

Experimental and Asymptotic Investigation of a Shear Stress driven Rotary Wave

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The free surface flow in a vertical, cylindrical, rotating container will be considered when axis-symmetric angular and radial shear stress distributions act on the free surface.

In the inviscid case, the well-known rotary wave can be described by a flow potential. We want to determine the stability limit of the axis-symmetric base state for small Ekman and Froude numbers. Under the above assumption, the critical flow conditions can be determined analytically.

The results will be verified experimentally using a vertical, cylindrical container partially filled with water where the top lid rotates with a given angular velocity. Thus, the induced air flow will exert shear stresses in the angular and radial direction onto the water surface. Above a certain threshold, rotary waves can be observed.

We will discuss another series of experiments performed at a turbine test stand. In particular, we will analyse the different stages of the development of the wave.