THE EFFECTS OF GAS EXTRACTION THROUGH VERTICAL MEMBRANES ON THE BUBBLE HYDRODYNAMICS IN A FLUIDIZED BED REACTOR

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Recently membrane-assisted fluidized bed reactors (MAFBRs) have emerged as a cutting-edge technology for intensification of a number of industrially important chemical processes. Such reactors combine the benefits of excellent separation properties of membranes and the excellent heat and mass transport characteristics of fluidized beds. Hydrogen production from methane reforming is one of the main applications of MAFBRs where H2 perm-selective membranes are employed to extract ultra-pure hydrogen and increase product yield. Understanding the effect of inserted membranes on the hydrodynamic behaviour of the fluidized bed reactor is of high importance for the design and optimization of MAFBRs. In particular, bubble properties (size, number and velocity) strongly influence the performance of fluidized bed reactors as they play a major role in heat and mass transfer phenomena. This work presents the experimental results of the effect of gas extraction via vertical membranes on the bubble properties using a Digital Image Analysis (DIA) technique. A pseudo 2D experimental setup (
Fig. *1*) with a multi-chamber porous plate mounted at the bottom of the back plate is used to simulate vertical membranes. This setup allows for gas extraction in specific locations from the back of the column. Thus the effects of vertical membranes (gas extraction rates and locations) on the bubble properties for different particle sizes and fluidization velocities are studied in great detail. Results showed that variation of gas extraction rates (

Fig. ***2***a) and locations (

Fig. ***2***b) significantly influences bubble properties.

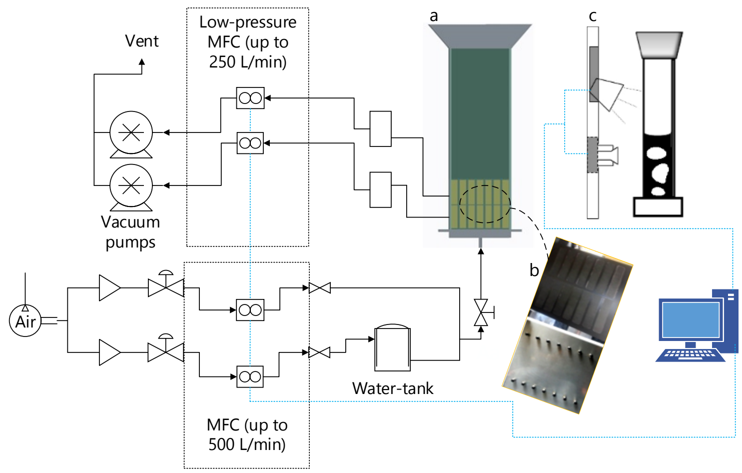

Fig. 1. a) Process flow diagram of the experimental set up, b) picture of front view (top) and rear view (bottom) of the multi-chamber plate, c) optical scheme

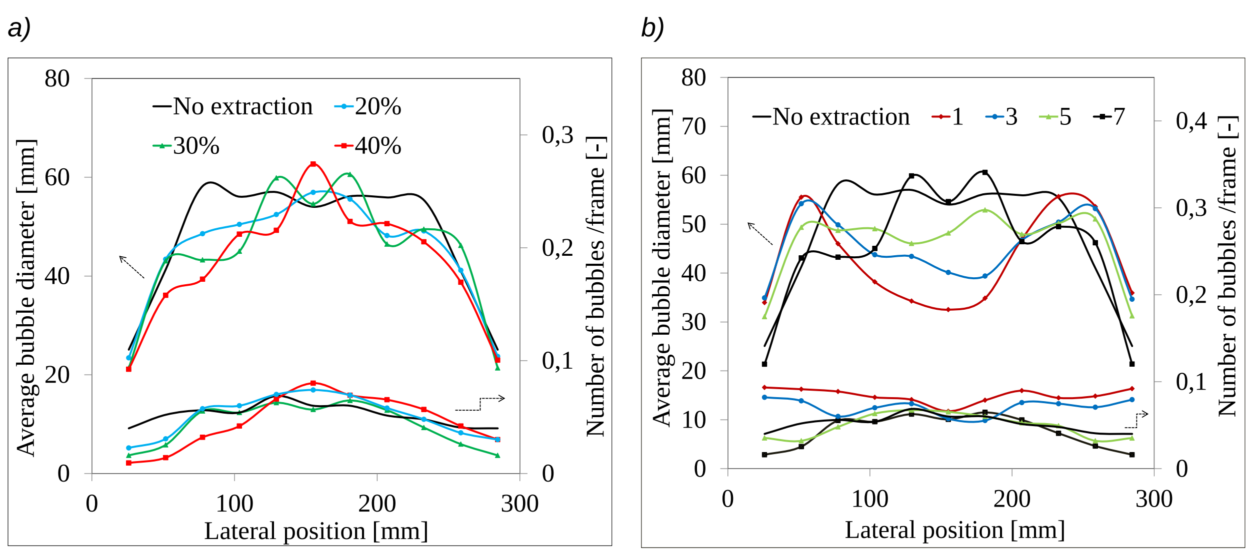

Fig. 2. Average bubble diameter and number of bubbles per frame as a function of lateral position: a) for different gas extraction rates at a bed height of 33cm from the distributor b) for different extraction locations (area) with 30% extraction rate at a bed height of 33 cm from the distributor