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Viability of Latex Application of the Amazonian Syringe (*Hevea brasiliensis*) as Concrete Additive to Improve Its Physical Properties

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Review Article

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ABSTRACT

The use of alternative materials in Civil Engineering is necessary due to environmental issues that trouble the world. The insertion of regional materials on concrete, which is one of the most essential elements in construction, is the main focus of this article. We will discuss the addition of latex from the Amazon region (*Heveas brasiliensis*) on the making process of concrete since the harvest of rubber is a common practice by local producers and river communities throughout the region. Considering the socioeconomic importance of the practice as a means to promote natural rubber extraction, employee turnover, and income of rubber tappers, the addition of latex will show a better performance to the concrete. The methodology has bibliographical and experimental researches, such as material characterization laboratory tests and a mechanical behavior study, which follow current technical regulations. Furthermore, future research should be conducted with means to further improving concrete by adding new components to latex.

INTRODUCTION

Developing new sustainable lines of research is becoming more necessary every day due to scarce natural resources that the globalized world is subjected to in all economic sectors. For this reason, new practices and alternative concrete forms have recently been created to mitigate the environmental damages in civil construction.

It is imperative to insert alternative materials into the means and modes of production in the world economy. Therefore, using aggregates and alternative additives in civil construction, whose function is to improve their properties and reduce material resources in production, is of extreme urgency [1].

For the production of durable and acceptable concrete, NBR 6118-2014 ratifies that the following aspects are considered: Concrete structures must be designed and constructed in such a way that, under environmental conditions envisaged at the time of the project, they maintain their safety stability and suitability in service for a minimum period of 50 years, without requiring extra maintenance and repair measures [2].

In order for there to be a link between sustainability and the production of resistant and durable concrete, the alternative material is chosen to be used is the latex of the syringe as a concrete additive for performance improvement, since the latex (or natural rubber) is an important compression-deformation resistant polymer. Even with the refinement and research of several polymers, this simple polymer of natural origin is still widely used in various everyday objects [3].

Latex is still an important material in the Amazon rubber plantations. The peak of Amazonian production was 42 thousand tons per year and Brazil dominated the world natural rubber market. Manaus, the capital of Amazonas, had its economic and social development through the rubber cycle, dating from the 19th century. It is a resilient material, resistant to fatigue, good adherence to metals, among other properties [4].

Concrete is composed of three basic elements: Portland cement, aggregates and water, and other components can be added to improve or modify their initial properties, such as developing new special properties [5].

The convenient choice of additives/additives is limited to the experience of concrete scholars and engineers today, after extensive studies of proven efficiency and integrity [6].

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The use of additions comes from the period of 1500 BC, in Greece, adopting a material of volcanic origin. This statement evidences the use of mineral additives in construction prior to the invention of concrete. Other additives were later adopted, as in Germany, which used these materials by adopting volcanic tufts [7].

However, the search for additions for use in the production of mortar and concrete was not restricted only to materials of volcanic origin. Materials such as calcined clay were subsequently used in other regions. Currently, due to economic, ecological and technical factors, it tends to increase the consumption of mineral additions in concrete [7].

Civil construction is one of the sectors that cause greater environmental impact, due to the high consumption of raw materials [7]. Civil construction consumes between 14% and 50% of the natural resources that are extracted from the planet. However, the use of waste as a raw material in construction can reduce the number of natural resources extracted from the environment [8].

It is important, therefore, that there exists a search for alternative materials that can be added to the confection of concrete. The latex extracted from the syringe is a regional ecological material and contributes to the local economy. It is a polymer that, when added to mortar and building coatings, increases bonding to the substrate, and provides impermeability and elasticity [9].

The present work, then, evidences the feasibility of the application of the latex extracted from the syringe, based on the rubber extraction practiced in the Amazon region for more than two centuries, whose purpose is the latex production, mainly of the *Hevea brasiliensis* species, popularly known as rubber tree, a tree belonging to the family Euphorbiaceae and of great natural occurrence in the Amazon region [10].

To reduce environmental damage, it is imperative therefore to affirm that the addition of alternative materials such as latex, regional, sustainable and resistant, in the various economic segments brings significant improvements. In this work we intend to mix it with concrete, seeking to improve its mechanical performance in terms of physical properties and, therefore, to promote the practice of sustainable materials and the local economy, since latex is still a means of survival for the Amazonian caboclo. In addition, future researches will have to be made with the addition of new components to the latex, for mixing to the concrete, in order to arrive at a better level of concrete.

METHODOLOGY

The executive method employed in the project is based on bibliographical and experimental research for theoretical principles, characterization of materials for concrete and test procedure, according to technical standards.

ABNT NBR NM 53: 2009 - ABNT NBR NM 51: 2001 - Abrasion Test "Los Angeles" (ABNT NBR NM 53: 2009, 2009, ABNT NBR NM 53: 2009 - Determination of Specific Mass and Absorption, and ABNT NBR NM 51: NM 51: 2001, 2001) [11,12]. The child aggregates will be made according to ABNT NBR NM 52: 2009 - Determination of Specific Mass and Apparent Specific Mass [13]. The analysis of the granulometric composition of the aggregates for concrete will be done according to the norms ABNT NBR NM 248: 2003 and ABNT NBR 7211: 2009 [14,15].

In relation to the characterization of the Portland cement, the determination of the time of picking will be carried out according to the ABNT NBR norm NM 65: 2003 - Determination of the Pick Time [16]. With regard to the preparation, control, receipt, and acceptance of the concrete will be done by means of standard ABNT NBR 12655: 2015 [17].

The aggregates used in the concrete will be gravel taken from the district of Moura, located in the municipality of Barcelos, Amazonas, and the small aggregates will be sand taken from the metropolitan region of Manaus.

Characterization of the latex of the syringe is also carried out in order to obtain important properties such as viscosity, specific mass (real and apparent), etc. The substantial material of the syringe will be made possible by the Secretariat of Rural Production (SEPROR), and complementary studies on rubber (handling, production) will be sought from environmental agencies such as the National Institute of Amazonian Research (INPA) and Instituto de Environmental Protection of the State of Amazonas - IPAAM. Laboratory procedures will be performed fundamentally for the optimal dosage of the latex in the cementitious mixture. The tests will be carried out using instruments and equipment in laboratories of the Federal Institute of Education, Science, and Technology of Amazonas - IFAM - Campus Manaus Centro, with recurrence to other institutions of higher education to substitute any absences of laboratory apparatus. The technological application will also be demonstrated through a practical research, evidencing the contribution of latex blending to the concrete for several purposes.

OBJECTIVES

To analyze the technical, economic, and social feasibility of the use of the latex extracted from the syringe in the confection of concrete, with the best objectives being to increase the mechanical resistance. To foment a local economy, to leverage the production and the accomplishment of the work through the civil construction.

Characterize the large aggregates (gravel or rolled pebble), small aggregates (sand or stone powder), hydraulic binder (Portland cement), and latex as an additive. Estimation of an ideal mineral dosage with the addition of latex in the concrete, an advantage of having an advantage with a concentration of modified aggregates in the blend. To analyze the advantages of the use

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of the latex additive in conventional casting, the influence of the material on the strength, impermeability, etc., of the concrete. Analyze regional material as alternative development bias for new studies to help society, improve structure, better concrete qualities.

CONCLUSION

The proposal can be used for the production of concrete artifacts. The project can become a vector of regional socio-economic development. The project inserts the natural rubber, once great economic vector of the Amazon in the nineteenth century, in the local economy, benefiting the small Amazonian producer. The project enables the participation of alternative materials in civil construction as well as sustainable and regional practices. The project begs the participation of the community in the construction of alternative concrete in civil construction. The project aims to seek new means of research with the addition of new materials for better results.

The performance of the mortar coatings is related, among other properties, to the adhesion and its durability. Thus, regardless of mortar proportions and the quality of the materials employed, it is essential that there is adhesion conditions of the base coat [18].

Before the tests, it is expected to observe improvement in the compressive strength, improvement in the workability of the materials, in terms of consistency and adhesion.

The knowledge and evaluation of the physical-mechanical properties of latex in the fresh and hardened state are fundamental but not sufficient to ensure maximum adhesion values between the surfaces, information on the characteristics and properties of the aggregates.

Highly crystalline ZnO nanoparticles were synthesized by co-precipitation method. In this work, attempts were made to tune the size of ZnO nanoparticles by controlling the growth parameters such as the concentration of doped nitrogen. The XRD analysis of the samples confirmed its hexagonal wurtzite phase. FE-SEM micrographs showed the morphology of nanoparticles as quasi-spherical with the concentration increase in the doped nitrogen decrease in the size is observed. The size of ZnO Undoped and Doped nanoparticles analyzed by Dynamic light scattering (DLS) is found to be in the range of 50-300 nm. Due to quantum confinement, blue shift is observed in bulk UV-Vis spectra studies is observed at 374.5 nm optical energy gap determined by applying Tauc's equation is approximately equal to 3.31 eV. FTIR spectroscopy shows an increased carboxylate and hydroxyl concentration in samples of smaller size, indicating that they are probably near-surface impurities. It is believed that these surface carboxylate and hydroxyl impurities serve as primary non-radiative recombination centers during the relaxation processes.

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