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Special Issue on Cavitation

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Overview

Special Issue on Cavitation

Cavitation is an extremely complex phenomena, as Knapp et al. stated in their classical text: "It is difficult to give a concise definition of cavitation and at the same time convey much significant information about it…" Some of the essential characteristics and issues can be: cavitation is a liquid phenomenon; cavitation is the result of pressure reductions in the liquid; cavitation is concerned with the appearance and disappearance of cavities in a liquid including water, oil, and liquid metals; and cavitation is a dynamic phenomenon. Moreover, the damage by collapsing cavitation bubbles is a serious surface wear problem, designated as cavitation erosion.

Cavitation is affected by pressure, velocity, temperature, vapor pressure, surface tension, viscosity, compressibility, and content air. Bubbles due to cavitation can be principally categorized into two types, vaporous and gaseous. Comparing water and oil, water is high vapor pressure and, in contrast, oil contains much air. Therefore, cavitation of water generates vapor bubbles, while that of oil generates gas bubbles.

Cavitation causes degradation and noise of fluid machinery such as turbo pumps, water mills, hydraulic equipment, marine propellers, pipe lines, and hydrodynamic bearings. The most important parameter of pumps would be the net positive suction head which corresponds to limitation of the operation based on cavitation. The performance and limitation of machines and propellers in relation to a liquid are determined by cavitation. Cavitation also causes erosion when the cavitation bubbles collapse near the solid walls. The motion of the bubbles is basically formulated by the Rayleigh-Plesset equation. Furthermore, when an acoustic bubble expands and contracts reputably by fluctuating circumferential pressure, the bubble emits light and high temperature due to adiabatic compression known as sonoluminescence.

On the other hand, cavitation can be used effectively for surface treatment, cutting, chemical reaction, and cleaning. For example, the high pressure caused by collapsing bubbles may contribute to residual stresses on solid surfaces and emulsification of liquids.

Cavitation erosion is multifaceted and there are several tests including ultrasonic vibration, cavitating jets, high-speed cavitation tunnel, and rotating discs. The representative standards can be listed ASTM G32, *Standard Test Method for Cavitation Erosion Using Vibratory Apparatus* and G134, *Standard Test Method for Erosion of Solid Materials by a Cavitating Liquid Jet*.

This Special Issue on Cavitation presents 10 papers on bubble dynamics, damage, erosion, materials, jet flow, luminescence, test method, application, and related subjects that include a wide variety of cavitation phenomena. This includes two papers on bubble dynamics and flow luminescence; two papers on cavitating jets and flow; four papers on material evaluation and test methods; and two papers on bearings and processing. Although these papers are categorized for convenience, each paper deals experimentally and theoretically with one or more subjects.

Producing this special issue required significant efforts from authors, reviewers, editors, and the publication team, which is gratefully acknowledged. The guest editors are also grateful for the support from

their respective organizations. The guest editors of this issue would especially like to thank Dr. Richard W. Neu and Dr. George E. Totten for their guidance and support in compiling this issue.

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Authors preparing papers for submittal should observe the conventions of style explained in the ASTM Style Manual. Since the journal does not request page charges, the author is expected to conform to these standard conventions for style. SI units are to be used throughout; if data were not measured in SI units, a note should appear to that effect and the original units should be included in parentheses after the SI units.

IN APPRECIATION

The high quality of the papers that appear in this publication is a tribute not only to the obvious efforts of the authors represented but to the unheralded, though essential, efforts of their reviewers. It is to the reviewers dedication to upholding the high standards of their profession that this note pays tribute. On behalf of ASTM International and the authors as well, we acknowledge with appreciation their important contribution to the success of this journal.

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