# Effect of packing media addition on mass transfer and power consumption in a bubble column

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## Abstract

Gas Absorption is the process where components transfer from a gas phase to a liquid phase due to the different concentrations. It is widely used in various processes, including the water production process, wastewater treatment, air pollution treatment, as well as volatile organic compounds (VOCs) recovery from petroleum industries. Among other equipment, a bubble column is one of the equipment that widely used in the absorption process due to its simplicity and high mass transfer performance. Besides, previous researches found that when a solid phase was appropriately added into the column, the mass transfer performance of a bubble column could be improved. However, the information regarding the optimum condition for the addition of the solid-phase into the bubble column is still required as there were limited researches focus on this three-phase bubble column. Therefore, the purpose of this work is to investigate the performance of a three-phase bubble column in terms of both mass transfer performance and power consumption when plastic media is presenting.

The study was performed in a bubble column with a diameter and height of 20 and 80 cm, respectively. Air and deoxygenated water were used as the gas and liquid phase to perform the oxygen transfer from air to water in order to increase the dissolved oxygen. The gas flow rate was regulated in the range between 4 - 24 liters per minute and throughput at the bottom of the column with a sparger, which varied in orifice sizes of 0.4, 0.8, and 1.2 mm. The smallest size was selected due to the production limitation of the perforated plate. The deoxygenated water was fed at the top of the column at the flow rate in the range of 50 - 100 liters per hour. The result indicated that the mass transfer coefficient ($k_La$) of the orifice size of 0.4 mm was the highest among other orifice sizes due to the fact that the orifice size of 0.4 mm produced smaller bubble sizes, leading to a larger specific interfacial area. However, when the small orifice size was used, the higher power consumption was required to operate the system. Besides, the increase of the water flow rate resulted in an increase in the mass transfer coefficient because of the higher turbulence within the column.

In addition, when the pall ring media was introduced in the column with different sizes and concentrations (25, 38, and 50 mm at 1 and 2.5 % by total liquid volume), the results indicated that the solid media reduced the rising velocities of bubbles as the media obstructed the rising trajectories of bubbles. This incident led to the increase of gas hold up and specific interfacial area in the column, where the higher mass transfer rate was then achieved. Moreover, it also found that the small packing showed superior performance compared with the larger packing in terms of the overall mass transfer coefficient. In addition, the solid concentration of 2.5% by volume yielded a higher mass transfer coefficient than the concentration of 1 %. On the other hand, as the power consumption majorly depended on the sparger size gas flow rate and liquid flow rate, the addition of the packed media did not significantly affect the power consumption but improved in the specific interfacial area. Therefore, when plastic media was added at an appropriate volume and size, it could increase the mass transfer rate without significantly increasing power consumption.

***Keywords***: *Mass transfer coefficients, Interfacial area, Bubble column, Power consumption*