

MECHANICAL PROPERTY ASPHALT MODIFIED WITH RUBBER POWDER, WOOD WASTE AND RECYCLED PLASTIC

JOHNNY GILBERTO MORAES COELHO¹, ANDRÉ LUIZ AMARANTE MESQUITA², CARMEN GILDA BARROSO TAVARES DIAS³

¹Graduate Program in Engineering of Natural Resources of the Amazon, Federal University of Pará – UFPA, johnny@ufpa.br

²Graduate Program in Engineering of Natural Resources of the Amazon, Federal University of Pará – UFPA, andream@ufpa.br

³Graduate Program in Engineering of Natural Resources of the Amazon, Federal University of Pará – UFPA, cgbtd@ufpa.br

Keywords: Recycled high density polyethylene. Mini-marshall. SEM.

Currently, there are different types of materials that have been used in asphalt concrete. Fibers and polymers are two important examples used for this purpose.^[1,2]

The modification of asphalt with a combined of plastic pellets and crumb rubber is an effective way to modify asphalt, not only improve the performance of asphalt, but also solve the problem of pollution caused by waste plastic packaging.^[3,4]

The goal is to test in tension by diametrical compression test specimens of binder and binder modified with ground tire rubber, sandy, wood type *Bagassa guianensis Aubi.*, recycled high density polyethylene, together with aggregates of the region, pebble and sand pit.

Initially it was done processing sandy/rubber (S/R) in the fraction 30/70 percent by weight, wood *Bagassa guianensis Aubi.* was comminuted wood through the mill with mortar/pestle motor, 6 Hz in frequency and time of 71 minutes, so *Bagassa guianensis Aubi./sandy/rubber (W/S/R)* was processed on 63/6/31 fraction percentage by weight fractions chosen empirically. S/R and W/S/R were processed by a helical rod embedded in a microprocessor controlled high-torque stirrer at a speed of 200 rpm for 12 min. and subjected to ultrasonic bath thermostat at 140°C.

The rheological characterization of asphalt with S/R and W/S/R was made in HAAKE rheometer, model RheoStress 6000, plate to plate with 35mm diameter, sensor type PP35, thermal controller of the type RS 6000, the temperature of 180°C. The dosages for testing rheology in weight percentage blends of AC 50/70 (AC) compounds with S/R and W/S/R compatibilized recycled high density polyethylene (P). Three dosages: A (with AC/P), B (AC/S/R/P) and C (AC/W/S/R/P) (Table 1).

Table 1: Dosing for rheology of table

%	A	B	C
AC	85,42	64,06	64,06
S/R	-	25,00	-
W/S/R	-	-	25,00
P	14,58	10,94	10,94

Dosages diametral-compression test mini-Marshall, based on testing according to standard conventional Marshall DNER ME 043/95 (Table 2). In which each witness has 1 g of polymer P on the surface with pebble (Pe) and sand (Sp) where MM1 (with AC/Pe/Sp/P), MM2 (AC/Pe/Sp/P with S/R) and MM3 (AC/Pe/Sp/P with W/S/R). The mixture was made at a temperature of 180°C for 30 min.^[3]

Table 1: Dosing for rheology of table

%	AC	Pe	Sp	S/R	W/S/R
MM1	8	47	40	5	-
MM2	8	45	39	3	5
MM3	8	45	39	3	-

The equipment used for optical microscopy (OM) is the optical microscope Leica polarized light, displayed in objective lens for 40x. In experiment by scanning electron microscopy (SEM) samples were metallized with platinum coating and the time was 2.0 min. In the analysis of secondary electron images was due to the following conditions: electron beam current of 90 µA, constant acceleration voltage of 10 kV and working distance between 15 to 12 mm.

The dynamic mode rheological curves where they were examined AC modified with P, S/R and W/S/R, we obtained values of G'(f) versus frequency in Hz (Figure 1).

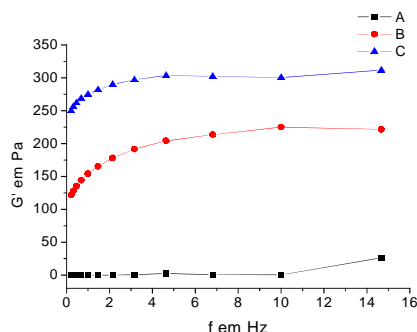


Figure 1: Dynamic rigidity modulus G '(f) as a function of the frequency

The result is favorable for samples the ligant with polymer P and W/S/R because the existing physical contact with W in the mixtures, increase stiffness.

The results of stability, maximum strength and fluency, total deformation of the specimen to the test mini-Marshall (Figure 2).

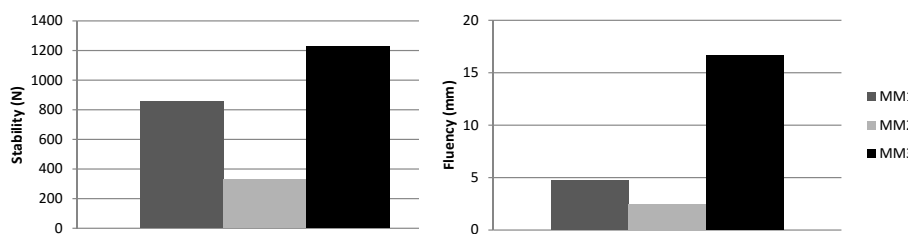


Figure 2: Stability and Fluency mini-Marshall

The diametral compression strength asphalt binder modified with P and W/S/R was higher than that and the other cases. We observed the compatibility of the asphalt specimens with P inserted and P on the surface through OM (Figure 3) [5].

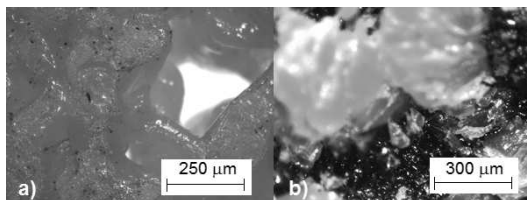


Figure 2: SEM, a) global view of the specimen, b) polymer P on the specimen, c and d) asphalt binder on the wood

We can observe the general appearance of the specimen and pieces of polymer P involved by asphalt binder (Figure 3-a) can also be seen polymer P compatibilized on the upper surface of the specimen (Figure 3-b).

Wood type *Bagassa guianensis* Aubi. involved by asphalt binder, showing the effective adhesion on the surface the wood (Figure 3-c). Approaching, we have wood shows the fiber surrounded by asphalt binder (Figure 3-d).

The results are favorable, mixed with asphalt binder compounds S/R, W/S/R and P matched with polymer P, when dispersed in asphalt, to form an elastic three-dimensional network (physical crosslinking) favoring increasing the elasticity and strength. The polymer P acts in the overall structure adding resistance.

The OM and SEM images show the good adhesion of the polymer P when inserted into the ligand, thus indicating a good compatibility and modification technology of asphalt with increasing interest due to the large amount of crumb tire rubber.

Acknowledgements

The authors thank CAPES and CNPq for encouraging research and all employees involved in this project.

References

- [1] S. M. Abtahi; M. Sheikzadeh; S. M. Hejazi. C. and B. Materials 2010, 24, 871–877.
- [2] H. Chen; Q. Xu; S. Chen; Z. Zhang. Mat. and Design 2009, 30, 2595–2603.
- [3] C. Fang; T. Li; Z. Zhang; X. Wang. Pol. Comp. 2008, 19, 1183 – 1187.
- [4] C. Thodesen; K. Shatanawi, S. Amirkhanian. C. and B. Materials 2009, 23, 295–303.
- [5] D. Lesueur. Adv. in Coll. and Interf. Sci. 2009, 145, 42–82.