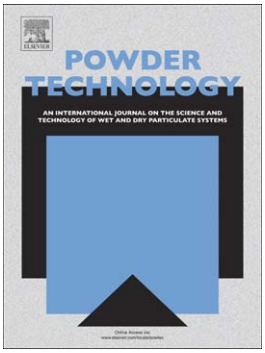

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Effect of Spray Nozzle Attachment Geometry on Rate of Liquid Released from Agglomerates Produced by Gas-Atomized Liquid Injection into a Fluidized Bed

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Abstract

Liquid injection into a fluidized bed is employed in several chemical processes in order to maximize contact between liquid reactants and solid particles. For example, in the Fluid Coking™ process, droplets contact the bed particles and form wet agglomerates that impair heat transfer from the hot bed to the reacting liquid, slowing down its endothermic cracking reactions. Agglomerate formation, thus, results in reduced reactor operability and a lower yield of valuable liquid product. The objective of this paper is to test the effect of different nozzle attachments on the rate at which moisture is released from agglomerates in a large scale fluidized bed.

The addition of a conical nozzle attachment impacts the performance of the spray inside a fluidized bed. An optimal diverging nozzle tip angle of 20° has been identified. This nozzle tip produces an open air spray angle similar to that produced by a regular nozzle, without an attachment. Increasing the diverging nozzle tip angle beyond 20° reduces the penetration length of the spray, and may induce detrimental instabilities downstream of the spray. Reducing the diverging nozzle tip angle stabilizes the spray, and increases its penetration depth; however, it also significantly reduces the jet-bed interfacial area, thereby reducing the number of solid particles wetted by the spray. As a result, stronger agglomerates are produced, that take longer to release trapped liquid into free moisture. The cloverleaf nozzle attachments improve the performance of the standard spray nozzle by increasing the interfacial area between the jet and the bed.