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## Utilizing the Uniqueness of Blood-seashell (*Anadara granosa*) as an Alternative Acoustics Material for a Diffuser Panels

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### Abstract

*Anadara granosa* is a very popular seashell in Indonesia which is known as blood-seashell. According to Direktorat Jendral Perikanan Tangkap Indonesia in 2012, 48 ton of seashell were fished. Seashell mainly used for food, thus making the shell that can't be eaten as a waste. The waste from the seashell has become a major problem, specially at Kenjeran beach in Surabaya. Basically, any material can be used as a diffuser as long as the materials' surface is not flat. The diffuser panels made have 0.6x0.6m dimension, with varied size of shells used, which are small, medium, and large. So, this experiment utilizes the original form of blood-seashells which shape is like a half sphere. This experimental investigation is performed to find out the scattering coefficients and scattering pattern of diffuser made from blood-seashell. The experiment carried out with reference to the ISO 17497 method. Based on scattering coefficient values, the best diffusers' performance is the diffuser panel with small sized blood-seashell. According to the results, the scattering coefficients for each blood-seashells' size have same pattern of value while the scattering pattern for each blood-seashells' size is best at frequency of 1000Hz.

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### 1. Introduction

The high price of diffuser panel and its material which are not environmentally friendly become separated issues for scientist nowadays to utilize nature material or a waste as an acoustics material. Some research had been done for acoustics materials such as using green-seashell (*Perna viridis*) as sound absorption materials which done by Margiasih (2015) for her final project. Then there was a research that utilizing Sumping-seashell as an aesthetic building element by Armando (2013) for his final project. The experiment is only look from the aesthetic side without looking its ability as acoustics materials. So, in this paper will use another seashell which is the main contributor of waste in Kenjeran beach Surabaya as acoustics material for a diffuser panels by utilizes its original form.

*Anadara granosa* is a very popular seashell in Indonesia which is known as blood-seashell. According to Direktorat Jendral Perikanan Tangkap Indonesia in 2012, 48 ton of seashell were fished. Seashell mainly used for food, thus making the shell that can't be eaten as a waste. The waste from the seashell has become a major problem, specially at Kenjeran beach in Surabaya. Basically, any material can be used as a diffuser as long as its surface is not flat. So, in this paper will use the original form of blood-seashell which is has half-sphere shape.

In many cases, diffuser is used to reduce echo and momentary reflection in room. In its application, diffuser can be placed on the wall, on the corner of room, and on the ceiling room, but it more often found on the wall. Every geometrical pattern of diffusers' surface have different scattering pattern.

Scattering coefficient is a comparison between random reflected energy and total reflected energy. The idea of scattering coefficient is to separate specular reflected sound and random reflected sound. When an incoming sound wave has contact with

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the diffusers' surface, the sound will be absorbed in part or all depends on the surfaces' absorption coefficient. If the incoming sound absorbed in part then the rest will be reflected whether it is random reflection or specular reflection.

## 2. The object of the study

The main material, seashells, in this experiment was collected from Kenjeran beach in Surabaya. Seashells were divided according to its size. In this experiment, the seashells' size is divided in three group which are small sizes (width 2cm-3cm, height 0,9cm-1,2cm), medium sizes (width 3,5cm-4cm, height 1,1cm-1,5cm), and large sizes (width 5cm-6cm, height 1,7cm-2,1cm). The seashells were arranged in the same direction onto plywood board which size 0.6x0.6m with 12mm thickness.

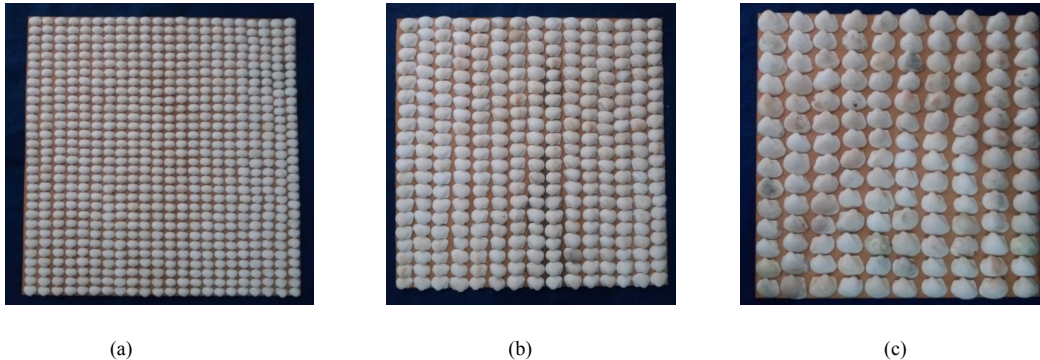


Fig. 1 Diffuser panels which made from blood-seashell (a) small size (b) medium size (c) large size

## 3. Methods

In this paper, the measurement consist two kind of measurement which is the first is to determine the scattering coefficient and the rest is to find out the scattering pattern of diffuser.

### 3.1. Measurement of Scattering Coefficient

The measurement of scattering coefficient (denoted as  $s$ ) was performed in semi-reverberation chamber of physics department of Institut Teknologi Sepuluh Nopember Surabaya. The measurement method of scattering coefficient based on ISO 345 trough the measurement of sound absorption in reverberation chamber. The frequency that used in the measurement of scattering coefficient are 125Hz, 250Hz, 500Hz, 1000Hz, 2000Hz, and 4000Hz. The scattering coefficient can be calculated from absorption coefficient ( $\alpha$ ) and specular absorption coefficient ( $\alpha_{spec}$ ).

$$s = (\alpha - \alpha_{spec}) / (1 - \alpha) \quad (1)$$

While the value of diffusers' absorption coefficients ( $\alpha$ ) and specular absorption coefficients ( $\alpha_{spec}$ ) are:

$$\alpha = (0,16 V/A)(1/T_2 - 1/T_1) \quad (2)$$

$$\alpha_{spec} = (0,16 V/A)(1/T_4 - 1/T_3) \quad (3)$$

Where,

$\alpha$  : absorption coefficient of diffuser

$\alpha_{spec}$  : specular absorption coefficient

$V$  : volume of reverberation chamber ( $m^3$ )

$A$  : diffusers' wide area ( $m^2$ )

$T_1$  : room reverberation time without diffuser (second)

$T_2$  : room reverberation time with diffuser (second)

$T_3$  : room reverberation time without diffuser when turntable is rotated (second)

$T_4$  : room reverberation time with diffuser when turntable is rotated (second)

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