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(A163)

Mechanical Characterization of Asphalt Rubber - Wet Process

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SUMMARY

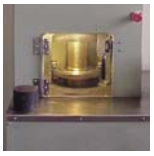
In many countries all over the world, bitumen modified with crumb rubber from ground tires is widely and successfully used, as binder in hot mix asphalt (HMA). Asphalt Rubber is commonly used as wearing course for HMA pavements in order to improve smoothness and skid resistance and to reduce cracking and traffic noise. As extra benefit, this bituminous mixture allows to recycle rubber from waste tires. In Italy, to date, this kind of mixture is not employed yet, except for some isolated situations, in spite of the encouraging results obtained all over the world.
This paper focuses on the mechanical characterization of a wet process asphalt rubber. This material was taken from the first experimental pavement section in Italy and then analyzed in laboratory. For this evaluation, Asphalt Rubber was subjected to several laboratory tests concerning stiffness modulus, fatigue and rutting resistance. For a better evaluation, the results obtained for ARFC were compared with those obtained with different mixes subjected to the same tests.
Results clearly showed that the use of Asphalt Rubber can noticeably improve the mechanical properties of asphalt mixtures suggesting potential advantageous applications also for the Italian road network.

EXPERIMENTAL PROGRAM

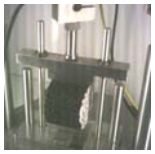
MATERIALS TESTED

- *ASPHALT RUBBER FRICTION COURSE (ARFC)*
  - taken during the construction of the first experimental road section in Italy;
  - gap graded granulometric distribution;
  - 8.6% of binder - 18% of rubber on bitumen.
- *SPLITTMASTIXASPHALT (SMA)*
  - coming from experimental road section;
  - 7.3% of polymer modified binder.
- *EXPANDED CLAY FRICTION COURSE (ECFC)*
  - coming from experimental road section;
  - 5.7% of polymer modified binder;
  - 39.1% of expanded clay on mineral aggregate volume.
- *HOT MIX ASPHALTS MANUFACTURED WITH PLAIN BITUMEN (P-HMA)*
  - manufactured in laboratory;
  - limestone aggregate and 7.3% of plain pen70/100 bitumen;
  - grain-size distributions were equal to those of ARFC mixture.
- *HOT MIX ASPHALTS MANUFACTURED WITH MODIFIED BITUMEN (M-HMA)*
  - manufactured in laboratory;
  - limestone aggregate and 7.3% of polymer modified bitumen;
  - grain-size distributions were equal to those of ARFC mixture.

EQUIPMENT AND TESTING PROTOCOLS

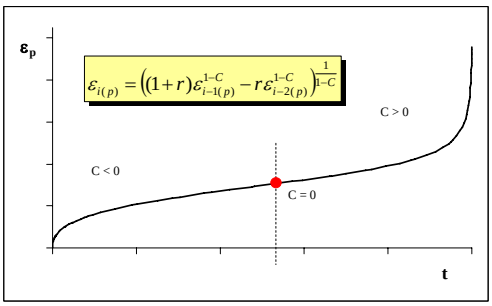


- *SPECIMENS PREPARATION*
  - shear gyratory compactor (EN 12697-31)
  - roller compactor (EN 12697-33)
- *TESTING PROTOCOLS*
  - Indirect Tensile Stiffness Modulus (EN 12697-26)
  - Indirect Tensile Fatigue Test (EN 12697-24)
  - Repeated Load Axial Test (BS DD 226)
  - Wheel Tracking Test (BS 598-110)



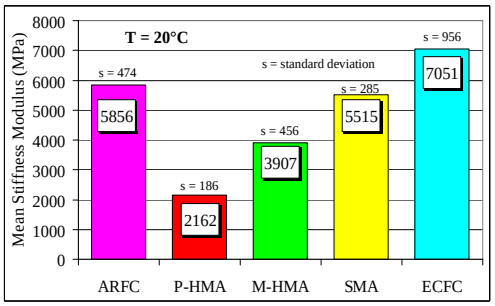
TEST RESULTS AND ANALYSIS

DESCRIPTIVE MODEL (Virgili et al. 2007)



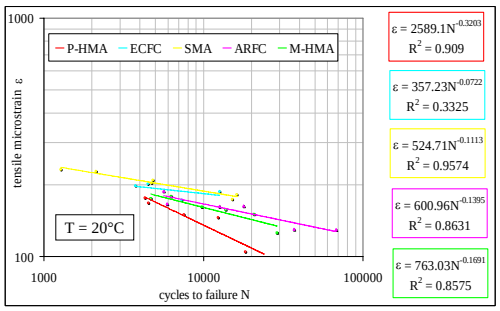
C is the only material parameter expressed as a five order function of the number of cycles

STIFFNESS MODULUS



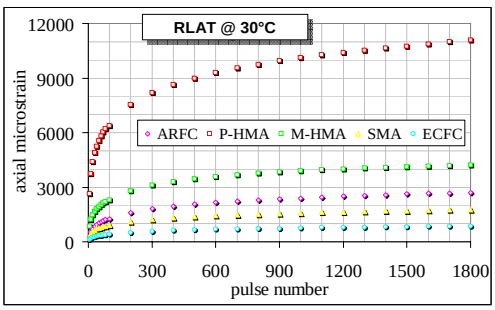
The results are represented as mean values of 6 repetitions for each type of material studied

FATIGUE RESISTANCE



Failure = the number of cycles to the flex point of the permanent deformation evolution law

PERMANENT DEFORMATION RESISTANCE



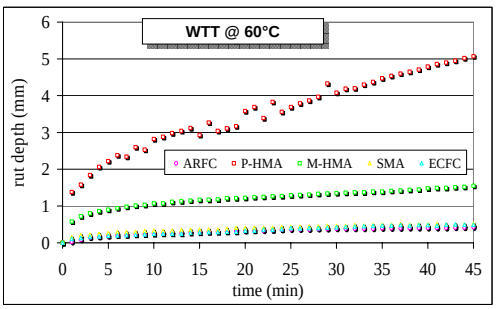
RLAT results are presented as mean values of two identical tests for each material studied

CONCLUSION & FURTHER STUDIES

The main results of this study can be summarized as follows:

- ARFC showed high value of stiffness modulus that means a good load spreading ability, comparable with that of asphaltic concretes suitably designed to withstand heavy traffic load;
- In spite of its high stiffness, ARFC performed very well also as regards fatigue cracking resistance. This is probably due to the elasticity of this asphaltic concrete coming from the presence of rubber inside the mixture;
- Analyzing permanent deformation resistance, ARFC demonstrated high rutting resistance notwithstanding its high binder content. Again, the presence of rubber in the bitumen was fundamental because it noticeably increases the bitumen viscosity that, as a consequence, allows greater amount of binder without danger of excessive permanent deformation.

So, according to many experimental studies on Asphalt Rubber all over the world, this study has shown very encouraging results on the mechanical properties of bituminous mixture manufactured with rubber modified bitumen suggesting potential advantageous applications also for the Italian road network.
This first mechanical characterization needs to be completed by investigating into durability properties such as aging, aggregate loss or water damage as well as into functional properties such as smoothness, skid resistance and quietness of ARFC.
Moreover, the assessment of the performance of open-graded bituminous concrete manufactured with asphalt rubber could also be another very interesting aspect to be studied in depth.



ARFC performance is comparable with that of SMA and ECFC showing virtually no deformation

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