

# **“Know Floe’s Korner”**

---



“Know Floe’s Korner” is a contribution from the members of Group 3c (Solids Handling and Processing). The objective of this section is to share their industrial learning experiences through a variety of articles and case studies. Please send your comments to Shrikant Dhodapkar at [sdhodapkar@dow.com](mailto:sdhodapkar@dow.com).

## **Top Ten Tips to Prevent and Resolve Segregation Issues**

*Lyn Bates (Ajax Equipment), Shrikant Dhodapkar (Dow Chemical)  
and George Klinzing (University of Pittsburgh)*

1. Free flowing particles tend to segregate if they have any physical differences. Particle size variation is a major discriminating factor; bulk dilation and agitation are great enablers. Remember, "segregation commences as soon as you stop mixing". Inhibit deformation of the mass in bulk transport by tight packing, gentle handling and close confinement.
2. Chutes, belt trajectories, pneumatic conveyor outlets, and pile formation by transverse flow streams are common locations for segregation in process plants. Ensure that feed streams are not deposited onto a pile or into a storage bin with a biased composition. Focus the flow stream, or divide it in a controlled manner, so that the surface is at least built up in an even manner around the point of fill.
3. Consider particle engineering to reduce variations between particle, or bulk manipulation to reduce the freedom of particles to separate. Question whether it is practical to remove troublesome fines at an early stage of production and add back at a late of production. Intermediate processes and handling may benefit and the final composition can be more carefully controlled. However, make sure that you do not create other handling problems.
4. Avoid long repose slopes when filling bins and silos. Use multi-point fill or dispersing plates, making sure that material in the split flow channels are of uniform composition.
5. Transfer batches of bulk material, such a mixer contents or bin discharge, as quickly as possible with maximum confinement. This restricts the time and space over which segregation processes can act, and limits the dilation that facilitates the differential migration of fractions.
6. Use mass flow type bins to re-mix the cross sectional contents when emptying, but be aware that faster flow in the center will concentrate material deposited in the outer periphery in the terminal discharge. Use a ‘Reverse Cone’ insert or ‘Binsert’ to attenuate flow velocity variations.

7. Fines segregated near the wall or on one side of the bin can alter the outflow pattern from mass flow to funnel or eccentric flow, thereby accentuating the problem at discharge or possibly introduce dangerous stresses on the bin walls. Check the hopper design against measured flow related values of the various size fractions of the bulk solid, to make sure that flow is reliable under all circumstances.
8. Watch carefully the end effects of batch and continuous operations. Refill contours in non-mass flow bins provide boundaries for segregation that provides sharp concentrations when the material subsequently discharges.
9. Fluctuating levels in non-mass flow storage bins, used to balance varying supply and demand, alternately tends to retain and re-enter preferential fractions as surface level rises and falls whilst the demand feed stream passes through the stored mass.
10. Remember that segregation is pervasive and pernicious. The place where it shows is not always where it occurs. Detectable results may be consequence of accumulated behavior, or even a partially rectified pattern. CHECK THE TOTAL FLOW PATH.

#### **Suggested Readings:**

1. Williams, J.C., *The Segregation of Particulate Materials: A Review*, Powder Technology, Vol. 15, pp. 245-251 (1976).
2. Johanson, J., *Particle Segregation... and what to do about it*, Chemical Engineering, May 8 (1978).
3. Carson, J.W., Royal, T.A. and D.J. Goodwill, *Understanding and Eliminating Particle Segregation Problems*, Bulk Solids Handling, Vol. 6, No. 1, Feb. (1986).
4. Bates, L., *User Guide to Segregation*, (Ed: George Hayes), published by British Material Handling Board, UK (1997).