EXPERIMENTAL TEST OF A CYLINDERICAL WAVE ENERGY SYSTEM WITH HORIZONTAL ROTATION FOR SHALLOW WATER

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INTRODUCTION

In the present study a cylindrical wave energy system with horizontal rotation for shallow water is newly suggested. The suggested cylindrical wave energy system is composed of the horizontal cylinder and the swing plate as shown in Fig 1. The horizontal cylinder is floated at the free surface, and rotated by the water particle velocity and the current flow. The electric generator is located in the horizontal cylinder. Thus, the generator is not affected by sea waters. The swing plate is submerged at the bottom of horizontal cylinder and has the pendulum motion according to incident wave motion. In real ocean environments, the propagation direction of wave may change from day to day. Therefore, the yaw system is adopted in this design. To evaluate the characteristic of cylindrical wave energy system the experimental test is carried out for the various parameters.

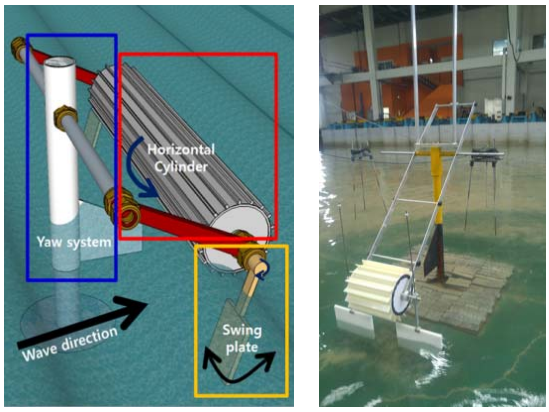

Figure 1 - Cylindrical wave energy system with horizontal rotation for shallow water

EXPERIMENTAL TEST

All the experimental tests are conducted in a wave basin of inner dimensions 40m (L) × 50m (W) × 1.3m (H). The water depth is kept at 0.6m and the resistance (0.06Nm) of the power generator is considered for all cases. The similarity law according to Froude number is adopted and the scale factor is 0.12. The detail parameters of experimental model and the regular wave conditions are presented in Table 1 and 2, respectively.

Table 1 - Experimental models

	Length (mm)	Diameter (mm)	Length of bucket (mm)	Number of bucket	Mass (kg)	Draft (m)
Cylinder	600	240	36	16	4.69	54
	Length (mm)		Height (mm)	Width (mm)		Mass (kg)
Swing plate	300		240	15		1.59

Table 2 - Regular wave conditions

	W1	W2	W3	W4	W5
Period (sec)	2.078	3.118	4.157	3.118	4.157
Height (mm)	120	120	120	240	240
Wave length (mm)	4571	7250	9850	7250	9850

RESULTS AND DISCUSSION

The experimental test is carried out for three cases such as only cylinder, cylinder and swing plate 1 with the 60mm distance between cylinder and swing plate and cylinder and swing plate 2 with the 120mm distance to evaluate the characteristic of cylindrical wave energy system and the interaction effects between cylinder and swing plate. The RPM of cylinder has the largest value at the short wave period and it is increased with the increment of wave height. Although the RPM of cylinder with swing plate is decreased, it is increased with the increment of distance between cylinder and swing plate. It means that the RPM of cylinder is strongly influenced by the interaction effects. The displacement of swing plate is measured at 540mm from the free surface. The period of periodic motion has a similar value with the incident wave period and the displacement is increased when the incident wave has the long wave period and high wave height. Since the water particle velocity is higher at the free surface, the displacement of swing plate is increased with the decrement of draft. The displacement of swing plate is also strongly influence by the interaction effects.

	Cylinder	Cylinder + Plate 1		Cylinder + Plate 2	
	RPM	RPM	Dis (mm)	RPM	Dis (mm)
W1	4.611	3.602	304	4.828	272
W2	3.051	2.451	365	2.713	306
W3	3.070	2.473	475	3.047	440
W4	6.113	4.692	506	6.069	467
W5	7.349	6.318	639	7.548	606

CONCLUSION

In the present study the experimental test of cylindrical wave energy system with horizontal rotation is carried out with regular wave conditions and the power generation efficiency has about 30% at W1 wave condition. In the future research, the test will be performed with irregular wave conditions and the power generation efficiency of cylindrical wave energy system for shallow water also calculated.

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