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Reuse of waste from the manufacture of the granilite floor

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Abstract**—***The purpose of this article is to seek a use for the waste obtained through the reuse of the waste from the breakdown of granilite. In order to become a more economical and beneficial option for use in the mortar mix. The tests were carried out at the Civil Construction Laboratory of the Instituto Tocantinense Presidente Antonio Carlos, ITPAC-Porto in Porto Nacional, Tocantins. Granilite rejects were added in percentages of 5, 10 and 15 in traces of mortar idealized for plastering the wall, then tested and analyzed, where the objective was to develop a resistance equal or superior to that of a conventional mortar, working at a lower cost and evolving into a new mortar additive for plastering purposes.*

Keywords**— Cement, concrete, granilite, recycling.**

I. INTRODUCTION

The progress and growth of civil construction in the urban environment is visible, each. The number of materials used in this field is growing, and it is noticeable that amount of tailings leaving the construction sites, tailings that can be highly polluting and which are often destined in unsuitable areas, causing irreparable impacts.

It is of fundamental importance that technical measures are developed to reduction of "debris in civil construction", as well as a correct disposal of this material, such as recycling, which is unfortunately very delayed in Brazil. For this, the recycling process needs to be less complex and expensive, and this is only possible with research and use of techniques capable of improving the quality of the reusable product (MIRANDA, 2000).

A very important factor in encouraging recycling is to avoid the problem of contamination and degradation of the environment. Due to the generation of damage to the atmosphere, soil, fauna and flora, water table, throughout the life cycle. Thereby, universities and companies invest more and more in research on the topic "Recycling", but even so Brazil still needs to reach several levels on this subject (RUFINO and GALDINO, 2015).

When it comes to recycling waste from the construction industry, sustainable practice is consolidated, as resources are seen as limited. In view of this paradigm, the need to reuse materials, which contributes both to sustainable development and to economy (JOHN, 1999; CIRELLI, 2004).

Construction waste accounts for approximately 61% of the counties. Where each municipality is required to carry out an Integrated Construction Waste Management. And the material most used in these constructions is concrete. A material used on a large scale around the world. Cement is used in several steps within a building, including the floor. Floors are considered any continuous surface or not, that allows transit, whether heavy or light. Have resistance to wear caused by friction, as well as diversification of colors and dimensions. They must have easy conservation and hygiene and their resistance must be adequate according to the norm for each building (CAMARGO,2010).

The challenge of designing and executing ever larger floors is a major bottleneck in the construction industry. Therefore, the need to analyze the floors andof its best features.

1.1 Granilite

According to Francelino (2012), Granilite is understood as a coating concrete, that is, composed of water, cement and aggregates. The aggregates can be made of marbles or granites and are called granitina or granilha.

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In addition to contributing to strength, these materials also have the function decorative for its texturing.

They are rigid floors, used on a large scale, at low cost. They feature high resistance to abrasion, immune to the action of oils, good impermeability, and easy maintenance. They can be of the polished or fulge type, while the first receives the smooth finish the second keeps the relief of granitinas. Pigments do not affect the resistance of the floor, can be organic with greater capacity of dyeing, and inorganics with greater durability. Must undergo a cure minimum of 7 days (CAMARGO, 2010).

It is considered a micro concrete, being executed on a subfloor level and with expansion joints. They are mortar, and can be prepared directly on the construction site, the application is done in the same way as the plaster, by launch (GUIMARÃES, 2015).

They are brittle coatings, modulated in loco where they are usually polished. Inits composition takes the aggregant (cement) and aggregate (mineral) from the marble, limestone, quartz, granite and etc. when adding water and passing through the homogenization process the 1: 1.5 trace mortar (cement, granitin). Right after the polymer expansion joint is proportionally measured and seated on the counter floor or dead floor forming a box, if starts the filling process (MIRANDA, 2000).

According to Camargo (2010), after seven days of curing the granilite coating, with the aid of water, the grinding machine is used, where the "inserts diamonds or emery"of weight 0 # to 400 # are responsible for the process granilite dilapidation and polishing, providing the coating with an evenly matte gloss finish.

Once the granilite is dilapidated and polished, it is carefully washed, where post-drying the application of plaster begins, (mortar prepared with cement and white glue) that will be used in the drawing and filling of the voids leaving the coating with better rolling and uniformity.

1.2Reject

During the "hydrated dilapidation" of the granilite floor, the tailings produced that have the characteristic of viscous mud, which is basically the powder of this binder with its clusters. In which it is usually carelessly discarded reaching streams, rivers or lakes, polluting and contaminating nature.

With that, it was thought about reusing the waste from the production of granilite. Since it is discarded as waste from civil construction, there is no utility employed. Studies will be developed for preliminary analysis of material.

The main reuse will be as a mortar additive, aiming to increase the resistance, reducing costs and recycling material that was previously destined improperly. In mortar specifically, it is expected that the material will decrease the use of cement, increasing workability and strength.

Adherence tests "PULL - OFF" will be developed as an analysis of the parameters, seeking to evaluate by comparison the resistance and adhesion of the material.

It is necessary that we find a use for this waste to be less polluting, low cost and easy handling. Trying tolessen the impacts through reuse and creating a starting point for further studies and research in this segment.

Materials obtained in works in the region will always be used, always seeking to meet technical standards and basic safety and sustainability requirements. The tests were developed at the institution itself, with the support of the same.

The research aims to evaluate the best trace with the aggregate of the effluent waste from dilapidation of the manufacture of the granilite floor, in order to know if it will be possible to increase the workability and strength of the mortar at low cost using as additive the tailings obtained from granilite.

II. MATERIAL AND METHODS

The residue from the breakdown of granilite after naturally occurring dry, went through a brief manual grinding using the stainless steel diameter of 2.4 mm for the purpose of a brief inspection, in which it was removed any organic or mineral contaminants such as: kindling, plastics, rocky or similar fragments. Then he spent 24 hours in study to ensure the removal of moisture.

Table 1. Characteristics of aggregates

Aggregates	**Fine Aggregate**	**Granilite tailings**
Specific mass of aggregates (g / cm³)	2,632	0,00
Unit mass (Kg / dm³)	1,644	0,660
Maximum characteristic dimension (mm)	-	2,40

Pin-type wooden crates, 75 cm in size, were made 80 cm which, after being sealed with a release agent, were used as forms for the proof bodies.In the laboratory, preliminary tests were carried out that classified and prepared the materials that would be used in the mortar

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mix, in which it was empirical formulation for the mortar1: 1: 1: 6.

Where the proportional volume required for mixing was 8 kg of cement, 8 kgof lime, 8L of water and 48 kg of sandThe materials used for the trace were coarse sand with 15% moisture, Nassau "CP-II E" cement, hydrated lime from the Hydra brand, and water distilled.Each line was subjected to the Flow Table Test, carried out in accordance with the procedures provided for in NBR 13276.

The first stroke to be rotated was used as an initial basis for analysis comparative, in which it would not take the rejection of granilite in its composition. The second streak received 400g of granilite tailings from 8 kg of cement, 5% of 8 kg. The third streak was replaced with 800g of the 8kg granilite residue of cement, 10% of 8kg. The fourth line was replaced with 1200 g of granilite of 8 kg of cement, 15% of 8 kg.After the lines were prepared, the wood shapes were filled and carefully vibrated for the best settlement and accommodation of the mortar, seeking to follow the same pattern for all specimens. A point to note was that right after the first 20 minutes, the dashes with 0.0%, 5% and 10% showed visible in the specimens, obtaining the same characteristics.

Numerous authors cited by Goodwin and West (1980) observed a maximum adhesion for a given moisture content on the substrate.

Considering this, the molded specimens were waited 24h, where all specimens were immersed in a water tank for 28 days. On the 28th day, they were removed and kept for 24 hours for the start of the adhesion.

Each specimen after being removed from the tank went through a cleaning being removed any impurities that could prevent a better adhesion of the glue, for this was used a steel brush with three rows of bristles polished carbon steel with running water.For the adhesion test, we implemented the use of a drill holder with a bench vise from the Sparta brand, which aimed straight and with greater precision, avoiding the loss of the 90º angle as a specimen, and preventing the dimensional loss of the hole.For gluing the tablets, special series plastic glue based on polyester resin from the Anjo brand, where the catalyst used was the catalyst for glue plastic based on Angel organic organic peroxides.

Given the start of the test, a 50 mm diamond cup saw was used for the proper holes in the specimen where the first was 0.0% addition, after the eleven holes have been drilled, using a medium sized hand air pump all residue from the hole was removed, leaving all the holes clean and free of particles. The plates were glued and waited 24 hours to be given the start of the. These procedures were carried out systematically with all the specimens where the 44 were methodically performed (forty-four) pull-outs, 11 (eleven) of which by specimens.

The entire assay used as an analysis standard was the NBR 13528.

III. RESULTS AND DISCUSSION

The results obtained on the consistency table, Flow Table Test were; for 0.0% of tailings addition obtained 263mm of cohesion, for 5% of tailings addition obtained 239mm of cohesion, for 10% of tailings addition it obtained 218mm and for 15% addition of tailings obtained 160mm of cohesion.

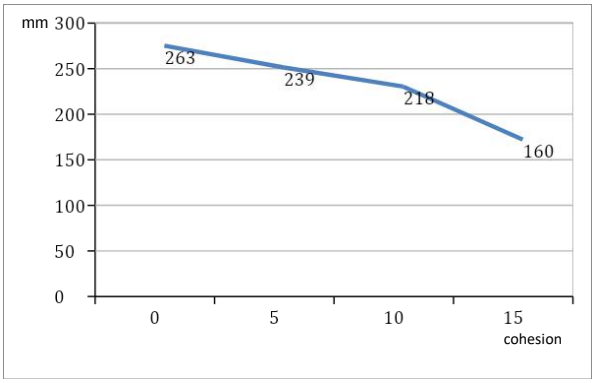

Fig 1: cohesion index graph

A few hours after the specimens were molded with the mortars, a longitudinal crack was observed in the specimens of 00% of 5% and 10% addition of the tailings, where after 28 days of curing, the demoulded this crack evolved into a crack after being demoulded.

As for the pathology, possibly "the phenomenon is caused by the dosage inadequate or inferior quality of the materials present in the mixture. Contribute for water loss failures in determining the type and content of binders, errors in the percentage of fines and the poor granulometric distribution of the sand"(AECWEB.2020). As well as indications indicate that this pathology has a correlation with cohesion index due to the retraction . In the adherence exit, three main types of disruptions being them.

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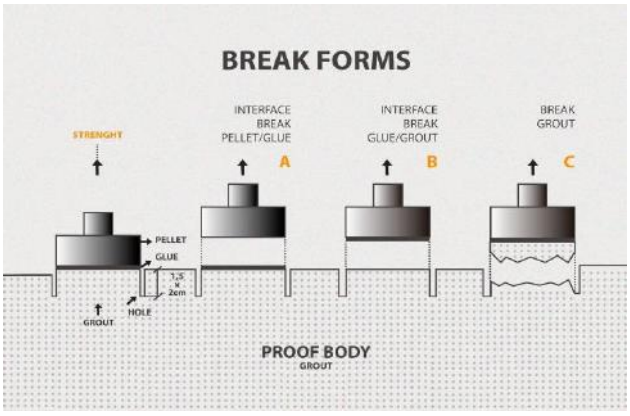

Fig. 2: forms of rupture

- Break in the insert / glue interface: indicates failure in execution (BARRETO and BRANDÃO, 2014).
- Break in the glue / mortar interface: considered as adhesive breaksindicates that this is the weakest layer of the coating. In this case, when results are low means that initial resistance is inadequate (powderiness) (BARRETO and BRANDÃO, 2014).
- Mortar break: Breaks are called cohesive when they occur in the internal regions of some constituent material (BARRETO and BRANDÃO, 2014).

To performing the test on the specimen we obtained the following data.

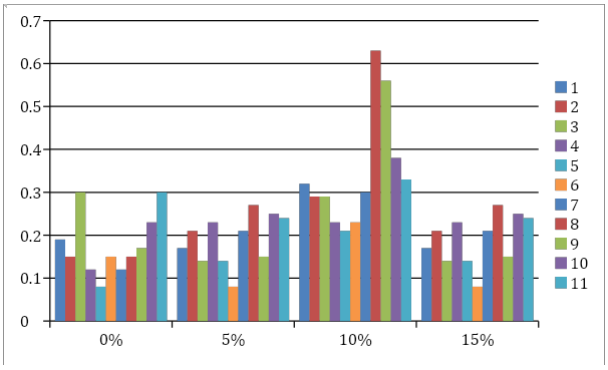

Fig 3: pullout graph

In the 11 (eleven) pull-offs performed on the specimen of 00% addition. I got 6 (six) adhesive breaks and 5 (five) cohesive breaks. In the specimen of 5% of addition we obtained 7 (seven) adhesive breaks and 4 (four) cohesive breaks. At the specimen of 10% addition we obtained 8 (eight) adhesive breaks and 3 (three) cohesive breaks. In the 15% addition specimen we obtained 10 (seven) breaks adhesive and 1 (one) cohesive breaks. There was not a break in the interface pastille / glue. Of the 44 holes, 29.6% resulted in cohesive rupture and 70.4% resulted in adhesive break. There is an increasing adhesive rupture, which points out that add the granilite tailings if there was a considerable increase in the characteristic powderiness. Data which was already expected due to the degree of fineness of the tailings.

Analyzing by the average of the efforts applied to each specimen we obtained the following parameters.

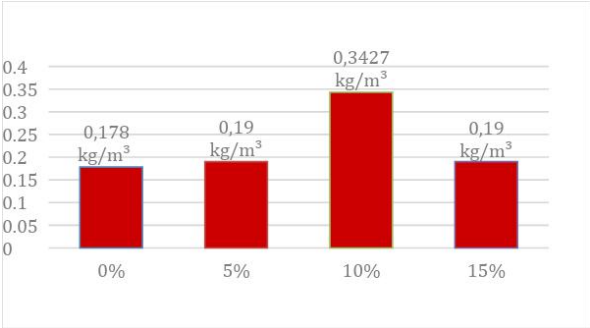

Fig. 4: averages chart

IV. CONCLUSION

When analyzing the results, some important points were obtained, among them evaluate the source of the tailings and the characteristics of the conditioning materials in its formation, such as the stone used in the execution of the floor that may be limestone or granite that due to the hardness index influences the dilapidation process, resulting in a rejection of greater or lesser weight, affecting the consistency that will result in the tailings. The pathology found in the specimens, possibly by the fine characteristic of the aggregate, limits its possibility of use, bringing greater attention to the possible use of mortars with the tailings.

As for the pullout result, in which 70.4% rupture of "adhesive" characteristic, demonstrates a worrying degree of powderiness, in which the chosen mortar mix was inadequate for the purpose. By analysis average of the efforts applied, it is observed that the bodies of evidence that received the granilite tailings in their composition behave positively, showing to support the efforts, the traction, as much as the sample without the rejection in composition, thus proving that it is possible to reuse this type of waste for civil construction works. It is also stated the importance of further studies and tests, like the ones presented in this article, for a better security of your application.

V. SUGGESTIONS FOR NEXT STUDIES

- Pathologies in plasters from purulent aggregates.
- Hardness index for materials based on granilite

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waste.

- Use of granilite tailings in structural concrete blocks.

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