NATURAL MATERIALS AS A BASIS FOR DEVELOPMENT OF A NEW PRODUCT

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ABSTRACT

Environmental issues are becoming increasingly important to product designers and manufacturers. This trend is most apparent when considering the environmental impacts of worn-out products. Many different materials are used for product designs including metals, glass, wood, plastics or combinations of more than one material as the composites. The disposal of waste materials is particularly significant in view of the recent focus towards waste management as the important environmental aspects of present-day society.

Natural materials have been incorporating in many new products for years. The solution of using natural materials could be an alternative approach to increase the value of products. Under this circumstance, the objective of this research is to utilize natural waste materials as a design basis of a coral restoration bases. Product prototype is developed to test whether it works as expected. The result found that the mixture of materials used in the production of Coral restoration bases has pH of 8, which is close to the pH of seawater and fits well with the structure of the coral.

Keywords: Coconut Fiber, Coral Restoration Bases, Natural Materials

INTRODUCTION

During the past period, global warming has been affecting coral reef in Thailand in several areas and causing an amount of coral bleaching and then died. Other problems occurring with the reefs are from waves in monsoon season through occurrence from tsunami and from tourism activities along the coral reefs such as anchoring and treading by tourists. This damage with the reefs is physical damage that appears in fracture.

The ways to recover the reefs damaged by waves and fracture from tourism in Thailand have several ways differed from types of effect such as closing area to prohibit use, creating imitation reef, expanding cohesion areas of coral planula, replanting fractured corals, etc.

Coral biological restoration by transplanting is to collect the cuttings in nature that have been fractured by several causes and including the cuttings from colony to be attached to the material which can fix corals to the seabed like PVC pipes [1], the use of cement and sand mixed in proportions and the use of fast-dried cement to stick corals to cement blocks.

To increase coral population by collecting fractured branches on seabed to rehabilitate has been built many types of nursery plots with different materials such as sticking corals with PVC pipes, brick blocks, natural rocks or using steel frames fixed on the seabed [2]. Although restoration them with these materials can increase the population well, the materials used for planting have different shapes and not blended to the surroundings, and some are hard to decompose themselves in the sea especially when the corals bleach and die in a large amount caused by global warming. When the corals die, these materials for restoration will be the waste that is hard to decompose themselves in the sea and to clean up, then cause sea pollution for a long period of time.

Problems of materials used for planting as mentioned above directly impact the use of materials of product designers, especially the design that concerns about environment like eco design. This is a concept for environmental conservation and avoids impact that degrades the environment by using environmentally friendly design process and improving eco-friendly products. Therefore, this research aims to design and develop products from natural materials like coconut fibers and shells in Samut Sakhon which is a province by the sea and people in this area do agriculture and many types of agricultural product processing that cause a lot of waste from both plants and sea lives.

To recycle this waste is to manage it following sustainable development guidelines by integrating knowledge of design to create material waste to be the new products as well as upcycling these materials. Most designers use this to consider design works by initially selecting the guidelines and materials for the design [3].

OBJECTIVE

To design coral restoration bases from natural materials.

METHODOLOGY

The objective of this research is to create designs from natural material waste in the community to be new products and to focus on experimental studies by using agricultural waste to design and produce as a coral restoration bases to help increase the number of coral branches. There are operating procedures as follows:

Step 1: Study about appropriate natural materials for the use in the production of coral restoration bases that consider eco-friendly materials and are good for corals growth. Therefore, this research is to use the waste from natural materials to benefit by choosing to study coconut fibers which are natural material that hard resistant to corrosion and can be easily found in the local area of Samut Songkhram province, and shells which contain a large amount of calcium carbonate and are similar to the main components of coral structures used as materials for the production of coral restoration bases.

Step 2 Product design and development. Beginning with the analysis to find the guidelines and concepts in the framework of eco-friendly designs; blended and get along well with nature under the sea; unique and including the importance of coral structures that must be attached to the coral restoration bases. Then, go into the process of drafting the coral restoration bases, design development process, product model development, improvement and development in order to get the models to be used for real production.

Step 3. Study the information about the suitable production methods for the use in producing the coral restoration bases by using basic principles that can be easily produced and not complicated.

Step 4. Using product models to grow corals in the actual area in Samae San Sub-district, Sattahip District, Chonburi Province.

RESULTS

From researching and analyzing all the data for designing and constructing coral restoration bases from natural materials. It can be summarized as follows:

Step 1: Study on suitable natural materials for the use in producing coral restoration bases.

The results of the study of information on suitable natural materials for coral restoration bases production can be concluded that the main materials used in the production of coral

restoration bases based on the concept of eco-friendly design comprise of coconut fibers and shells. Coconut fiber is a natural material that is non-toxic, has the characteristics of long fiber, flexible, tough, durable, and has a long-life use. This can resist reactions from microbes and corrosion from saltwater and is also an eco-friendly material as it is a natural product [4][5]. Therefore, using coconut fibers as a material for the production of coral restoration bases is possible to develop strength and durable properties because coconut fiber is mainly composed of cellulose or fiber with an amount of up to 60 – 80 percent of all compounds that affects the coral restoration bases stronger and more durable. Shell is a natural material that looks quite hard and contains a lot of calcium carbonate. It is often used to make artificial corals. The chemical properties of the shells are mostly calcium carbonate [6] as shown in Table 1.

Table 1
Percentage of elements in shells

Compound	Cockle (Percentage)	Mussel (Percentage)
Ca	40.999	35.212
Al	0.175	0.445
Fe	0.034	0.246
K	0.053	0.048
Mg	0.001	0.106
Mn	0.016	0.014
P	0.016	0.477
Si	0.037	0.050
Ti	0.055	0.718
Sr	0.002	0.022
LOI	0.056	0.150

Calcium is important for living organisms, especially in cell physiology and muscle contraction. Like coral, it is generally known as a special feature that is possible to build limestone structures to be the habitat of each one. These limestone structures have different shapes according to coral types. The hard structure of the coral is an external structure of calcium carbonate that accumulates under each tissue of the coral. In general, corals are grouped together and connected by limestone structures, which are called coral reefs [2]. Therefore, the use of shells which contain a lot of calcium carbonate as a material for production of coral restoration bases is possible to get along well with coral structures and helps the corals to easily attach to the restoration bases including having good growth.

Step 2: Product design and development

This research has designed and developed products under the framework of eco-friendly design concepts, blended and get along well with nature under the sea, and unique. Therefore, the design concept for the coral restoration bases are to use the shape of the coral to design.

Figure 1
Design concept

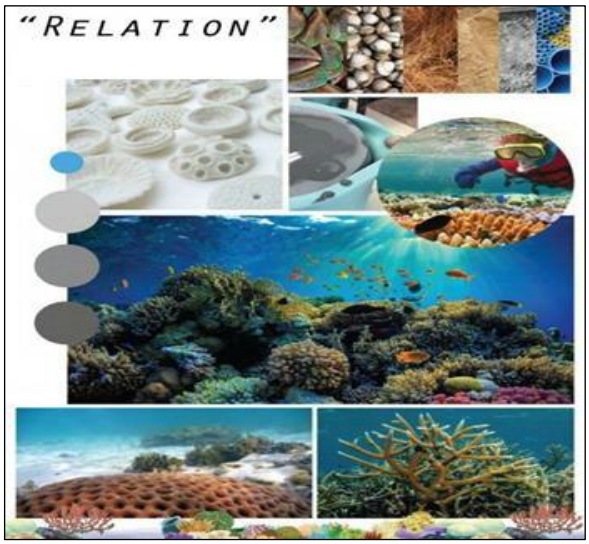
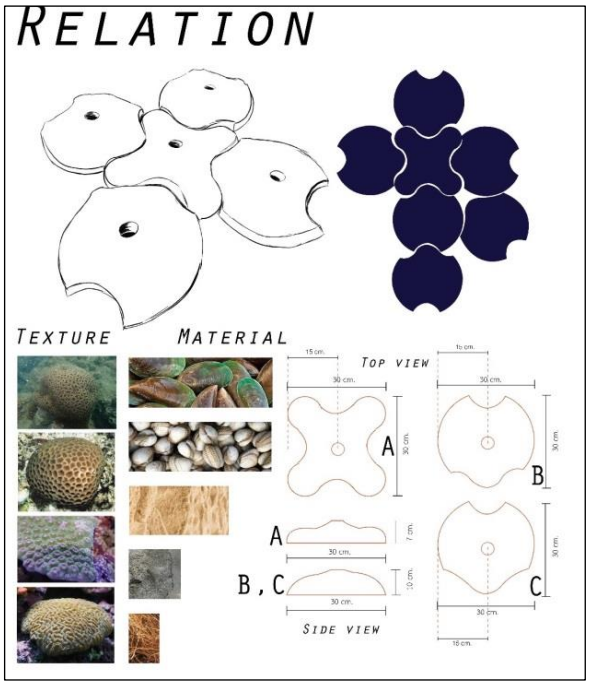


Figure 2
Sketch design



The pH test results of the products by Standard Methods for Examination of Water and Wastewater, APHA, AWWA, WEF, 23rd ed., 2017, found that the coral restoration bases products have the pH value average at 8.0 which is close to the sea water pH value.

Step 3: Study the information about the suitable production methods for the use in producing the coral restoration bases.

From the study of the information about the main materials used in the production of coral restoration bases to lead to the design of the raw materials used in the production and the methods of the coral restoration bases, it can be summarized as follows:

3.1 Design of raw materials used in the production of coral restoration bases

The results of the study of materials used in the construction of artificial corals found that concrete is molded into various shapes by using cement and sand in different proportions. And, from continuously monitoring, it is found that corals can grow well on concrete [2]. Therefore, for this research, raw materials used in the production of coral restoration bases by using the proportions of general roughcast to improve their qualities with coconut fibers and shells are designed. These have a framework for production concepts that are not complicated and can be easily produced in the community as shown in Table 2.

Table 2
The proportions of materials used in the production of coral restoration bases

Ratio of Materials	Results	Characteristic analysis	pH value when immersed in sea water
Formula 1 Cement 128 g. / Sand 64 g. / Shell 128 g / Water 128 g. / No coconut fiber		The work piece is not strong; very fragile; and when using hands to touch, there will be dust in hands.	pH 8.6
Formula 2 Cement 192 g. / Sand 192 g. / Shell 128 g / Water 128 g. / No coconut fiber		The workpiece is stronger than Formula 1, and when touched by the hand, there is still dust in hands.	pH 8.9
Formula 3 Cement 128 g. / Sand 128 g. / Shell 256 g / Water 128 g. / Add 2 layers of coconut fiber inside, then pour the mixture over		The work piece is very strong because the internal structure has coconut fiber to help stiffen.	pH 8.0
Formula 4 Cement 128 g. / Sand 192 g. / Shell 128 g / Water 64 g. / Add coconut fiber mixed with other ingredients and pour in the mold.		The workpiece is less strong than Formula 3 because the coconut fiber mixed with other ingredients and then poured into the mold causes gaps in the workpiece and being brittle and easily broken.	pH 8.2

3.2 Forming and production methods for coral restoration bases

From the analysis of the materials used in the production of coral restoration bases and the raw materials used, it can be concluded that proper forming techniques and production methods for coral restoration bases are making the molds and casting since it is a method that can be mass produced and reproduced. It is also the right technology that people in the community are able to produce by themselves without relying on complicated machine. The process of product forming and production starts from making models to casting molds, making silicone mold, preparing ingredients for pouring into the molds, then pouring the mixture into the mold and leaving it dry. After drying, remove the workpiece from the mold for cleaning by washing.

Figure 3
Production process

4. Pour the mixed material into the mold 5. Remove the workpiece from the mold and wash it thoroughly with water

Step 4. Use product models to test planting in the real area in Samae San Sub-district, Sattahip District, Chonburi Province by bringing staghorn corals from nursery plots that have grown strong enough to be used for coral reef restoration to be attached to the structure of the restoration bases to be transplanted into the restoration area. The results show that after placing the coral restoration bases in a designated area for a month, staghorn corals have grown well. In addition, algae are found on the surface of the coral restoration bases and inhabited by fish.

Figure 4
Place a coral restoration bases in the experimental area in the sea

CONCLUSION AND FUTURE WORK

The results show that natural material from coconut fibers that are tough has a high amount of lignin, resistant to seawater corrosion and can decompose by themselves. When used as a material for the production of coral restoration bases, they help to combine materials, increase product strength and make the product have a long-life use. The shell is a material that has a high amount of calcium carbonate and is well compatible with the external structure of corals that contain calcium carbonate as well. Therefore, the use of shells as a material for the production of coral restoration bases helps corals grow well.

Natural materials from coconut fibers and shells can be well used to produce coral restoration bases by casting and using of the ratio of general roughcast to improve its properties with coconut fibers and shells. Coral restoration bases product has pH value average at pH 8, which is close to the sea water pH value, so it does not affect corals and marine organisms. In addition, the design of products that resemble natural shapes has a positive effect on the organisms that live in that area and makes them feel that there are no alien objects in the area.

The problems encountered in the research were that while doing the experiment by using the product models to test coral planting in the real area, coral bleaching occurred during the experiment process and caused all coral reefs to die and a new experiment must be started. Therefore, recommendations for further research should be well planned and distribute experimental areas to prevent unexpected events occur and there should be a long-term follow-up for further research development.

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