

## **Improvement of Waterfront Environments Using the Permeable Breakwater with Wave Absorbing Pipes**

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In order to improve the quality of seawater in harbors, fishing ports and bay areas, KUBOTA has developed the PERMEABLE BREAKWATER WITH WAVE ABSORBING PIPES which is implanted with pipes horizontally. The pipes are highly durable ductile iron pipes by KUBOTA, widely used for the water and drainage pipeline. The nominal diameter of the pipe is 1000 mm, having a 500 mm diameter 'Venturi'-like section in it.

The functions of this new type breakwater are as follows;

1. Absorption of the wave and dissipation of the wave force
2. Conversion of the wave to turbulent, diffusion and bubble flow (i.e. aeration effect)
3. Introduction of fresh seawater

The PERMEABLE BREAKWATER WITH WAVE ABSORBING PIPES is able to replace the seawater in the bay with fresh one by means of not only tide but also the usage of wave energy. The fresh seawater comes into the pipe and vertical wave motion is turned to lateral stream at 'Venturi'-like section. At the same time, the flow is aerated and causes the bubble flow near the water surface. As a result, the improvement of the quality is achieved with keeping calm condition in the bay. This new type breakwater has the feature that the flow of seawater always comes into the bay even wave height is only 10cm with no relation to the tide which the flow direction reverses periodically.

The poster presentation will show the following:

- a. System and structure
- b. Results of the model experiments
- c. Results of the investigation on site (extract from 36 sites)