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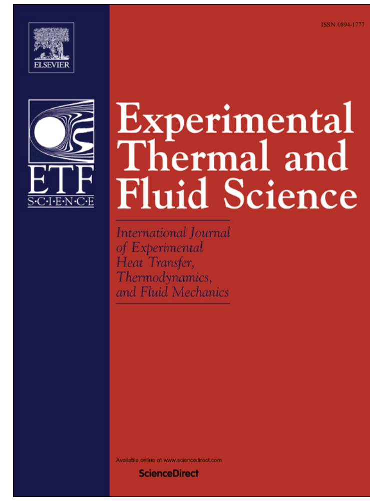

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Deng Li, Yong Kang, Xiaolong Ding, Wenchuan Liu

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Experimental study on the effects of feeding pipe diameter on the cavitation erosion performance of self-resonating cavitating waterjet

Deng Li[a,b,c], Yong Kang[a,b,1], Xiaolong Ding[a,b], Wenchuan Liu[a,b]

[a] *School of Power and Mechanical Engineering, Wuhan University, Wuhan 430072, Hubei Province, China*

[b] *Hubei Key Laboratory of Waterjet Theory and New Technology, Wuhan University, Wuhan 430072, Hubei Province, China*

[c] *Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, 1206 West Green Street, Urbana, IL 61801, United States.*

Abstract: Self-resonating cavitating waterjet (SRCW) combines the advantages of pulsed waterjets and cavitating waterjets, and is thus much superior to a plain waterjet in many applications. In order to further improve the erosion performance of SRCW, the effects of feeding pipe diameter were studied as a pioneering effort. A preliminarily theoretical exploration of the relations between feeding pipe diameter and the cavitation capability of SRCW was performed with respect to wave propagation and damping. Organ-pipe nozzles were used to produce SRCWs under pump pressures of 10, 15, 20, and 25MPa. Numerous cavitation erosion tests were conducted with the use of three feeding pipes of diameters of 6, 13, and 25mm. Cavitation erosion intensity evaluated by mass loss and erosion area, erosion rate, and specific energy consumption were used to characterize the performance of SRCWs influenced by feeding pipe diameter. Results show that feeding pipe diameter dramatically affects the cavitation erosion performance of SRCWs, especially at high pump pressures. By comparing with conventional cavitating waterjets issuing from a conical nozzle, it is expected that feeding pipe diameter mainly influences the hydroacoustic waves and the self-resonance, which are the basis for generating SRCWs. Moreover, feeding pipe of diameter of 13mm is always the one for achieving the best cavitation erosion performance of SRCWs under the experimental conditions. Feeding pipe with a diameter of 6mm is better than that with a diameter of 25mm in improving the cavitation erosion intensity and rate only under pump pressures of 10 and 15MPa. And at pump pressures of 20 and 25MPa, the roles of these two pipes are reversed. Although such an approach is empirical and qualitative in nature, this procedure generates information of value in guiding future theoretical and experimental work on exploring the relationships between feeding pipe and the self-resonating nozzle.

Key words: self-resonating cavitating waterjet; feeding pipe diameter; hydroacoustic wave; vortex rings; cavitation erosion

1. Introduction

Over these years, it has been observed a rapid development of high-speed waterjet technology in a great many of practical and industrial applications, such as cutting a wide range of materials, surface cleaning, metal surface strengthening, rock breaking, mine exploiting, and concrete structures repairing [1-3]. High-speed waterjet is currently the only existing non-thermal technology and plays a significantly important role in machining thermal-sensitive materials such as wood plastic composites, nature fibers,

[1] Corresponding author. Tel.:+86 02768774906; fax: +86 02768774906. E-mail address: kangyong@whu.edu.cn (Yong Kang)