

Influence of argon gas composition as a static reducer in a high-temperature pressurized polyethylene fluidized bed

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Abstract:

Triboelectrification is commonly observed in gas-solid fluidized reactors, with examples of those employed by the polyethylene industry. Vigorous mixing of the fluidizing particles leads to particle-particle and particle-wall collisions, leading to charge generation. This triboelectric charge is a concern for the industry as it leads to particle agglomeration and particle adhesion to the reactor wall. Eventually, reactor shutdown is enforced as the wall fouling results in sheeting. Hence, there is a need to study and explore mitigation techniques of charge generation in fluidized bed reactors to increase efficiency and avoid economic losses.

Over the years, numerous studies have found different parameters to affect triboelectrification in fluidized bed reactors including particle size and distribution, humidity of the fluidizing gas, fluidization pressure and temperature, use of continuity additives, fluidization gas velocity and fluidizing gas type. In an earlier study in our research group, while investigating the effect of the gas type on the fluidization of a linear low-density polyethylene (LLDPE) resin, we found that changing the gas from nitrogen to argon reduced the charge generation and wall fouling by approximately 90% [1]. This is because argon has a much lower dielectric strength (0.6 kV/mm [2]) than nitrogen (3.4 kV/mm [3]). Additionally, the same study found that for the binary gas mixtures of argon and nitrogen, the addition of small quantities of argon was significantly beneficial. However, there is a need to explore the effect of argon in mitigating charge at operating conditions relevant to commercial gas-phase polyethylene reactors which typically operate at 2600 kPa and 70-110°C. Considering this, the present study investigated the effect of fluidization gas type, varying from pure nitrogen and argon to argon-nitrogen gas mixtures containing 10%, 25%, and 50% argon by volume at 2600 kPa and 70°C. Results for the net charge and the extent of wall fouling for LLDPE resin fluidization using pure argon, nitrogen, and its mixtures will be presented.

[1] N. Sridhar and P. Mehrani, "Utility of argon as a static charge and wall fouling suppressant in atmospheric gas-solid fluidized beds," *Powder Technology*, vol. 442, pp. 1–8, Jun. 2024. doi:10.1016/j.powtec.2024.119880.

[2] J.F. Szul, K. Deshpande, P. Mehrani, A. Sowinski, M.I. Nimvari, N. Sridhar "Decreasing triboelectric charging of, and/or reactor fouling by, polyolefin particles" Patent 85051: US 63/431773, 2022.

[3] K.P. Brand, Dielectric strength, boiling point and toxicity of gases - different: aspects of the same basic molecular properties, *IEEE Trans. Electr. Insul.* EI-17, 451–456, 1982.

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