ON A QUANTITATIVE FEATURE OF MAXIMUM PENETRATION DEPTH OF DROP-FORMED VORTEX RINGS

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KEYWORDS:

Main subjects: Drop-formed vortex rings, Flow visualization

Fluids: Water liquid, Glycerol-water mixture, Silicone oil

Visualization method(s): Reduction of meniscus interface interference, Specially well-controlled experimental facility with minimum disturbances

Other keywords: Maximum penetration depth, Quantitative analysis

ABSTRACT: The formation of vortex rings produced by the drop impact with small velocity is beautiful and also important in the nature and industrial applications. It has been long since noticed that drop experiment with low impact energy is very sensitive to the experimental conditions, e.g., vibrations, liquid contamination, nozzles, flow feeding conditions, and target tank size etc. Any small perturbation could influence the trajectory of vortex ring so that significantly changes of the penetration depth. Over the past hundred years, oscillation of drop has been considered as an influential factor that is related to the penetration depth of drop impact onto liquid surface; however, there is still no consistent conclusion for describing the common feature of the phenomena up to now [1-4]. Main aim of this paper is to find out whether there is any quantitative result of the maximum penetration depth for various drop fluids. We revealed firstly how to design a facility to produce repeatable experiments with minimum disturbances (Fig. 1(a) water drop and (b) 60% glycerol-water mixture drop onto water tank). The “interference black zone” caused by the meniscus interface has been also minimized (Fig. 1(c)). Based on a well-defined criterion for determination of vortex penetration depth, it shows repeatable development of vortex rings from various liquids. Furthermore, the first quantitative relationship of maximum penetration depth and drop size with excellent correlation will be shown in the presentation.

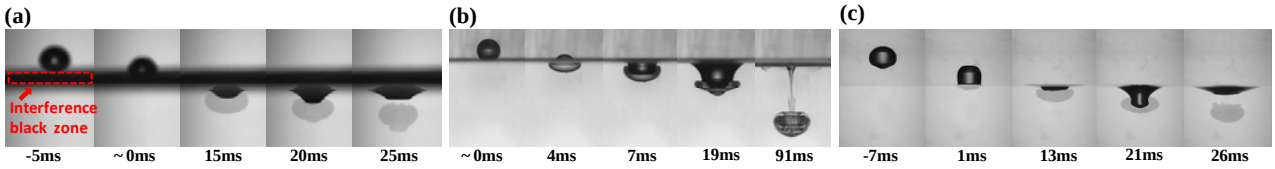

Fig. 1 The development of vortex ring by (a) water drop (drop diameter D=5.52mm, impact height H=24mm) and (b) 60% glycerol mixture (D = 3.69mm, H = 24mm) impacting onto water target liquid, (c) water drop (drop diameter D=5.52mm, impact height H=22mm) with special control of meniscus interface.

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