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Behavior of Bubble Columns

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OURE Project

BEHAVIOR OF BUBBLE COLUMNS

By

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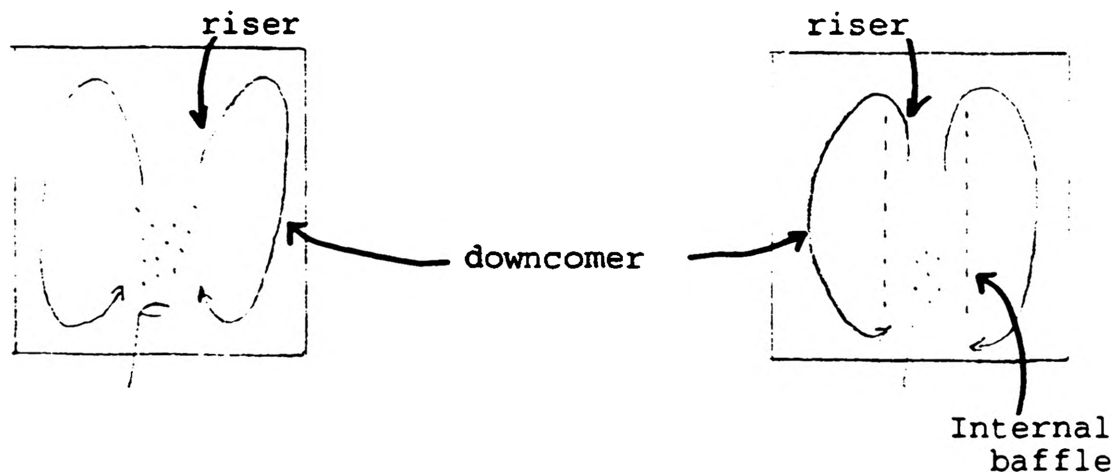
In the research program I studied different methods used in mixing gas and liquid in industrial reactors. I was introduced to the bubble column, the airlift reactor, and the bubbling stir tank through text reading, experimentation, and designing. From readings coming from the instrument and observation with my own eyes, I was able to learn much about the flow of particles in tanks such these.

The bubble column and the airlift reactor contain two sections of water flow (riser and downcomer). The riser area has a lower bulk density of fluid because of the rising air bubbles. The downcomer area has a higher bulk density of fluid than the riser. This is what causes the fluid to circulate in the reactor.

BUBBLE COLUMN AIRLIFT REACTORS



The bubble column would have advantages over the airlift reactor and the bubble stir tank reactor. With the airlift reactor the internal baffle sometimes erodes away over time by certain chemicals. This would cost the plant production time to replace the baffle and the money to replace it. The bubble column has no internal baffle to cause that sort of a problem. The bubbling stir tank can cause shear damage to the cells. Shear damage is thought to cause poor performance of certain products. The bubble column has no stirrer to cause a shearing problem.

The drawback to the bubble column might be its lower velocity of particle movement,causing a slower mixing time or having to compensate by forcing a higher amount of gas into the tank to get a velocity of the particles you want.

These bubble columns have many uses in industry and to the environment. Some of there uses are aerobic fermentation, treatment of wastewater, production of beer,vinegar,citric acid, biomass, bacteria, fungi, and yeast cultivation.

Experimentation was done on the bubbling stir tank. Here I collected data at different locations of the tank and determined radial particle velocities and radial bubble velocities from the computer print outs. The computer was set to collect 4000 samples in 20 seconds at the blade spinning at 300 RPM (there was difficulty in keeping this speed) and when the air was turned on, having it set to 30. This was what seemed to work best. The data we collected consisted of average radial velocities,turbulence, and peak radial velocities, which were determined from graphs. We would first collected the data without any air and then with the air on. At different locations it was difficult to determine where the peak existed. Away from the blade the radial velocity was very low which made it hard to determine peaks. At these locations, the particles would be moving with both positive and negative radial velocities, this was one problem we had in determining peaks. Another problem with the printouts came from the computers averaging, which allowed for extra peaks.

A bacteria problem was encountered inside the tank. This led to first slower radial velocities and then eventually no data at all. It was also interesting to find that after the tank had been cleaned out thoroughly that the tap water filled tank was getting particle readings without any particles ever being added. We believe the tank should be filled with distilled water instead of tap water in order to get better readings. The tap water particles may be flowing at different rate than the particles being analyzed, do to a different shape, weight, or size. We feel that six drops of particles in distilled water would work well.

The research program allowed me to help in the designing and building of a bubble column and a frame from which the column could be analyzed in the future. The sketch is on the following page.

BUBBLE COLUMN