PARTICLE CLUSTER SIZING IN DOWNER UNITS. AN APPLICABLE ACROSS DOWNER SCALE METHODOLOGY

H. de Lasa, Chemical Reactor Engineering Centre, Faculty of Engineering, The University of Western Ontario, Canada
hdelasa@eng.uwo.ca
A. Lanza, Chemical Reactor Engineering Centre, Faculty of Engineering,The University of Western Ontario, Canada

Data analysis from downer requires a comprehensive methodology for setting the data baseline. This can be accomplished using solid mass balances as proposed by A. Lanza et al (1). This analysis involves an iterative calculation. Each signal baseline is defined as, $X+ n\ \sigma_x$ where X is the signal average; σ_x is the signal standard deviation; and "n" is a baseline parameter (2). By using this methodology the noise resulting from secondary reflection is eliminated and all valuable data is kept in the time series.

More than 500 experiments with more than 50 million data record were obtained using two independent gas-solid circulating fluidized bed downer units of 3 m height and different diameters (1 inch ID and 2 inch ID). The solid used was a FCC catalyst with a mean particle diameter of 84.42 µm and a particle density of 1,722 kg/m^3. Measurements were effected using a CREC-GS-Optiprobe, an optical sensor equipped with a GRIN lens. This lens forms a 118 ± 34 µm diameter highly irradiated volume, placed at 8.05 mm away from the sensor tip. CREC-GS-Optiprobes do not require calibration and offer minimum intrusion (3).

Figure 1a) provides a graphical representation of the baseline reference factor *n*. It can be noticed that *n*, decreases when the solid mass flux, *Gs*, is increased in both downer units (1 inch and 2 inch ID). The superficial gas velocity, *Ugs*, on the other hand, did not have such a significant influence on the *n* factor. To explain this behavior on *n* with *Gs* changes one can argue that larger *Gs* may lead to increased secondary ray reflections from particles or particle clusters increasing both the signal average, *X*, and its standard deviation σ_x (4).

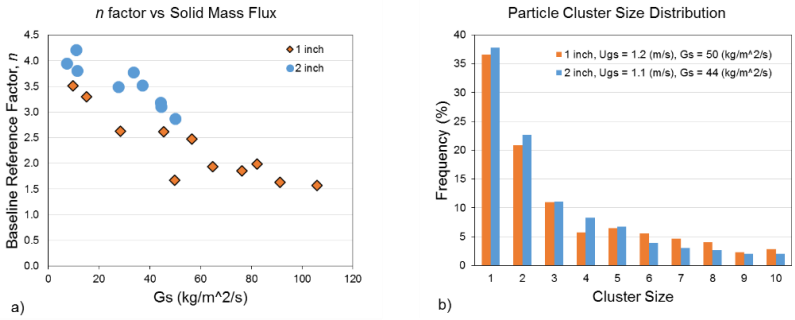

Fig 1.(a) n Baseline Reference Factor Dependence on Solid Mass Flux, Gs, (b) Particle Cluster Size Distribution at close operating conditions, for 1"ID and 2"ID downers.

On the basis of the data obtained, our study reports a valuable methodology, applicable to downers of different diameters. This leads for the two downer studied to particle clusters with close asymmetric distributions, as reported in Fig.1b. A typical example is given for *Gs*=50-44 (kg/m2/s) and *Ugs*=1.2-1.1 (m/s).

REFERENCES

1. A. Lanza, M.A. Islam, H. de Lasa, Particle clusters and drag coefficients in gas–solid downer units, Chemical Engineering Journal 200-202 (2012) 439–45.
2. Lanza, A., Islam, M., de Lasa, H. (2013). Particle cluster size distribution in gas-solid downer units. In 2013 ECI Conference on the 14th International Conference on Fluidization-From Fundamentals to Products. The Netherlands
3. S. Nova, S. Krol, H. de Lasa, Particle velocity and particle clustering in downflow reactors, Powder Technology 148 (2004) 172–185.
4. A. Lanza, Cluster fluid dynamics in down flow reactors: experimental and modeling study, Ph.D. Thesis Dissertation, The University of Western Ontario, 2015.