture workability, and compaction, as well

as adhesion promoters (antistripping agents). The added amount and temperature reduction depends on the specific product used. The chemical additive package is used either in the form of an emulsion or added to bitumen in the mix production process. This results in relatively minor modifications necessary for the asphalt plant or to the mix design process [14; 5].

BENEFITS AND DRAWBACKS OF WMA

WMA technologies promise a number of benefits, when used. They can vary depending upon which specific WMA technology is used. However, generally the benefits can be categorized in four groups:

- environmental;
- production;
- paving;
- economic.

The concerns are mostly subjected to a relatively short WMA implementation period and insufficient accessibility of in-situ performance results. The test results in laboratory show some potential problem areas that should be given particular consideration when designing and using WMA. They will be discussed later.

Environment and production

The most important benefit of WMA is the possibility to reduce the greenhouse gases in the atmosphere. This is realized through reduced temperature for production and paving of asphalt. The ranges of possible energy reduction in the production process reported in research [20] are:

- WAM Foam – 30% to 40%;
- Aspha-Min – 30%;
- Sasobit – 20%;
- Evotherm – 50% to 70%.

According to the research [3], this gives a plant stack emission reduction of:

- CO₂ in the range of 15% to 40%;
- SO₂ – 20% to 35%;
- volatile organic compounds (VOC) up to 50%;
- carbon monoxide (CO) – 10% to 30%;
- nitrous oxides (NO_x) – 60% to 70%.

The reduction of aerosols, fumes and dust is also beneficial for the health of workers and the people situated in the surrounding territories of production and paving sites. This may mean that it will be easier to gain permission for a plant site in urban areas. The actual reduction in each specific case depends primarily on the temperature reduction rate and according to [21] greenhouse gases (CO₂, N₂O, and CH₄) are reduced in the same proportion as energy gain, which is illustrated in Figure 1. Reduction of fuel used for asphalt production results also in reducing the demand for non-renewable fuel extraction and decreasing the carbon footprint of fuel production and transportation.

Because of the different production technology for WMA, it promises several benefits that are indirectly related to the reduction of atmospheric pollution. Lower mixing temperatures and the modification of bitumen results in

different visco-elastic behaviour of binder in the WMA technology pavements. Less aging during production and paving process tends to improve pavement flexibility, which reduces susceptibility to fatigue and temperature cracking. This results in the improvement of pavement longevity (life cycle), further reducing the potential costs for restoring the asphalt overlay [5]. The lowering of bitumen viscosity in the production process allows incorporating a higher percentage of reclaimed asphalt pavement (RAP). The figure as high as 90% of RAP is reported in research [9] and WMA still results in less effort needed for compaction, which means an additional energy saving realized in the paving process. The overall benefit of RAP usage is the resolving of the problem of RAP utilisation, saving of landfill space, reduction of virgin aggregates and energy used for mining.

It must be noted that some of the environmental benefits may be offset with the carbon footprint embodied for producing additives and/or any additional equipment supporting the production of WMA. The producers of two WMA additives were contacted. None of them was able to provide the necessary information ofn the amount and types of energy used in manufacturing of these products or the amount of greenhouse gases produced.

Paving

Improved workability and compaction are attained when using WMA. Lower paving temperature enhances working conditions for the paving crew, which means enhanced productivity and improved quality. The reduced viscosity decreases the risks of ensuring necessary compaction, especially when working in cold weather and, because the difference between mix and ambient temperature is smaller than for HMA, a longer compaction window is provided. It may permit a longer paving season and/or paving during nights. Additionally, producing WMA at HMA temperatures will permit even longer compaction time. The Latvian road specifications [22] permit paving of asphalt wearing course only when the temperature is higher than 10°C (for layers between 40-60mm) or higher than 15°C (for layers <40mm). These temperatures are usual for Latvia only from April to September [23]. Use of WMA additives could allow extending the paving season by several months thus ensuring significant economic effect for contractors. It is reported [3] that field trials were conducted in Germany with Sasobit at ambient temperatures ranging from +1°C to + 3°C and better density was achieved if compared to HMA mixture.

Similarly to cold weather paving, because of possibility to compact the mixture in lower temperature, longer haul distances are promised for WMA. Therefore producing WMA technology mixtures at the temperatures traditional for HMA, more distant sites and large urban areas like Riga can be

served from large distances without losing asphalt workability. This means expanded market areas and reduced asphalt cost due to the decrease in mobilisation expanses. Another benefit for the city or high maintenance roads that need to be opened for traffic as soon as possible is that faster launching times can be achieved. Since the initial temperature is significantly lower, less time is necessary for cooling the mixture. This can also be important for expanding airports, like International Airport of Riga, where the stretch of time for construction can be very tight.

Economic

Different techniques of producing WMA promise various energy saving methods for the production - this mostly depends on the production temperature - and should be discussed together with the cost and type of energy used, as higher energy prices promise greater savings. Indirect economic effects can be realized through the reduction of mobilization costs and longer paving season. Another indirect benefit is less wear on asphalt plant due to the reduced temperature.

Economic benefits should be evaluated together with environmental benefits. If stricter emission standards are implemented, there may be higher economic potential for WMA. In this case the potential benefits may not be completely economically quantifiable and should be evaluated together with environmental regulations. However in Latvia for now the taxes for greenhouse gas emissions are too small to encourage contractors switching to more sustainable solutions.

The savings with reduced energy consumption may be offset by the additional costs of WMA production technologies. It must be established whether the reduced energy consumption reduces the overall costs of WMA production in each specific case. If no proof on production cost lowering is established, it may be possible that contractors will not choose this technology for the other benefits alone. Potential increases depend on production techniques as different WMA technologies require different additional costs. Increase in costs may arise from:

- the investment and the depreciation of plant modification;
- the costs of the additives;
- possible costs of technology licensing.

Research [20] involves comparison of the possible additional expenses for WMA production (Table 2). The data is gathered from different research and therefore describes using different production plants and other specific conditions. However, it gives a good impression on the additional costs of different WMA technologies.

TABLE 2
ADDITIONAL COSTS FOR SOME OF WMA PRODUCTS

Parameter	WAM Foam	Aspha-min	Sasobit	Evotherm
Equipment modification or installation costs	\$30,000-\$70,000	\$0-\$40,000	\$0-\$40,000	Minimal
Royalties	\$15,000 first year \$5,000 plant/ year 0.30/tonne	None	None	None
Cost of material	N/A	\$1.3/kg	\$1.7/kg	7-10% more than asphalt binder
Recommended dosage rate	N/A	0.3% by weight of mix	1.5 to 3.0% by weight of binder	Use in place of bitumen
Approximate cost per ton of mix	\$0.30 (not including royalties)	\$3.60	\$1.30-\$2.60	\$3.50-\$4.00

CONCERNS ON WMA PERFORMANCE

In order to reach widespread implementation of WMA, it is necessary to ensure that the asphalt has the same or better mechanical characteristics and long-term performance as the HMA. WMA has been used in all types of bituminous mixtures, including dense graded, stone mastic, porous, and mastic asphalt. It has been used with different aggregates and all grades of binder as well as polymer modified bitumen and Reclaimed Asphalt Pavement (RAP), and a variety of layer thicknesses and traffic levels have been applied for WMA. Based on these findings, there are generally no restrictions on WMA implementation. However, there is some concern about some mechanical properties and longevity of WMA.

Permanent deformations

There is a general concern for WMA rutting performance that is connected with the decreased mixing temperature which may lead to incomplete drying of aggregates and insufficient coating with bitumen. Another aspect that may influence decreased resistance to permanent deformations is the decreased oxidative hardening of bitumen due to the lower production and compaction temperature. These problems might be treated with adding active adhesion agents or initially choosing harder bitumen grade.

Potential rutting problems require careful evaluation of asphalt in laboratory. Testing samples should be prepared carefully, because there might be a necessity for mixture aging before compaction to ensure proper correlation with actual production process. The choice of the right compaction method might also be a problem, because some methods might not be sensitive enough to temperature changes.

The WMA that is produced by treating bitumen with wax usually shows better resistance to deformations than reference HMA. This can be explained by the forming of the lattice structure in bitumen below the crystallisation point of wax, which stiffens the asphalt at in-service temperatures.

Moisture sensitivity

Due to low mixing temperatures, moisture contained in the aggregate may not completely evaporate during mixing and the retained water in the aggregates could lead to increased susceptibility to moisture damage. Because of residual

moisture left behind by the microscopic foaming process, this is even more critical for WMA technologies that involve foaming as a binder viscosity lowering action. These problems, if they occur, may be successfully treated with active adhesion agents.

Low temperature behaviour

It is reported in several research papers from the USA [24; 25; 14] that the use of waxes for tests with the Bending Beam Rheometer (BBR) increases the bitumen stiffness and reduces relaxing abilities at low temperature regimes. Accordingly, wax modification leads to worsening of the low temperature behaviour and it has been determined that the threshold of SUPERPAVE concept PG bitumen leads to worsening of low temperature grade of 2-3°C and the bitumen's ability to creep is worsened by 6-9°C.

Compaction

WMA is reported to have better compaction potential due to decreased viscosity and less bitumen ageing in the production process. This can allow saving compaction energy and reducing the time necessary for compaction which may be especially important in low temperature paving. The reduced compaction risks, if realized, cause the cost that can far exceed additional costs for WMA production.

However, if wax technologies are used, they require additional attention regarding the temperature conditions for rolling. The compaction must be finished before the wax starts to crystallize; after this temperature the wax forms lattice structure in the asphalt that may be damaged if the compaction is continued. This means that compaction window is shorter than for HMA and additional rollers may be required to reach the necessary density in the given time window.

WMA AND NORMATIVE

The European standards for bituminous mixtures (EN 13108-1 to -7) do not preclude the use of WMA. The standards include maximum temperatures for particular mixtures, but there are no minimum requirements. The minimum temperature of asphalt mix is declared by the manufacturer. The standards also allow usage of additives if the performance of asphalt is equivalent to reference mixture.

Thus European standards are not a barrier for introduction of WMA.

The Latvian Road Specifications 2010 [22] also allow introduction of different chemical additives, if the asphalt manufacturer can ensure the required asphalt performance and a test section of 2 lanes in 50 m length to prove this has been built. The production temperature is precluded and depends on the bitumen type. For example for 70/100 bitumen it is 140°C-180°C. At the moment only for asphalt with polymer modified bitumen it is allowed to define different temperature. However the work group that develops the newest edition of the Latvian Road Specifications has proposed to remove this provision, therefore this will no longer be an obstacle when the new document is approved.

A workgroup is also developing entirely new road construction specifications for Latvia where the evaluation of asphalt will be more based on performance-related characteristics which could facilitate the introduction of new technologies, like WMA.

CONCLUSIONS

The most significant advantage of the use of WMA is of course the possibility to reduce the use of fuel and thus cut the carbon footprint of asphalt industry. The results show, for example, possible direct savings of CO₂ in the range from 15% to 40% and other, indirect environmental benefits. The mechanical properties of WMA show that it has a potential to replace conventional HMA and in special circumstances it even has advantages over HMA. However despite the promising performance in comparison with HMA, this technology has not yet gained widespread acceptance in asphalt industry in Europe, mostly because of the lack of information on the testing results. More data and in-situ case study examples that compare WMA and HMA technologies would help to overcome the caution in the road building society for implementation of WMA. Introduction of EN standards for WMA and national specifications, which would allow adequate evaluation of WMA, would also stimulate the usage of WMA technologies.

Environmental and other benefits alone are not sufficient for a widespread implementation of this technology. It must be established whether the reduced energy consumption also reduces the overall costs of WMA production. If no proof of lower production costs is established, it is most likely that contractors will not choose this technology for its other benefits alone, and WMA may not become widespread. However, the economic benefit from energy saving should be discussed together with the cost and type of energy used, because higher energy prices promise greater savings when temperature is reduced. The prices of additives may also change when the technology becomes more widespread and finally, application of stronger environmental regulations and additional taxes for carbon footprint will also stimulate faster development of WMA technologies and usage in actual commercial projects.

At the moment the most promising specialization for WMA in Latvia is the reduced pavement compaction risks in cold

weather. This could allow extending the paving season and thus ensuring decreased due dates of construction objects and additional turnover for contractors.

There are some considerations on the physically-mechanical characteristics of asphalt that have to be taken into account before switching from production of WMA to HMA. The research results show varying performance of different WMA products therefore careful examination should be performed with the local materials and in the given climatic conditions to examine the characteristics of a particular WMA product before using it regularly. Performance based tests are considered to be the most useful for the evaluation of WMA at the desired temperature and special consideration should be given to the evaluation of moisture sensitivity, permanent deformation, low temperature properties (for waxes) and stiffness.

REFERENCES

- [1] M. Zaumanis, *Asphalt is Going Green*. Saarbrücken: LAP LAMBERT Academic Publishing GmbH & CO, 2011.
- [2] LEA-CO "Low Energy Asphalt". [Online]. Available: http://www.lea-co.com/lea_co/index2.php?lang=en [Accessed: 05.04.2010].
- [3] J. D'Angelo, E. Harm, J. Bartoszek, G. Baumgardner, M. Corrigan, J. Cowser, T. Harman, M. Jamsihidi, W. Jones, D. Newcomb, B. Prowell, R. Sines, B. Yeaton, *Warm-Mix Asphalt: European Practise*. American Trade Initiatives. Washington, DC: U.S. Department of Transportation, 2008.
- [4] F. Olard, B. Heriter and E. Beduneau, *Low energy asphalt LEA: new half-warm mix asphalt for minimizing impacts from asphalt plant to job site: Asphalt Pavements and Environment*, August 18-20, 2008, Zurich, Switzerland, p. 207-230.
- [5] S. Perkins, *Synthesis of warm mix asphalt paving strategies for use in Montana highway construction*. Montana: The state of Montana, department of transportation, 2009.
- [6] Shell bitumen, "Shell WAM Foam process. For reducing energy consumption and emissions". [Online]. Available: http://www-static.shell.com/static/bitumen/downloads/business/shell_wamfoam_brochure.pdf [Accessed: 05.04.2010].
- [7] Aspha-Min GmbH, "Aspha-min – The high performance additive". [Online]. Available: <http://www.aspha-min.com/asphamin-en.html> [Accessed: 05.04.2010].
- [8] G. Hurley and B. Prowell, *Evaluation of Aspha-Min zeolite for use in warm mix asphalt*. Auburn: National Center for Asphalt Technology, 2005.
- [9] L. Drüschner, *Experience with Warm Mix Asphalt in Germany: Miljøtilpassede belægninger, NVF-rapporter*. June 7-9, 2009, Sønderborg, Denmark.
- [10] Sasol-wax "Sasobit". [Online]. Available: http://www.sasolwax.com/sasolwaxmedia/Downloads/Bitumen_Modification-p-409/Sasobit_since_1997.pdf [Accessed: 08.03.2010].
- [11] G. Hurley, B. Prowell, *Evaluation of Sasobit for use in warm mix asphalt*. Auburn: National Center for Asphalt Technology, 2005.
- [12] K.W. Damm, J. Abraham, T. Butz, G. Hildebrand and G. Riebesehl, "Asphalt Flow Improvers As 'Intelligent Fillers' For Hot Asphalts - A New Chapter In Asphalt Technology," *Journal of Applied Asphalt Binder Technology*, pp. 36–69, 2002.
- [13] WeadWestvaco "Evotherm warm mix asphalt". [Online]. Available: <http://www.meadwestvaco.com/SpecialtyChemicals/AsphaltAdditives/MWV002106> [Accessed: 05.04.2011].
- [14] A. Chowdhury, J. W. Button, *A Review of Warm Mix Asphalt*. Springfield, Virginia: National Technical Information Service, 2008.
- [15] CECA Arkema group "Green Road Formulation – Warm Mix Asphalt". [Online]. Available: http://www.cecachemicals.com/sites/ceca/en/business/bitumen_additives/warm_coated_material/warm_coated_material.page. [Accessed: 05.04.2011].
- [16] Akzo nobel N.V "Akzo Nobel Asphalt Applications". [Online]. Available:

- <http://www.surfactants.akzonobel.com/asphalt/newwarmmixsystem.cfm> [Accessed: 03.03.2010].
- [17] Star Asphalt S.p.A "Technical data sheet Warm-Mix L". [Online]. Available: <http://www.starasphalt.com> [Accessed 30.03.2011].
- [18] Asphalt Institute, *Asphalt handbook MS-4 7th edition*. USA: Asphalt Institute. 2007.
- [19] M. Zaumanis and V. Haritonovs, "Research on Properties of Warm Mix Asphalt," Scientific Journal of Riga Technical University, Construction Science, 2010, pp. 77-84.
- [20] O. Kristjansdotir, Warm Mix Asphalt Technology Adoption: NVF 33 Annual Meeting, June, 2007, Trondheim, Norway.
- [21] Y. Brosseau and M. Saint Jacques, *Warm asphalt mixes: overview of this new technology in France: Transport Research Arena Europe 2008*, Paper No. 10.1.7. pp.187 .
- [22] "Ceļu specifikācijas 2010" (*Road Specification 2010*) Latvijas Valsts Celi, Riga, Latvia, 2009.
- [23] Latvijas vides, ģeoloģijas un meteoroloģijas centrs "Meteoroloģiskie apstākļi Latvijā". [Online]. Available: <http://www.meteo.lv/public/29591.html> [Accessed: 02.02.2011].
- [24] M. Wanger, K. Stangl and R. Blab, *Fischer-Tropsch paraffin modified bitumen - performance parameter and reduction of energy consumption: Asphalt Pavements and Environment*, August 18-20, 2008, Zurich, Switzerland. p. 197-206.
- [25] G. Hurley and B. Prowell, *Evaluation of Potential Processes for Use in Warm Mix Asphalt*. Alabama: National Center for Asphalt Technology, Auburn University. 2006.
- Mārtiņš Zaumanis**, M.sc.ing. (2010), Riga Technical University, The Institute of Transportation, Riga, Latvia.
Doctoral student and Research Assistant at Riga Technical University. Quality Engineer SIA "Union Asphalttechnik", Road construction and asphalt production company.
Phone: +371 26665537
e-mail: jeckabs@gmail.com
- Viktors Haritonovs**, Riga, Latvia, Engineer (2002), Dr.sc.ing. in the field of Transport and Infrastructure, Riga Technical University (2010). Construction Science Centre, Researcher at Riga Technical University
Address: Azenes Street 16/20 – 448, Riga Latvia
Phone: +37126412568
e-mail: viktors.haritonovs@rtu.lv
- Guntis Brencis**, Road Engineer, Riga Technical University, Head of Road Building Materials Laboratory.
- Juris Smirnovs**, Prof., Dr. sc. ing. ,
Dean of the Faculty of Civil Engineering of Riga Technical University.
Address: Azenes Street 16/20, Riga, Latvia
Phone: +371 67089278
e-mail: smirnovs@latnet.lv

Mārtiņš Zaumanis, Viktors Haritonovs, Guntis Brencis, Juris Smirnovs. Silto asfalta maisījumu pielietošanas potenciāla un iespēju analīze Latvijā

Siltā asfalta maisījumu (WMA) ražošanā tiek izmantotas tehnoloģijas, kas ļauj būtiski samazināt tradicionālo karsto asfalta maisījumu ražošanas un iekļāšanas temperatūru, nepasliktinot asfalta īpašības. Tas rada vairākas priekšrocības salīdzinājumā ar karsto asfaltu, piemēram, tiek samazināts enerģijas patēriņš, var sasniegt augstāku sablīvējumu, iespējams nodrošināt lielāku pārvadāšanas attālumu utt. Tomēr, lai panāktu WMA plašu ieviešanu komerciālajā ražošanā, nepieciešams nodrošināt pietiekami daudz kvalitatīvas informācijas par šo tehnoloģiju priekšrocībām. Šajā publikācijā ir apkopota informācija par dažādiem WMA produktiem un ražošanas tehnoloģijām. Kopumā apskatīti piecpadsmit Eiropā pielietoti produkti. Tomēr, nepieciešamo ieguldījumu iekārtās, vietējā klimata, Latvijas normatīvu un ceļu būvniecības tradīciju dēļ, ne visas tehnoloģijas ir piemērotas lietošanai Latvijā. Tiek apskatītas Latvijas apstākļiem potenciāli visvairāk piemērotās tehnoloģijas un noteikta to atbilstība autoceļu specifikāciju prasībām. Pētījumu rezultāti rāda, ka WMA tehnoloģijas ļauj samazināt CO₂ izmešu daudzumu atmosfērā par 15-40%. Tomēr plašu WMA pielietojumu Eiropā bremzē asfaltbetona ražotāju skepse attiecībā uz ienākumiem, kas iegūti, izmantojot WMA tehnoloģijas, jo finanšu izdevumi tehnoloģiju ieviešanai un WMA asfalta ražošanai ir aptuveni vienādi ar ienākumiem, kas iegūti, ekonomējot enerģiju. Plašāku WMA tehnoloģiju pielietojumu nākotnē var stimulēt enerģijas cenas, nodokļu atvieglojumi uzņēmumiem, kas ievieš šādas tehnoloģijas – „par ekoloģiskumu”, kā arī plašāks WMA pielietojums Eiropā un konkurence ļaus samazināt WMA piedevu iepirkuma cenu.

Мартиньш Зауманис, Викторс Харитоновс, Гунтис Бренцис, Юрис Смирновс. Оценка потенциала и возможности использования теплой смеси асфальта в Латвии

Технологии производства теплой асфальтобетонной смеси (WMA) позволяют существенно снизить температуру производства и укладки асфальта, не снижая свойства материала. Это дает большее преимущество по сравнению с горячей асфальтобетонной смесью (HMA), например, позволяет сократить потребление энергии, возможность достичь лучшего уплотнения, обеспечивает возможность перевозки смеси на большие расстояния и т.д. Однако, для того, чтобы достичь более широкого применения WMA, необходимо доказать преимущества этой технологии. Настоящая статья представляет собой обзор различных продуктов и производственных технологий для WMA. В общей сложности в статье представлены и сравнены пятнадцать различных продуктов, которые широко используются в Европе. Однако не все технологии, представленные в статье, подходят для Латвии. Главные тому причины - особенности местного климата, необходимость инвестировать большие средства в новые технологии, специфика местного законодательства и технической документации, а также промышленные традиции. В статье рассматриваются наиболее перспективные технологии для условий Латвии, учитывающие местный климат и требования дорожных спецификаций. Результаты исследований показывают, что применение технологий для производства WMA позволяет на 15 – 40% уменьшить выброс в атмосферу CO₂. Однако широкое применение WMA в Европе тормозит неуверенность производителя асфальта в выгоде применения новых технологий, так как финансовые затраты на внедрение новых технологий и производство WMA асфальта примерно равняются выгоде, полученной на экономии энергии. В будущем более широкое применение будут стимулировать цена на электроэнергию и налоговая политика - налоговые льготы за экологичность, а также более широкое применение WMA технологий позволит снизить закупочную стоимость добавок для производства WMA.