Fluidization Regimes for Alginate Aerogel Particles in a Laboratory Scale Wurster Fluidized Bed

Işık Sena Akgün [a*], Can Erkey [a,b]

[a]*Department of Chemical and Biological Engineering, Koç University, Sarıyer 34450, Istanbul, Turkey*
[b]*Koç University Tüpraş Energy Center, Koç University, 34450 Sarıyer, Istanbul, Turkey*
*iakgun16@ku.edu.tr

Aerogels are nanoporous materials which have open pore structures, very high specific surface areas and pore volumes [1]. These properties of aerogel particles can be further enhanced by functionalizing their interior and exterior surfaces, coating and encapsulating them with various polymers. In the industry, Wurster fluidized beds are very attractive for carrying out these kinds of treatments of various particles [2]. In a fluidized bed, various particle fluidization behaviors are observed which are characterized by different fluidization regimes by chancing physical properties of particles, design and operating parameters [3]. A classification of fluidization regimes with their boundaries is necessary for accomplishing product uniformity, providing desired end product quality, protecting core material surface morphology and decreasing process cost [4].

In this study, fluidization regimes for alginate aerogel particles with two different particle sizes were characterized in a laboratory scale Wurster fluidized bed. Minimum fluidization and bubbling regimes were found in the annular zone. In the tube zone, minimum fluidization, bubbling and pneumatic regimes were observed. A new regime which was horizontal circular motion was identified for large particles in the tube zone. There existed two other regimes in the bed which were turbulent and circulatory particle motion regimes. Each fluidization regime was mapped on Kunii and Levenspiel diagrams. Circulatory particle motion regime was given on these diagrams for the first time. Moreover, effects of particle size, batch volume, partition gap height and Wurster tube size on superficial air velocities at the onset and the end of each regime were investigated. In general, higher superficial air velocities were needed to reach the onset and the end of each fluidization regime, when particle size, tube diameter and partition gap height were increased. For both particle sizes, superficial air velocities at the onset of bubbling, pneumatic and turbulent regimes changed significantly with batch volume.

References

[1] M.A. Aegerter, N. Leventis, M.M. Koebel, Aerogels handbook, Springer Science & Business Media2011.
[2] A.F. Kydonieus, Controlled release technologies: methods, theory, and applications, CRC press2019.
[3] H. Che, J. Ye, Q. Tu, W. Yang, H. Wang, Investigation of coating process in Wurster fluidised bed using electrical capacitance tomography, Chemical Engineering Research and Design, 132 (2018) 1180-1192.
[4] I.S. Akgün, C. Erkey, Investigation of Hydrodynamic Behavior of Alginate Aerogel Particles in a Laboratory Scale Wurster Fluidized Bed, Molecules, 24 (2019) 2915.

I would prefer oral presentation