= Clapotis =

In hydrodynamics , the clapotis (from French : " lapping of water ") is a non @-@ breaking standing wave pattern , caused for example , by the reflection of a traveling surface wave train from a near vertical shoreline like a breakwater , seawall or steep cliff . The resulting clapotic wave does not travel horizontally , but has a fixed pattern of nodes and antinodes . These waves promote erosion at the toe of the wall , and can cause severe damage to shore structures . The term was coined in 1877 by French mathematician and physicist Joseph Valentin Boussinesq who called these waves ? le clapotis ? meaning ? ? the lapping " .

In the idealized case of " full clapotis " where a purely monotonic incoming wave is completely reflected normal to a solid vertical wall , the standing wave height is twice the height of the incoming waves at a distance of one half wavelength from the wall . In this case , the circular orbits of the water particles in the deep @-@ water wave are converted to purely linear motion , with vertical velocities at the antinodes , and horizontal velocities at the nodes . The standing waves alternately rise and fall in a mirror image pattern , as kinetic energy is converted to potential energy , and vice versa . In his 1907 text , Naval Architecture , Cecil Peabody described this phenomenon :

At any instant the profile of the water surface is like that of a trochoidal wave , but the profile instead of appearing to run to the right or left , will grow from a horizontal surface , attain a maximum development , and then flatten out till the surface is again horizontal ; immediately another wave profile will form with its crests where the hollows formerly were , will grow and flatten out , etc . If attention is concentrated on a certain crest , it will be seen to grow to its greatest height , die away , and be succeeded in the same place by a hollow , and the interval of time between the successive formations of crests at a given place will be the same as the time of one of the component waves .

= = Related phenomena = =

True clapotis is very rare , because the depth of the water or the precipitousness of the shore are unlikely to completely satisfy the idealized requirements . In the more realistic case of partial clapotis , where some of the incoming wave energy is dissipated at the shore , the incident wave is less than 100 % reflected , and only a partial standing wave is formed where the water particle motions are elliptical . This may also occur at sea between two different wave trains of near equal wavelength moving in opposite directions , but with unequal amplitudes . In partial clapotis the wave envelope contains some vertical motion at the nodes .

When a wave train strikes a wall at an oblique angle , the reflected wave train departs at the supplementary angle causing a cross @-@ hatched wave interference pattern known as the clapotis gaufré (" waffled clapotis ") . In this situation , the individual crests formed at the intersection of the incident and reflected wave train crests move parallel to the structure . This wave motion , when combined with the resultant vortices , can erode material from the seabed and transport it along the wall , undermining the structure until it fails .

Clapotic waves on the sea surface also radiate infrasonic microbaroms into the atmosphere , and seismic signals called microseisms coupled through the ocean floor to the solid Earth .