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THE FLOW PATTERNS OF BUBBLE PLUME IN AN MBBR*

LI Shi-rong
Key Laboratory of Northwest Water Resources and Environmental Ecology of Ministry of Education, Xi'an University of Technology, Xi'an 710048, China
Oil Production Plant of No. 4 Changqing Oilfield Company, China National Petroleum Corporation，Jing Bian 718500, China, E-mail: lsr_cq@petrochina.com.cn
CHENG Wen, WANG Meng, CHEN Chen
Key Laboratory of Northwest Water Resources and Environmental Ecology of Ministry of Education, Xi'an University of Technology, Xi'an 710048, China

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Abstract: The flow patterns of the gas-liquid two-phase flow in a Moving-Bed Biofilm Reactor (MBBR) have a critical effect upon the mass transfer by the convection. Bubble plumes promote unsteadily fluctuating two-phase flows during the aeration. This article studies the unsteady structure of bubble plumes through experiments. The time-serial bubble plume images in various cases of the tank are analyzed. The Recursive Cross Correlation-Particle Image Velocimetry (RCC-PIV) is used to calculate the velocities in those cases, and then the time-serial vortex, the total turbulence intensity, the time-serial streamline are obtained. It is shown that the aspect ratio and the void fraction are the dominant factors influencing the unsteady structure of bubble plumes. When the aspect ratio is unity and the void fraction is high, the bubble plumes see a symmetrical vortex structure with a long residence time, which is beneficial for optimizing the aeration system and enhancing the applied range of bubble plumes.

Key words: bubble plume, Recursive Cross Correlation (RCC), Particle Image Velocimetry (PIV), flow pattern

Introduction

Bubble plumes have a great application value in projects, such as alleviating the damage of waves to building structures, preventing the invasion of the brine with air bubble curtains in the estuary, controlling the stratification structure of reservoirs and lakes to improve water quality, preventing channels and harbors from being frozen, enhancing the oxygen content for aquatic growth and so on. In view of serious pollutions caused, especially in recent years, by the oil-gas blowouts, with the large-scale exploitation of oil and gas under the sea, bubble plumes can used to control the pollution area. A great number of studies of simulations of bubble plumes have widened the application range[1]. The bubble plume becomes now a key issue in the current field of fluid mechanics.

The Moving-Bed Biofilm Reactor (MBBR) is a new biological wastewater treatment technology with many desirable features, such as efficient operation and low energy consumption, which takes both advantages of the traditional fluidized bed and the biological contact oxidation process with the combination of the activated sludge process and the biological film process. The suspension filler latched by the bacterial biofilm is turned into a fluidized state by the aeration and the flow promotion in the device. Therefore, the selection of a suitable aeration mode is of great importance for the stable operation of MBBR. The aeration plays its role in two aspects: one is to supply the microbiological oxidation with oxygen, another is to enhance the turbulent intensity of fluid, and they are both important for the efficiency of the wastewater treatment.

The aeration is a usual engineering measure,

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Biography: LI Shi-rong (1973-), Male, Ph. D. Candidate, Senior Engineer
Corresponding author: CHENG Wen,
E-mail: wencheng@xaut.edu.cn