STUDY OF THE EFFECT OF POLYOLEFIN–ARAMID FIBERS ON PA MIXTURE

Poster · January 2020

CITATIONS
0

READS
54

5 authors, including:

Daniel Castro-Fresno
Universidad de Cantabria
286 PUBLICATIONS **2,300** CITATIONS
SEE PROFILE

Carlos Slebi
Universidad de Cantabria
16 PUBLICATIONS **49** CITATIONS
SEE PROFILE

Anik Gupta
Universidad de Cantabria
6 PUBLICATIONS **3** CITATIONS
SEE PROFILE

Pedro Lastra-González
Universidad de Cantabria
41 PUBLICATIONS **193** CITATIONS
SEE PROFILE

STUDY OF THE EFFECT OF POLYOLEFIN-ARAMID FIBERS ON PA MIXTURE

Daniel Castro-Fresno; Carlos J. Slebi-Acevedo;
Anik Gupta; Pedro Lastra-Gonzalez;
Juan C. Ruge-Cardenas

ABSTRACT

The present research seeks to investigate the performance of a PA mixture reinforced with polyolefin-aramid fibers. The functional and mechanical performance of the mixture was assessed by different volumetric and mechanical tests including total air voids, interconnected air voids, Cantabro particle loss in dry and wet conditions and binder drainage test.

HORIZON 2020
European Union Funding
for Research & Innovation

ACKNOWLEDGMENTS

This research is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769373.

FORE SEE PROJECT

www.foreseeproject.eu

GITECO
Construction Technology Applied Research Group

www.giteco.unican.es

Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos (ETSICCP)
Avenida de los Castros 44.
39005 Santander, Cantabria. Spain

MATERIALS

Characteristic	Standard	Value	Limits
Specific weight (g/cm3)	EN 15326	1.035	-
Penetration at 25 °C	EN 1426	57	50 - 70
Softening point (°C)	EN 1427	51.6	46 - 54
Fraass brittle point (ºC)	EN 12593	-13	≤ - 8

TABLE 1 Characteristics of 50/70 conventional binder

Characteristic	Standard	Value	Limits
Coarse Aggregate			
Specific Weight (g/cm3)	EN 1097 - 6	2.794	-
Water absorption (%)	EN 1097 - 6	0.60	< 1%
L.A abrasion (%)	EN 1097 - 2	15	≤ 15%
Slab Index (%)	EN 933 - 3	< 1%	≤ 20%
Polishing Stone Value	EN 1097 - 8	60	≥ 50
Fine Aggregate			
Specific Weight (g/cm3)	EN 1097 - 6	2.724	-
Sand Equivalent	EN 933-8	78	> 55

TABLE 2 Physical properties of coarse ophite and fine limestone aggregate

Fiber	Aramid	Polyolefin
Form	Monofilament	Serrated
Color	Yellow	Yellow
Density (g/cm3)	1.44	0.91
Length (mm)	19	19
Tensile Strength (MPa)	2758	483
Decomposition temperature (°C)	> 450	157
Acid/Alkali Resistance	Inert	Inert

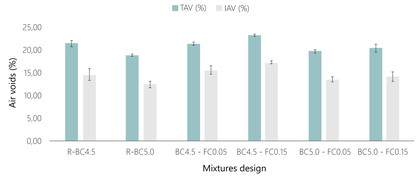
TABLE 3 Characteristics and properties of polyolefin-aramid fibers

METHODOLOGY

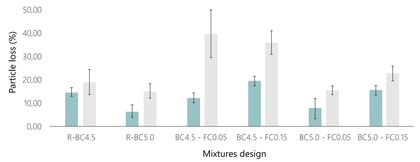
A set of PA mixtures with different fiber dosages and different binder concentrations were prepared following the European standard EN 12697 – 30

PA mixture Design	Asphalt binder content (%b/w of mix)	Fiber content (%b/w of mix)
R - BC4.5	4.5	-
R - BC5.0	5.0	-
BC4.5 - FC0.05	4.5	0.05
BC4.5 - FC0.15	4.5	0.05
BC5.0 - FC0.05	5.0	0.15
BC5.0- FC0.15	5.0	0.15

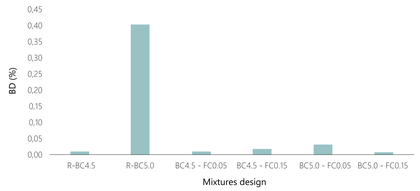
RESULTS AND DISCUSSION



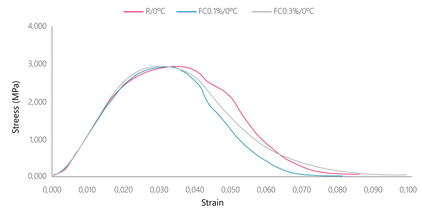
The addition of fibers does not have a significant impact on the total and interconnected air voids. However, an increase of binder content of 0.5% in the mix leads to a 2%reduction in the voids content, approximately. Reinforced PA mixtures with 4.5% binder content had TAV over 20% while reinforced PA mixtures with 5.0% binder content had TAV over 18%.

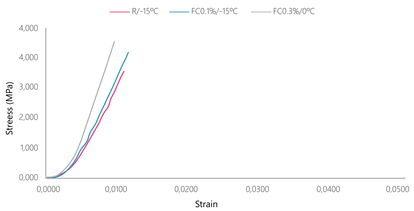


Adding 0.05% polyolefin-aramid fibers increased the raveling resistance in dry conditions of PA mixture with 4.5% binder content. Better results were obtained by increasing the binder content instead of using fibers. Regarding the particle loss in wet conditions, 5.0% binder content is recommended to properly coating the aggregates and hence strengthening the cohesive forces that can be affected by the action of water.

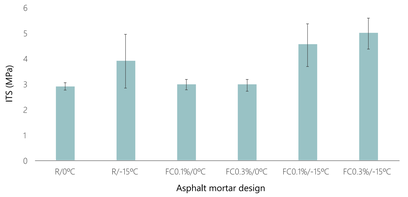


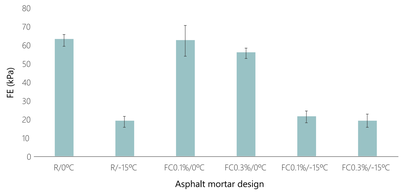
Polyolefin-aramid fibers have proved to work well as stabilizer additives. However, with low binder contents (i.e., 4.5%) the use of fibers is not necessary to prevent binder drain-down. On the other hand, the use of fibers is recommended for higher binder contents (i.e., 5.0%) in order to retain the free bitumen in the mixture.

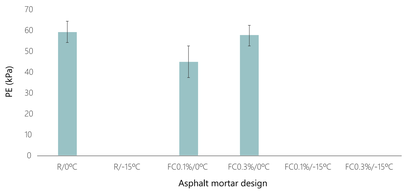




As for the ITT at 0°C, the effect of adding polyolefin-aramid fibers in the asphalt mortar on its tensile strength was not relevant at all. However, at -15°C the inclusion of fibers has the potential effect of increasing the tensile strength in the asphalt mortar. The highest tensile strength was obtained when adding 0.3% polyolefin-aramid fibers.







In relation to the FE and PE parameters, only at 0°C it was possible to obtain both parameters. Thus, at -15°C the mortar becomes more rigid and brittle, so only FE can be obtained. Based on the results, at 0°C there are no evident improvements of FE and PE when adding polyolefin fibers. On the other hand, slight improvements were observed in terms of FE at -15°C when adding 0.1% polyolefin fibers.