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CONFECTION OF ALTERNATIVE PRODUCTS FROM EXPANDED POLYSTYRENE (PES) AND CASHEW NUTS (LCC)

Profº MSc. Glauber Oliveira Benjamim. glauberepsantana@gmail.com
EEEP Francisco das Chagas Vasconcelos – Santana do Acaraú-Ce

Participantes: Mariana Canafístula da Penha; Iara Kelly da Penha

ABSTRACT
The present project consisted in promoting the recycling of styrofoam (polystyrene) through its solvent solubilization using natural and technical LCC as stabilizer in order to observe possible changes in the properties of the samples. It was possible to produce materials such as volumetric containers, sports articles such as rackets and spices in general. It has been found that the LCC technique better stabilizes the resin molding process, making it more manageable during drying, allowing a greater variety of useful products.
Keywords: Styrofoam, Recycling, LCC.

CONFECÇÃO DE PRODUTOS ALTERNATIVOS A PARTIR DO POLIESTIRENO EXPANDIDO (PES) E DO LÍQUIDO DA CASTANHA DE CAJU (LCC)

RESUMO
O presente projeto consistiu em promover a reciclagem do isopor (poliestireno) através da sua solubilização em solvente, utilizando LCC natural e técnico, como estabilizante, a fim de observar possíveis mudanças nas propriedades das amostras. Foi possível produzir materiais como recipientes volumétricos, artigos esportivos como raquetes e especiarias em geral. Constatou-se que o LCC téc/nat estabiliza melhor o processo de moldagem da resina, tornando-a mais manipulável durante sua secagem, permitindo maior variedade de produtos úteis.
Palavras-chave: Isopor, Reciclagem, LCC.

INTRODUCTION

Polystyrene is an industrial polymer derived from petroleum, whose monomer, or forming units, is the styrene molecule, which in turn is formed by the covalent union between a benzene ring and an ethylene radical. The junction of its monomers occurs by breaking the double bond in the radical and its consequent molecular bond with the others. The reaction takes place at relatively high pressures and temperatures and in the presence of catalysts.

Among its various forms of production, which match the purposes for which they are intended to be obtained, the expanded polystyrene stands out, which consists of the same product described, however, prepared hot, under the action of certain gases that lead to expansion, such as pentane, making its final composition basically air, but without interfering with its most interesting properties. Like all petroleum products, polystyrene is non-polar, therefore insoluble in water, but soluble in organic solvents.

The dissolution reaction of styrofoam in acetone happens very quickly when we use this organic solvent in pure form. Under these conditions, its pure form has a reasonably high price on the market, which, in principle, may make the recycling proposed here unfeasible. However, there is an alternative method, which consists of using commercial ketones, sold in any pharmacy or supermarket. Because it is very diluted, its direct reaction with styrofoam has no effect, making its purification necessary.

In turn, cashew is a tree of the Anarcadiaceae family, of South American origin and very common, especially in the coastal region of Northeast Brazil (MAZZETO and LOMONACO, 2009). Scientific name Anacardium occidentale, it has a fruit popularly known as cashew nut, which turns out to be less used than cashew itself. In it (chestnut) is contained a dark, oily and caustic liquid, called Liquid of Cashew Nuts, or simply LCC, whose mass corresponds to ¼ of the nut itself. According to the IBGE, Ceará stands out as the largest national producer and exporter of this pseudofruit, followed by Piauí and Rio Grande do Norte.

Much research has been carried out on the properties of this liquid, as well as its possible applications as an insecticide and antioxidant for polymers and biodiesel.

The present project consisted of promoting the dissolution of styrofoam in different sources of acetone (pure and commercial), using LCC as an additive to facilitate the molding of the resin. The characteristics of each sample allowed the making of some alternative products, which aroused a lot of interest and curiosity for the polymer content within the school.

MAIN GOAL

• Through chemical knowledge, synthesize alternative products of a didactic and sports nature, from a resin obtained via styrofoam/acetone solubilization, having LCC as an additive.

Specific Objectives

• Check the impacts on the properties of the resins depending on the type of acetone used (commercial x pure).

• Identify the influence of the addition of LCC (technical and natural) to the resin, in terms of general properties and handling methods.

• From the molding, produce various utensils for use in the school itself.

SOCIAL RELEVANCE OF THE PROPOSAL

Styrofoam (PES) occupies an immense volume, in relation to its mass, which makes it uninteresting for companies specialized in recycling to reuse it, given also the energy costs involved in the process of processing the new resin. Fadini (2001) states that it has taken up valuable space in landfills, becoming a threat to fauna, especially aquatic ones. Thus, it is essential to obtain and disseminate new forms of recycling that can have greater scope and cause attitudinal and behavioral changes that excel in the quality of human life and the environment.

The solubilization of styrofoam in acetone is a widespread practice in science classes, however, little is discussed about the advantages and how this residue can be reused. The pasty mass obtained can be molded, but it makes the process difficult due to the sticky aspect and the absorption of air inside, limiting its potential. It was in this work to evaluate the impact on these properties, when small aliquots of natural and technical LCC are added to this mixture.

Therefore, this project was responsible for obtaining alternative products from polystyrene/LCC resin, after solubilization in acetone, through laboratory analyses, which allow qualifying its capacity for the various applications, understanding that the knowledge of its properties between dissolution and obtaining rigidity, as a function of time, can be essential for the effectiveness of what is proposed.

METHODOLOGY

As a project aimed at the production of a resin from recycling, the first activities consisted of publicizing it in the school environment and the mobilization for the selective collection of the material to be used. Here, the base polymer investigated was expanded polystyrene, present in the most diverse materials that Styrofoam constitutes.

In the school environment, it is not difficult to find good amounts of styrofoam, since it is widely used in works and projects developed by all subjects. In addition, selective collection was carried out by the community, collecting food packaging, household appliance protection linings, etc. In a short time, it was possible to gather enough quantity to start the laboratory work.

The material was then separated and cleaned. We also chose to divide it into fractions of the same size, for later solubilization.

The chestnuts were donated by schoolmates. It is so common, many of the students claimed to have the plant in their own backyard.

The extraction of LCC Natural chosen in this project was done by pressing, using tools such as pliers. The method by solvent separation was not used, as it requires a material that is difficult to handle, toxic and expensive; the hexane. To obtain the technical LCC, small amounts were taken to the oven and heated to 80°C for an hour and a half.

As for the solubilization of styrofoam, two ways were chosen: through pure acetone, and another using purified acetone. In this second, we used commercial acetone and extracted the purified fraction by mixing it with turpentine and decanting. Thus, even without the presence of LCC, it was possible to obtain two resins with different characteristics, which will be described later.

The addition of LCC to the mixture was made immediately after the styrofoam solubilization, during the drying process. Both types of LCC were used, in small amounts that, initially, were not quantized. Finally, we sought to apply these resins through their molding, according to the observed structure. Some alternative materials were made, which will also be described later.

IMPACT ON THE DISSEMINATION OF KNOWLEDGE AT SCHOOL

All the procedures proposed and developed in this project aimed to show, from the possibility and advantage of recycling styrofoam, something still little known in the social context, to minimize the impacts of its future disposal, in terms of occupied volume, to produce resins with special properties. and improved by the LCC, which can, after proven effectiveness and quality through experimental analyses, offer a low-cost option for the manufacture of various materials.

From an environmental perspective, the recycling of expanded polystyrene, through dissolution in acetone, proved to be very positive. The large volume variation observed after the procedure is notorious, since all the air contained within the material is released. As one of the major problems caused to nature is related to its large volume of disposal in garbage and landfills, it can be emphasized that, once recycled in this way, when it is discarded again, the future waste will occupy a volume about 25 times smaller. Furthermore, as it has a new density that is relatively high in relation to the initial one, it will offer more resistance to the actions of the wind, an agent that greatly contributes to.

Various materials were produced, such as a ping-pong racket, solar tiles and volumetric containers, which were even used in classes in the laboratories of that school.

Each product was produced with the proper combination of solubilization pathway and type of LCC added. For the rackets, given the need for rigidity, the resin obtained by styrofoam via pure acetone and technical LCC was used as the best combination. The technical LCC was obtained by heating the natural LCC in an oven at 80ºC for one hour.

In practice, the report was that the alternative racket has functionality and qualities very close to those commercialized, being classified, therefore, as satisfactory for its intended purpose.

Figura 1: Combinações de Isopor por tipo de LCC e acetona

Fonte: O próprio autor

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In practice, the report was that the alternative racket has functionality and qualities very close to those commercialized, being classified, therefore, as satisfactory for its intended purpose.

The use of this sporting article, as well as other small articles made within the laboratory, left the school's student body quite curious and surprised, because it was produced by their own colleagues and in a laboratory without much provision of structure, since it was of high school.

The results were very interesting, and point to a series of advantages in carrying out the dissolution as proposed. The advantages and distinctions between the resins, as well as the possibilities of applications, discussed and enumerated throughout this report, confirm that, more than the product itself, the activities carried out in line with the perspectives of this work, contributed to the personal training of those involved. , and are also reported as the result and objectives achieved in this successful experience.

FINAL CONSIDERATIONS

Regarding ecological viability, the recycling of expanded polystyrene (styrofoam raw material) through the acetone solubilization method proved to be incredibly efficient. Given the release of all the air contained in the interior, estimated by the literature at around 95%, the volume of waste expected as disposal, when this material becomes garbage, becomes 25 times smaller. In environmental terms, we can conclude that, when in the future, the old styrofoam is discarded again, it will cause considerably less damage, since it will occupy smaller volumes in the dump, in addition to having its increased density, it will offer greater resistance to the actions of the wind, being thus, difficult to be spread by soils and rivers. About $3m^3$ of styrofoam were collected and recycled during the project. It is estimated, by known standards, that this same material will occupy a volume of 150L. As for LCC+ Polystyrene + Pure/Purified Acetone resins, it was observed that the production route is crucial to obtain the different properties, and finally, the appropriate destination for each resin. The influence of these properties is evident when both types of LCC are used. The recycling of expanded polystyrene, via solvent and with LCC as a stabilizer, is, therefore, a productive alternative, which offers interesting materials for school studies and the social environment, which contributes to environmental preservation, in addition to offering a pleasant alternative to the practice of experimentalism in the teaching of chemistry, for the dynamism of classes for teachers and students, inserting them in the experiential context of the scientific method and its implications.

Although it was very interesting to observe each characteristic according to the way in which the samples were obtained, it is worth mentioning that all analyzes were of an observatory and organoleptic nature. As a continuation of this project, it is interesting, and still an object of research, to submit the resins to more precise and technical analyses. Therefore, it is intended to carry out some characterization analyses, such as Scanning Electron Microscopy, Magnetic Resonance, Infrared, among others. The objective is to better describe the behavior of the atoms and molecules involved, their type of interaction and the possible reactions that may occur during the process. Since the caustic property of LCC disappears after mixing, one must imagine that there was some interaction. Therefore, it is up to these analyses, to make us understand the microscopic mechanisms that perhaps govern this interesting "transformation" observed, and their knowledge may even lead to other procedures that increasingly improve the physical and chemical properties of these resins.

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