The effect of porous round on waves produced on the wave simulation tool, laboratory scale

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Abstract. Bangka Island is one of the islands that has beautiful beach tourism destinations but also has the largest tin reserves in the offshore area. This causes a very significant difference and can be a gift or a curse. Waste from the results of offshore tin mining activities carried out by production suction vessels (KIP) in the form of mud and changes in seawater quality. Then the sludge produced by mining causes waste/mud to be carried by the waves of the sea and settles along the shore and imposes silting and causes seawater on the shore to become turbid. One way to determine the effect of waves on the deposition of mud, among others, with a wave simulation tool. The study aims to determine the length and height of the waves produced on a laboratory scale Floating Breakwater Simulation. From the results of the study it can be concluded that the shaft rotation speed affects the waves produced, the higher the shaft rotation the higher the resulting waves. The frequency of the simulation tool also increases while the wave period decreases as the rotation of the shaft rotates, which means that the resulting wave appears more frequently and with a high propagation speed at the highest rotation of the shaft.

1. Introduction
Bangka Island is known for having many beautiful beaches and almost stretches along the island. This great potential can be developed for tourism which can certainly improve the welfare of the surrounding community, but currently, some beaches on the island of Bangka are experiencing a tendency to settle mud and change the quality of seawater caused by tin mining activities carried out by suction production vessels (KIP), waste resulting from activities Offshore tin mining is carried by ocean waves and settles along the shore and imposes silting and causes seawater waters to become murky.

Stagonas [1] states there are two types of waves of seawater, the first beach-forming waves and waves of beach destroyers. Coast-forming waves are waves that have a small height and flow propagation velocity. So, when the wave breaks on the beach it will carry sediment (beach material). Coastal material will be left on the beach (deposit) when the backflow of broken waves seeps into the sand or slowly flows back into the sea. While the beach destroyer waves usually have a high height and propagation speed (very high). Returning water has less time to seep into the sand. When the waves come back to hit the beach there will be a lot of volume of water collected and transporting beach material to the middle of the sea or other places.

Triadmojo [2],[3] sea waves are natural phenomena that cause high and low swings of water masses that move ceaselessly on the surface layer or below the surface of the sea. The composition of waves in the sea in both its shape and type is so varied and complex that it is almost unable to be deciphered and is difficult to describe systematically because it is not linear, three-dimensional, and has a random shape. The resulting waveforms tend to be erratic and depend on several wave characteristics such as the period and height of the waves formed.
Pratiko [4] said that the shape and propagation of waves that vary and irregularly greatly affect the characteristics of the waves that occur in these waters. In addition to changes in height, length, and speed of waves also occur other phenomena such as silting, refraction, diffraction, and reflection before the wave breaks. Wave siltation is the process of decreasing the wave height due to changes in depth where the wave velocity decreases and consequently there is also refraction because the direction of motion of the wave peaks follows the contour shape of the ocean depth. Refraction is emphasized on the change in wave height due to the bending of the wave peak direction. While diffraction is the process of moving towards a protected area causing waves.

Murali and Mani [5], experimentally examined floating type breakwaters of a pontoon trapezium with vertical pipelines. In the first study without using a vertical pipe, it was found that the value of the transmission coefficient \( K_t = 0.5 \) at a \( W/L > 0.4 \). By adding a vertical pipe, the value of \( W/L \) can be reduced until 0.1. Ningsih [6], a one-year simulation of tide- and wind-driven circulation in the Java Sea, which is one of the Indonesian seas located in a tropical area, has been carried out using a three-dimensional hydrodynamic model incorporating the influence of the wind waves generated at the sea surface. This area is influenced by the monsoon climate (east- and west-monsoon). Six hourly-wind fields at 10 m above the sea surface were used as a representative wind field. In other respects, the effect of waves on the three-dimensional hydrodynamic model has been represented by the surface and bottom stresses.

The actual waves that occur in nature are very complex and cannot be accurately defined. However, in studying the phenomenon of waves that occur in nature, several assumptions were made, so that several wave theories emerged [7]. Any coastal or marine engineering study such as a coastal improvement project or port design planning requires information on wave conditions in the area of interest. Usually, wave characteristics are collected offshore and it is necessary to transfer this offshore data on wave heights and wave propagation directions to the project site. [8] To determine accurate wave conditions in waters and obtain input data for the analysis of sediment transport and surf zone circulation has resulted in significant advances from wave transformation models over the last two decades, one of which is using wave simulation tools.

2. **Materials and Methods**

![Figure 1. Design of a wave simulation tool.](image)

Tools in this study consisted of 1. Water-holding ponds, 2. Wave-producing plates, 3. Eccentric shafts, 4. Scaffolding motors, 5. V-belts connecting motor rotation, 6. Simulation tool frames.
This research equipment can regulate artificial wavelengths through the speed of the driving motor so that this study can analyze the effect of length, frequency, and wave height on seawater turbidity caused by Production Suction Ships (KIP). The testing procedure and data collection process can be carried out as follows: 1. Filling a pool of water with an average height of 34 cm, 2. Turn on the electric motor and adjust the motor rotation, 3. Make sure the wave generator plate is functioning properly, 4. Measure rotation on the shaft using a tachometer, and 5. In this study, the shaft speed is varied by 5 variations. Data to be measured include wavelength by measuring the wavelength from one peak to another, and wave height by measuring the distance of the wave valley to the wave crest.

3. Results and Discussion

Waves are the movement of up and down water in a perpendicular direction to the sea surface which forms a sinusoidal curve or graph [9]. Meanwhile, sea tides are a phenomenon of periodic rise and fall of sea level that occur throughout the hemisphere due to the tidal forces that mainly come from the sun and moon [10].

From the research on the Laboratory Scale Floating breakwater simulation tool with a water level of 34 cm and by varying the shaft rotation by 5 variations, the following results are obtained:

**Table 1. Wave simulation research data.**

| Shaft Speed (RPM) | Wavelength (cm) | Wave Height (cm) | Period (seconds) |
|------------------|-----------------|------------------|------------------|
| 52               | 61              | 8.5              | 2.21             |
| 57               | 61              | 8.9              | 2.10             |
| 58               | 59              | 7.8              | 1.98             |
| 61               | 59              | 9.8              | 1.78             |
| 62               | 57              | 11.0             | 1.59             |

**Figure 2.** Graph of the relationship of shaft rotation variation to wavelength.

In figure 2, it can be seen that the wavelength produced by the simulation tool decreases with an increasing rotation of the shaft. The highest wavelength is obtained at 52 RPM rotation and the lowest wavelength at 62 RPM.
In Figure 3, it can be seen that the highest wave height generated by the wave simulation tool is 11 cm at 62 RPM shaft rotation, when viewed on the graph the wave height has increased along with the increase in shaft rotation. This is inversely proportional to the wavelength that decreases with an increasing rotation of the shaft. The lowest wave height produced is at 52 RPM rotation.

In Figure 4, it can be seen that the wave propagation speed generated by the simulation tool increases with an increasing rotation of the shaft. The highest fast-wave propagation is obtained at 62 RPM rotation which is 36.26 and the lowest fast-wave propagation is 27.6 at 62 RPM shaft rotation.
Figure 5. Graph of the relationship of shaft rotation variation to the wave frequency.

It can be seen that the frequency of the waves produced by the simulation tool increases with an increasing rotation of the shaft in Figure 5. The highest wave frequency is 40 Hz at 62 RPM, and the lowest wavelength at 52 RPM is 28.5 Hz.

Figure 6. Graph of the relationship of shaft rotation variation with the wave period.

The shortest wave period generated by the simulation tool can be seen in Figure 7 is 1.59 seconds. The wave period is decreased with an increasing rotation of the shaft. The wave period at 52 RPM is the longest period of the wave simulation tool, which is 2.21 seconds.

4. Conclusion
From the results of this study, it can be concluded that the rotational speed of the shaft affects the resulting waves. An increase in shaft rotation causes the resulting wave to be higher. The wave frequency in the simulation tool increases with increasing shaft rotation while the wave period decreases with increasing shaft rotation. It can be concluded that the waves produced appear more often and with a high creepage speed at the highest rotation of the shaft.
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