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Airlift technology for improving aquaculture farms

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Airlift pumps have been used for the past century in many industries such as the oil and gas, waste water treatment and aquaculture. Unfortunately, these simple pumps are being used inefficiently which causes many loses. A new airlift design has been developed to maximize the potential of these pumps in industries such as aquaculture farms. The pump relies on a novel way to inject air into the pump to help it carry and aerate the water as it flows. This could have huge potential in recirculating aquaculture system as not only does it provide an adequate water flow for the fish, it also increases the oxygen level of the water while stripping the carbon dioxide. The airlift only requires air to operate, this eliminates the need for a centrifugal pump to move the water in recirculating systems. This reduces the need of having two systems to carry water and air in a fish farm, which would reduce the overall energy consumption of the system. The performance of the pump relies on two major components, the submergence ratio and the amount of air injected to each chamber. Submergence ratio is defined by the ratio of the immersed length to the total length of the airlift system. The higher the ratio is, the better the performance of the pump will be. Air flow also changes the intended application of the pump. If the air was to be distributed unevenly, the resulting flow can react that change. If more air was to insert the axial injector, the outlet flow would increase, as more bubble slugs are created. While increasing the air flow to the radial injector, the mass transfer rates increase as well as the aeration of the water. This is due to the creation of smaller bubbles that are easily dissolved in the water. Four field tests were conducted to test the performance, water surface velocity and the aeration capabilities of the pump. These tests were all conducted in aquaculture fish farms, and included tests in open net cages, raceways and recirculating tank fish farms. In each location, the airlift was tasked with a certain objective such as lifting water from deep levels such as in an open cage system, or to increase the oxygen level and the flow velocity such as in the circular tank and raceway systems. The pump was also subjected to different modifications to understand the complete performance of the pump. One of these modifications included the extension of the suction length from the bottom of the pump. It was found that the suction length did not have any effect on the performance of the pump due to the increase of pressure due to the depth. This allows the pump to draw in water from deeper sources as long as the submergence remains the same. The data collected proved the potential of use of the airlift to improve the efficiency of aquaculture farms. This efficiency stems from reducing the energy usage of the farm by eliminating the need of a centrifugal pump, increase of water flow and velocity, and increase in the amount of oxygen available in the tanks.

Biography

Mohammad Shallouf is a graduate engineering student at the University of Guelph working on his master's thesis with Dr. Wael Ahmed's multi-phase and airlift lab. Mohammad's research focus is on multi-phase flow, as well as the simulation of the effects of the airlift on a surrounding body of water. Mohammad is also a part of an interdisciplinary team focused on researching the effects of an airlift pump in aquaculture farms.

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