ABSTRAK

Microbubble merupakan teknologi penting dalam aplikasi pengolahan air, aerasi, dan reaksi gas-cair, karena kemampuannya meningkatkan efisiensi pelarutan udara melalui luas permukaan kontak yang tinggi dan waktu tinggal yang lama di dalam cairan. Salah satu metode pembentukannya adalah menggunakan *microbubble generator* tipe *orifice*. Penelitian ini bertujuan untuk menganalisis pengaruh parameter aliran, yaitu debit aliran air, debit aliran gas, dan variasi diameter *orifice* (7 mm, 9 mm, 11 mm), terhadap *pressure drop*, *hydraulic power*, dan *bubble generating efficiency*. Metode penelitian yang digunakan adalah eksperimental kuantitatif dengan pengujian langsung di laboratorium menggunakan MBG yang dirancang khusus. Data diperoleh melalui sensor tekanan, *dissolved oxygen* meter, serta alat ukur debit udara dan air. Hasil penelitian menunjukkan bahwa semakin kecil diameter *orifice*, semakin tinggi nilai *pressure drop* yang dihasilkan. Diameter *orifice* 7 mm menunjukkan *pressure drop* tertinggi sebesar 141677,698 Pa, sedangkan diameter 11 mm menghasilkan *pressure drop* terendah sebesar 110911,966 Pa. *Hydraulic power* meningkat seiring bertambahnya debit aliran, dengan pengaruh terbesar berasal dari debit air. Peningkatan *hydraulic power* tertinggi terjadi pada kombinasi debit air 1 m³/h dan debit udara 1 lpm dengan diameter *orifice* 9 mm, mencapai 1,747 W. *Bubble generating efficiency* meningkat dengan penambahan debit udara, namun mencapai nilai optimal pada kombinasi debit dan *orifice* tertentu. *Orifice* 7 mm menunjukkan efisiensi pelarutan oksigen yang paling konsisten dan stabil terhadap variasi debit air 0,25 m³/h dan debit air 1 lpm.

Kata kunci: *Microbubble*, *orifice*, *pressure drop*, *hydraulic power*, *bubble generating efficiency*, parameter aliran

ABSTRACT

Microbubbles are an important technology in water treatment, aeration, and gas–liquid reaction applications due to their ability to enhance gas dissolution efficiency through a large interfacial surface area and long residence time in the liquid. One of the methods for generating microbubbles is by using an orifice-type microbubble generator (MBG). This study aims to analyze the effect of flow parameters namely water flow rate, gas flow rate, and variations in orifice diameter (7 mm, 9 mm, and 11 mm) on pressure drop, hydraulic power, and bubble generating efficiency. The research method employed is a quantitative experimental approach through direct laboratory testing using a specially designed MBG. Data were collected using pressure sensors, dissolved oxygen meters, and flow meters for both air and water. The results show that smaller orifice diameters produce higher pressure drop values. The 7 mm orifice diameter yielded the highest pressure drop of 141,677.698 Pa, while the 11 mm diameter produced the lowest value of 110,911.966 Pa. Hydraulic power increased with higher flow rates, with the most significant influence coming from the water flow rate. The highest hydraulic power was observed at a combination of 1 m^3/h water flow and 1 LPM air flow with a 9 mm orifice diameter, reaching 1.747 W. Bubble generating efficiency improved with increasing air flow rate but achieved an optimal value at specific combinations of flow rate and orifice diameter. The 7 mm orifice demonstrated the most consistent and stable oxygen dissolution efficiency at a water flow rate of 0.25 m^3/h and an air flow rate of 1 LPM.

Keywords: *microbubble*, *orifice*, *pressure drop*, *hydraulic power*, *bubble efficiency*, *flow rate.*