PHYSICAL PROPERTIES OF THE ECOLOGICAL MATERIALS VERSUS ARTIFICIAL MATERIALS

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The methodological limitations have their influence on the physical assessment of the new methods and tools aimed to take into account and to place in the very heart of the designing process the human factor. The purpose of this paper is to set a bio-sourced test for the natural materials in order to predict their degree of use, based on the technical properties of the bio-sourced material surface. One of the manufacturers' issues now is to be able to create environmental responsible products, using the new ecological materials that have at least the same quality as the classics ones. After a critic art stage, we are able now to present in this paper the architecture of a mechanical design method that suits our materials. A set of experiments allowed us to prove the pertinence of our approach.

Keywords: Design, bio-sourced materials, environment, eco-design, hardness, physical properties

1. Introduction

The way a consumer perceives a product has a great influence on the commercial success of that product. According to Adréani [1], only one of five projects is viable and almost 95% of the new products fail. Therefore, is best to set a strategy to minimize a product risk of not being well received by its target. According to Pinheiro [2]: "the consumer likes first something that catches his or her attention and then what he or she finds essential".

There is no need to prove the human role in all the stages of a production chain: design, supervision, production, etc. After a replacement stage, the eco-design is looking now to integrate the human being in the life cycle of a product. This integration is determined by the decision making process, but also by the perception abilities of the human being [3], [4].

The core issue of this paper is simple: to finely describe the possible physical differences between bio-sourced materials and classics ones. Eventually, the products of our study (natural fiber materials versus conventional materials) have the potential of an interesting space-product for the instrumental characteristics.

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The existing methods that allow us to take into account the consumers' preferences are not suitable for the bio-sourced materials manufacturers' constraints. Therefore, it was imperative to develop new methods in order to represent this diversity and, if possible, the physical properties of the new products made to meet the needs and the expectations of different targets.

2. Eco-design – to minimize the impact on the environment

The designer job is a complex one, consisting in displaying and associating in a short time, with limited resources, an ensemble of know-how in order to get to a technical compromise, acceptable for the performance criteria of the multiple and often opposite constraints. This definition epitomizes in a few words the core issue of the design with its many constraints and its three area of expertise: know-how, understanding and associating [3]. Designing activity is a decision making activity that leads to establish the rules, to define the sphere of the problem to solve and the solutions in order to get to the final compromise [4]. Designing is a delicate process, uneasy to subject to classifications. The design consists in defining at the same time the problem and the solution [5]. According to Duchamp [6], it can also be defined as the transformation of a concept into a product.

Eco-design it's an abbreviation for "ecological design". It is a way of creating goods by taking into account the environmental aspects. A design called "environmental responsible" needs to consider for its product developing process a new constraint, the environment.

The father of eco-design is Victor Papanek [7]. For him, the eco-design seems like a good solution for the companies to integrate their priorities for a lasting development along with commercial interrelationships [8]. In product development, according to Brezet and Van Hemel, the eco-design is the lasting solution for finding a perfect balance between ecological and economical demands [9].

The technical innovations had imposed on the market the need to develop new materials having more properties like safety, efficient, flexibility and also being "eco-friendly". Now that there are new materials to replace the conventional ones, the question is how to prove it from a hardness point of view.

3. Bio-source materials

The notion of "bio-sourced" materials is no longer a trend or a fashion... It's a necessity. Usually, this notion means materials with plant or animal origins like woods, straw, hemp, feathers, etc. More and more, the companies are seeing the environmental factors as opportunities for growing their efficiency,

stimulating innovation, lowering the costs, improving the positioning and the communication [10].

There is a growing interest for a lasting lifestyle in its urban forms [11]. This new materials are very well replacing the old ones, allowing us to create a new product with new functions, based on hardness properties.

4. Experimental data

The purpose of this physical study is to qualify or / and to quantify one or more properties of one or more products into theirs characteristics. It's about describing and assessing the intensity and the quality of an ensemble with technical properties – the tested items. It's about describing the products, achieving to some mechanical profiles, distinguishing the differences between products by different aspects, assessing the physical quality over time. From now on, the purpose of our scientific research presented in this paper is to propose a mechanical assessment method viable for the whole process of designing and developing products based on bio-sourced materials. Also, we managed to find a protocol able to be used under control for human assessments.

Our research hypothesis is to study and to compare a bio-sourced material with a artificial one. So, the question that arises now is: It is possible that the new materials to replace the old ones from technical aspects? To answer this question we initiated an experiment concerning the physical properties. We managed to conceive a process for physical assessment of bio-sourced materials integrated in a designing ensemble.

Mastering the technical properties is the major key to control the quality of the product. The purpose is to describe in a few words and with great efficiency the product to analyzing, in order to provide an accurate and comprehensible identity to be reproduced by all people.

Until now we really insisted on the importance of the physical aspects of a bio-sourced material in its raw form and on the necessity to take that into account. But if we review closely the literature, we find eventually that no study treating the role of the hardness aspects in the buying decision and the physical properties had not being published yet.

We established and set two types of materials. We prepared three samples from bio-sourced materials (from natural fiber) with three roughness variation and another three samples from artificial materials in order to compare it with the bio-sourced ones. For confidentiality reasons we can't disclose the nature of chosen materials.

5. Results

The physical analysis of a final product or, in amonte, of a textile, describes all its properties called mechanical, meaning the experimental data by the technical device. The Shore hardness is measured with an apparatus known as a Durometer and consequently is also known as “Durometer hardness” [12]. The hardness value is determined by the penetration of the Durometer indenter foot into the sample.

Shore hardness is a measure of the resistance of material to indentation by 3 spring-loaded indenter [12], [13], [14], [15]. The higher the number, the greater the resistance. The results obtained from this test are a useful measure of relative resistance to indentation [16].

The measures of hardness have been done using a durometer instrument (model HD 3000), Fig. 1. The used instrument has circular scale with good visibility.

Fig. 1. Durometer instrument (Share A D009/A) *(* www.proma.ro)*

The graduation of this instrument is between 0 and 100, and is divided into 100 units. Such instrument is characterized by precise displaying of the test's results. Durometer instrument allowed measuring exactly the degree of hardness of the chosen ecological and artificial materials in our study.

The hardness of one material is defined as the relative resistance of material’s surface to the penetration of a body more hard than this material. Based on the norms, the bio-sourced and artificial materials’ samples must have a contact surface with plane faces of 35 mm at least and with thickness of 7 mm [17].

When reading the results of the experimental data, we made a quality synthesis of the experimental data which characterize the physical properties, trying to achieve minimum of information for maximum of meaning, an average

value of the results presented in Table 1. The results are illustrated in Fig. 2 for bio-sourced materials, Fig. 3 for synthetic materials.

Table 1

The measure of Shore hardness

Type of materials	**Shore Hardness Stabilized** [Shore D]		
Ecological	90.6	88,3	91,1
Artificial	84.2	85.7	82.6

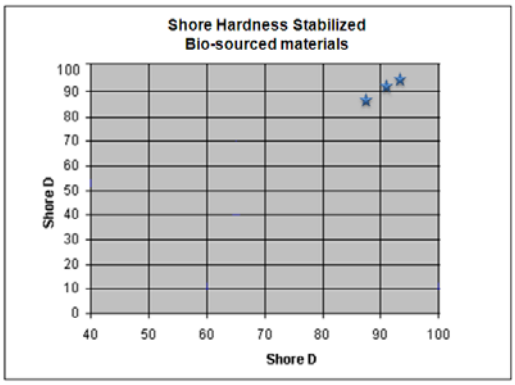

Fig. 2. The results of Shore hardness – *a. bio-sourced materials*

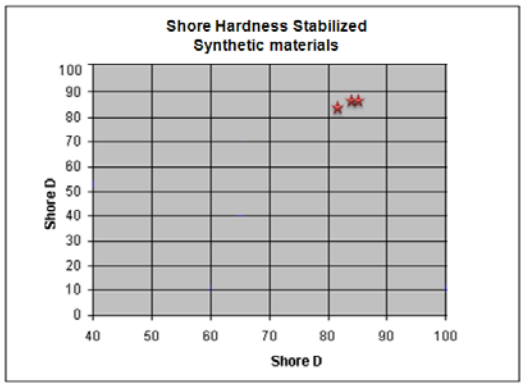

Fig. 3. The results of Shore hardness – *b. artificial materials*

Like we said at the beginning of our research, we were very interested in physical aspects of our bio-sourced and artificial materials. Therefore we noticed that the purpose of our study: to determine the differences between various materials in order to find and to describe the nature of experimental data. Fig. 4 illustrates the remaining description aspects after the synthesis of all two materials types: bio-sourced and artificial materials. The products analyzed via various approaches, like direct results, for example, formed a hierarchy. This comparative

classification is achieved by following the experimental data results, like presented in the Fig. 4.

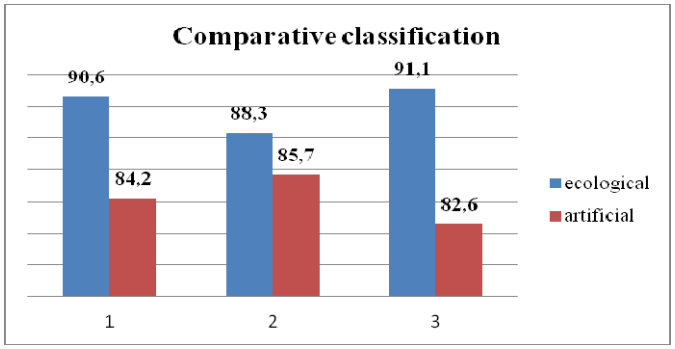

Fig. 4. The comparative classification

6. Conclusions

Our research work at the University Politehnica of Bucharest, joining the Department of Engineering Graphics and Industrial Design team is a study about physical assessment of ecological materials integrated in a designing ensemble. In fact, one of the manufacturers' issues is to be able to create environmental responsible products using new and ecological textiles with at least the same quality as the conventional artificial materials. To take into account the environmental aspects is a difficult task, but it's the key to design the best product and to release it on the market at the right time. The results of this experiment lead us to a number of conclusions. The items of our study, the bio-sourced materials (from natural fibers – hemp) and the conventional materials (from glass fiber) could represent an interesting space-product.

The first original aspect of our work is to propose our methodology in order to physical assess a bio-sourced material, thus letting no question unanswered: Who? How? Why? What? The purpose is a minimum number of description aspects for maximum information about the physical properties of the natural materials to analysis. After creating an experiment protocol, we sought to find out if material's physical information could provide us very useful insights about the replace process of the materials.

The second original aspect of the study is the measurement of the intensity for hardness aspect of the materials.

The third original aspect of our work is the creation, based on physical aspects, of a mechanical profile for the ecological materials. That's the reason why we developed a methodical approach, placing the human factor in the very heart of the method.

Our final contribution, based on the exchange of experience of all experiments presented here, establishes an original methodology for physical assessment on the ecological materials that doesn't exist until our days.

It is necessarily to manage and to understand the role of the bio-sourced materials in our days in the actual industrial context, especially for the multidisciplinary convergence about the "Environment – Human Factor" couple. The comparative study, presented in this paper, between two types of materials (ecological material and artificial material) investigated the requirement types that were evaluated by the hardness device.

The collected data was analyzed using descriptive and non-parametric statistics based on the choosing the results which show the highest hardness. The results showed us that the bio-sourced materials are more interesting to evaluate the hardness properties related to the product use. Moreover, the ecological materials generally can replace the artificial ones very easy. In the other side, the bio-sourced materials, non there are a hardness better then artificial ones, but there are even better with a good hardness. This paper presented first results of our experiments.

7. Further work

For the next research, we propose the accomplishment of a methodological approach for a sensory assessment of the ecological (from natural fibers – hemp) materials, having the purpose to acknowledge the subjects' sensitivity. The properties of the samples are going to be assessed instrumentally and sensory. For better results, we propose the searching for connections between subjective and objective measurements, in other words an original methodology for sensory assessment, the human factor being the measurement tool having its own instrumental properties. We are intending to study the comparison between the ecological materials and the artificial materials by their roughness.

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