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Production of Interlocked block with added Tire Rubber Waste

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***Keywords*— Resistance, Residue, Paving.**

***Abstract*— *Currently, much is being studied about the inappropriate disposal of useless tires, where it causes many health and environmental problems. Therefore, the work aims to develop a research on a very important topic, which is the reuse of tire rubber residue, which will be crushed and replaced by fine aggregate (sand), for the production of interlocking blocks for paving. For this, bibliographic searches, queries on articles and standards will be carried out, where the bodies of evidence will be made, conventional blocks (blocks without the addition of rubber), the other mixtures with rubber residue, the sand will be replaced by the residue in the following percentages 2 , 5%, 5%, 7.5% and 10%, and axial compression will be tested at 7, 14 and 28 days of curing. With all this, the resistance of conventional blocks will be compared with blocks with the addition of rubber. And with the test results obtained, check if it meets the standard required by NBR 9781 (ABNT, 2013), for the production of interlocking blocks.*

***Resumo*— *Atualmente muito se estuda sobre o descarte inadequado de pneus inúteis, onde causa muitos problemas sanitários e ambientais. Diante disso, o trabalho tem como finalidade desenvolver uma pesquisa sobre um tema muito importante, que é a reutilização de resíduo da borracha do pneu, que será triturada e substituído pelo agregado miúdo (areia), para a produção de blocos intertravados para pavimentações. Para isto, serão realizadas pesquisas bibliográficas, consultas em artigos e normas, onde serão feitos os corpos de provas, blocos convencionais (blocos sem adição da borracha), as demais misturas com resíduo da borracha, a areia será substituída pelo resíduo nas seguintes porcentagens 2,5%, 5%, 7,5% e 10%, e será ensaiado a compressão axial aos 7, 14 e 28 dias de cura. Com tudo isso será comparado a resistência dos blocos convencionais com os blocos com adição de borracha. E com os resultados do ensaio obtidos, verificar se atende a norma exigida pela NBR 9781 (ABNT, 2013), para a produção dos blocos intertravados.*

***Palavras-chave*— Resistência. Resíduo. Pavimentação.**

I. INTRODUCTION

Currently in Brazil, interlocking blocks have been gaining a lot in the civil construction market, these blocks have been used mainly in sidewalks, squares, parks, streets and patios. The advancement of interlocking blocks and due to their characteristics, among them are the low maintenance cost, the removal of blocks in paved areas and the reuse of approximately 95% of the pieces. Subsequently running the floor can have instant traffic of people and vehicles, there is no need time d and healing and has varieties of both formats as colors. The interlocking floor blocks vary in thickness, 6 cm and 10 cm. The 6 cm pieces are used for lighter traffic such as: light vehicles, pedestrians and bicycles, since the traffic is more intense, the 8 cm and 10 cm blocks are used where the traffic is much heavier, such as: buses and ways. The structure of the interlocked pavement will depend a lot on the traffic intensity applied on the pavement, the soil has characteristics that make up the subgrade. The base of the interlocking pavement is composed of several layers: rolling layer, laying layer, base, sub-base and sub-grade.

The use of the rubber tire brought many serious health and environmental problems, because when tires become useless, the tires are discarded in inappropriate places, causing great disturbances to people's health and quality of life. The improper disposal of tires has many serious consequences, occupations of large spaces in landfills, increased risk of fire, proliferation of insects that can transmit serious diseases and the silting up of rivers and lakes (RAMOS, 2005). Taking into account law no. 258, of August 26, 1999, of the National Environment Council - CONAMA (BRAZIL, 1999), the Minister of the Environment has a requirement that tire manufacturers and importers have to collect and dispose of tires , environmentally appropriate, waste tires existing in the national territory. The fact is of fundamental importance, as it forces companies to look for logistics that are contrary to the recycling activities and reuse of their products.

According to Rodrigues and Santos (2013), due to the characteristics of rubber, such as lightness, thermal properties, elasticity, energy absorption and acoustic properties, recycled rubber tire aggregates are very promising in the construction industry . It is possible to deduce that every tire at some point will turn into a waste that is harmful to health and the environment, and recyclable material would be the most suitable solution. However, reuse requires in-depth knowledge of the technical and technological aspects of the environment and the performance of the tire as a construction material. To soften the impact on nature, the addition of crushed rubber and the mixture in the production of interlocking floors is a solution, the floor better known commercially as pavers.

II. DEVELOPMENT

2.1 Materials and Methods

The tire waste (crushed rubber) (Fig.1a) used in this investigation came from the tire resurfacing process in the city of Porto Nacional / TO / Brazil. The rubbers were collected in eight 50 kg bags, after which they were classified in an ABNT sieve according to NBR 248 (Determination of the granulometric composition), where the material retained in the 1.2 mm sieve, the crushed rubber, was used. Gravel powder and washed sand were used as natural aggregates and were sieved using the No. 200 sieve according to (ABNT) to discard contaminating materials. All materials were oven dried for a period of 24 hours at temperatures of (105 ° ~ 110 ° C) and cooled to room temperature so that there is no influence of the natural humidity in the results. Portland cement CPII-F 32 ABNT NBR 7211/2005 was used as a binder. The water was supplied by the sanitation company network in the state of Tocantins.

The concrete mix was formulated: 1: 1.68: 2.68: 0.482 (cement, sand, gravel powder, water) to show resistance to uniaxial compression of 20 MPa at 28 days of curing. Five cylindrical specimens (10 cm x 20 cm) were developed for each concrete formulation with the addition of crushed rubber. s compression tests were performed at 07, 14, 21 and 28 days according to ABNT NBR5739 (concrete - cylindrical specimen compression test). The investigated dosages with the addition of rubber are shown in Table 1.

Fig.1: (a) crushed rubber, (b) sand, (c) gravel powder, (d) Portland cement.

Table 1. Formulation of concrete dosages with the addition of rubber.

Sample	Rubber grease(%)
CP-0	0
CP-2,5	2,5
CP-5	5
CP-7,5	7,5
CP-10	10

CP - Reference specimen without the addition of rubber.

III. RESULTS AND DISCUSSIONS

3. 1 Compressive strength

The results presented by the sample without the addition of the crushed rubber (CP0) were used as a reference to evaluate the results presented by the samples with the addition of the crushed rubber (CP 2.5, CP5, CP7.5 and CP10). The results presented for the compressive strength test for the control specimens and those added with rubber can be seen in figure 2.

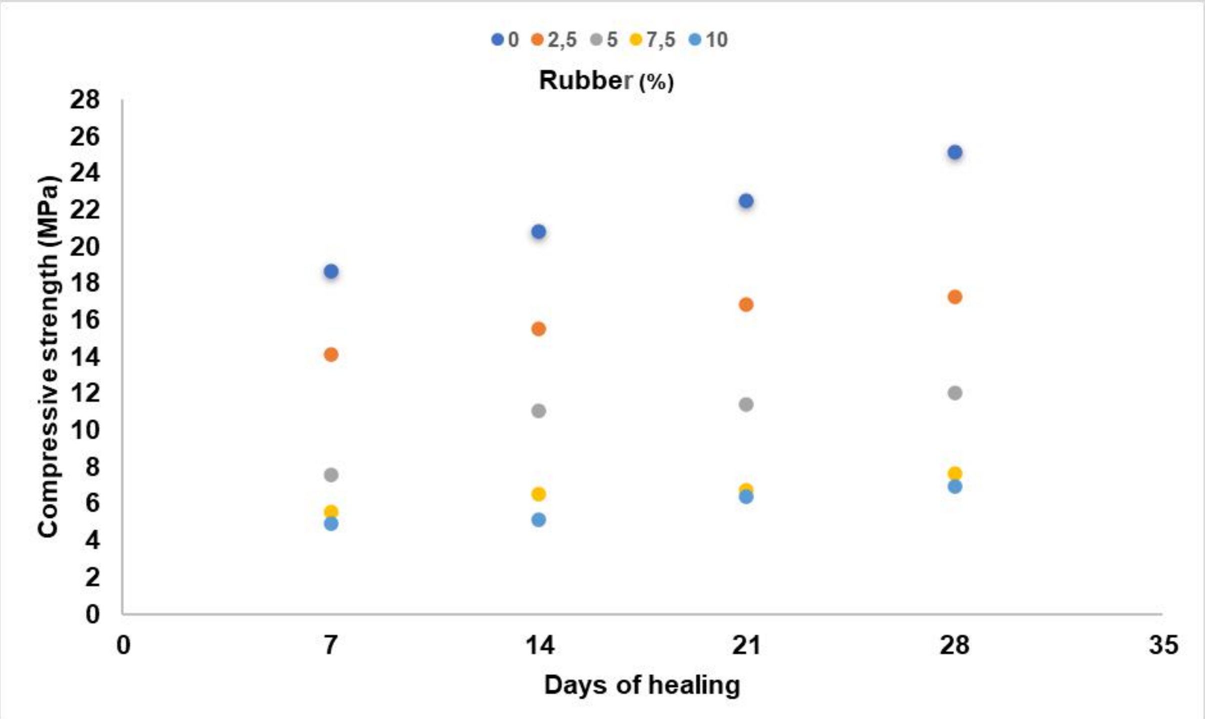

Fig.2: Resistance to uniaxial compression of samples with the addition of rubber: 2.5%, 5%, 7.5% and 10% replacing the aggregate.

After the rupture of the specimens with the hydraulic press, the results sketched in figure 2 shows that the greater the addition of the crushed rubber to the concrete, the lower the compressive strength, therefore, the size of the rubber particles also influences the important performance affect the porosity of resistance. The reduction of resistance with the increase of the rubber content in the investigated specimens can be attributed to three main reasons: weak interfacial bond between the rubber particles of the tire and the cement matrix , deformability of the rubber particles in relation to the microstructure surrounding cement, resulting in the beginning of cracks in a pattern similar to that of air voids in normal concrete and possible reduction in the density of the concrete matrix that still depends on the size, density and hardness of the aggregates.

IV. CONCLUSION

The results presented by the tested samples in relation to the compressive strength, show that it is possible to use the tire residue (crushed rubber) as aggregate in the non-structural concrete in partial replacement of the washed sand with addition 2.5%, 5%, 7, 5% and 10% for the production of interlocking blocks for the use of sidewalks, roads, cycle paths, squares, parks and garages. The greatest contribution of adding this residue to the concrete mass is the reduction in density (± 26%) when compared to traditional concrete.

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