RESEARCH PAPER | Engineeing | Volume : 4 | Issue : 9 | September 2014 | ISSN - 2249-555X

The Influence of Iter PPS Composite Fibers in the Stone Mastic Asphalt

KEYWORDS: fiber, elastomers, plastomers

Ciprian Tarta

Technical University of Cluj-Napoca, Faculty of Civil Engineering.72-74 Observatorului Street, Cluj-Napoca, Romania.

ABSTRACT *The composite Iter PPS fibers (fig.1) are fibers manufactured through the combination of classic cellulose fibers with elastomers or different products which can react in the asphalt mixture. In this study it has been noticed the influence of the components from which Iter PPS fibers are made of, in the stone mastic asphalt(SMA). The samples used were dynamically-tested: stiffness, dynamic creep and permanent deformation resistance. The results obtained with every type of fiber were compared to the standard mixture, mixture that has the same structure but in which the fiber has not been added. Through these tests it has been noticed that each fiber component influences the results.*

Introduction

PPS variety of products is a new and revolutionary criterion for chemical-structural modification of asphalt concrete. These products can act simultaneously in several properties. The innovation consists in the adding product system which generates the modification directly on the mix, without the need to modify the bitumen in special plants. This results in a considerable economical, energy ant time saving, and allows the application even in the most remote places, not equipped with industrial facilities.

The PPS systems have been designed to helpthe companies which are confronting with budget problems, equipment and logistics. In this way, the costs for the storage of the modified bitumen are eliminated.

Using PPS products leads to an improvement of asphalt concretes, as well as fatigue resistance and stiffness. They can be applied both for wearingcourses and for binder and base layers. Allow to reduce the structural thickness or, at equal thickness, increase the mechanical resistances and durability.

Basically, the PPS variety of products partially or completely replaces the use of modifiedbitumen according to the normativesor specifications. The products have a cylindrical granulate form, are easy to use and can be added directly to the asphalt mixer.

Materials

A series of fibers that can produce the most significant change in the asphalt mixture have been analyzed.

Iter PPS fibers have a cylindrical granulate form (pellets), approximately 1cm and must be added directly to the asphalt concrete using a suitable dosing device. In this way is ensuring the homogeneity of the finite product. The dosage of the fiber can vary between 0.2% and 0.6% of the total weight of the aggregates and it depends on the percentage of bitumen, the type of fiber, dosage of filler and the final desired features of the mix.

ITER PPS 1000-C fiber is composed of plastomers and natural cellulose microfibers. The plastomeric compound (always the same type) is made of flexible thermoplastic polymers which have the same characteristics and softening point as bitumen. This fiber is used for making different types of hot asphalt concrete in which the improvement of the complex modulus is necessary. In this way, the deformations which appear due to recurrent loadswill be reduced, improving the fatigue resistance.The fiber compound contributes to the improvement of the rheological behavior of the asphaltmastic. It increases the thickness of the bitumen film, resulting in the increasing of the stability and mechanical characteristics of the asphalt concrete.

The ITER PPS 2000 Elast-C fiber is made from elastomers and natural cellulose microfibers. The polymeric component perform an action similar to traditional modifier, increasing the complex modulus. The fibrous component contributes to further improve the rheological behavior of bituminous mastic, providing a better distribution of the binder and an increase of the film thickness on the aggregates, resulting in increased stability and mechanical characteristicsof the final mix.This is due both to the characteristics of the additive, both to its greater compatibility with bitumen, compared to traditional filler. The modification of the asphalt concrete with the Iter PPS 2000 Elast-C fiber involves, in general, the increase of the mechanical resistance and elasticity, improving the complex modulus and fatigue behavior.

The Iter PPS 3000-S fiber contains cellulose fibers and synthetic fibers doped with paraffinic derivatives and elastomeric polymers. It is used for the improvement of mechanical characteristics of the asphalt mixture, in particular for those which contain a large percentage of milled mixture. Along with a specific chemical additive (Iterlow R type) it allows the production of mixtures at low temperatures (warm mix). Therefore thegas emissions(CO_2, NOx etc) and smell are diminished and major energy and cost savings are made.

The Iter PPS 4000 includes cellulose fibers, elastomers (SBS type) and natural bitumen from Seleniza, all these merged in a small cylindrical granule (pellets type). These are recommended to be used inmixes which require the use of low-penetration and high modulus bitumen, but in the same time to ensure an elastic behavior.

Choosing between one of the above mentioned fibers depends on the fiber compound and the asphalt mixture

Volume : 4 | Issue : 9 | September 2014 | ISSN - 2249-555X

type (opened, closed, drained or SMA) and on the desired technical characteristics. For obtaining some particular values it is necessary to make a precautionary study in establishing the right dosage.

Figure 1. Iter PPS fibers

Results

The effects of the PPS variety of fibers on the asphaltic mixture SMA16 (fig.5), for wearing course,having the same base mix, have been comparatively studied. The basic materials used were analyzed, verified according to the EN standards and norms. The materials used are Orlen bitumen 50/70, Holcim filler, crushed sand and chippings from "Poieni" quarry. The bitumen percentage used in the mixture was 5.9% and the dosage of the fiber was 0.5% of the weight of the aggregates.

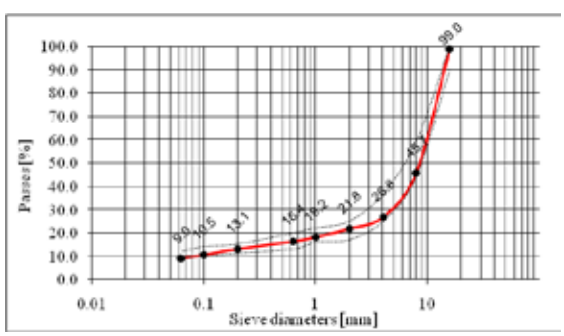

Figure 2. Grading curve of the mix design aggregate of SMA16

Characteristics	Iter PPS 1000-C	Iter PPS 2000 Elast-C	Iter PPS 3000-S	Iter PPS 4000 Black	Reference mixture	Admissible values / Technical class road
Mixture type	SMA16	SMA16	SMA16	SMA16	SMA16	I-II
Fiber content from the mix weight	0.5%	0.5%	0.5%	0.5%	0.0%	-
Stiffness modulus at 20°C, 124 ms, MPa	4769	3387	2780	3857	3272	min. 4600
Dynamic creep • Deformation at 50°C , 300 KPa and 10000 impulses, µm/m • Deformation speed at 50°C , 300 KPa and 10000 impulses, µm/m/cycle	9564 0,08	13952 0,12	18944 0,41	---- ----	16112 0,13	max.20 000 1
Permanent deformation resistance,60 °C (wheel tracking test) - Strain rate at wheel tracking test, mm/1000 cycle -Rut depth, 60°C, % from the primary sample thickness	0,016 5	0,02 4.2	0,04 3.5	0,06 5	3.5 16	max. 0.5 5
Void volume at 80 yaw, % maximum	3,8	3,5	3,6	3,3	3,1	3...6
Schellenberg Test, %,	0,07	0,6	0,16	0,15	1.1	max. 0.2

Table 1. Results of SMA mixes made with Iter PPS fibers and reference mixture

Conclusions

After analyzing the different types of ITER PPS fibers, due to each of their characteristics,a slight difference between the results obtained can be observed.

There is a significant improvement of the wheel tracking test in the case of any PPS type of fiber. On the other hand, in the case of fibers with elastomers there is no improvement of the stiffness modulus because there is no such effect. In the case of the plastomer fiber, an increase of the stiffness modulus has been observed.

In general, in the case of a 0.5% PPS fiber dosage, the requirements of quality and performance are not fully met only if the fiber-granule also contains polymer. Under these conditions, a study based on higher fiber dosage can be continued or other stabilizing solutions can be followed.

REFERENCE

*** Technical data sheets: Iter PPS 1000 series, Iter PPS 2000 Elast series, Iter PPS 3000 series, Iter PPS 4000 Black series (2014) made by sc Iterchimica srl.