Bulk solids agglomeration can be a tricky process that requires a large capital investment, quite a bit of energy, frequent operator interventions, and high downtime and maintenance costs. Agglomeration always adds to a product's manufacturing cost, but in some applications, the increased value of the final product more than offsets the cost increase. In this column I’ll discuss why and when you should consider using agglomeration in your bulk solids manufacturing process.

In his 2002 book, *Agglomeration Processes: Phenomena, Technologies, Equipment*, Wolfgang Pietsch provides a technical dictionary definition of agglomeration as the “sticking or balling of (often very fine) powder particles due to short-range physical forces. Therefore these forces become active only if the individual particles (forming the agglomerate) are brought closely together by external effects.” This definition gives us insight into why agglomeration can be so difficult. First, agglomeration processes often handle very fine powders, which can be dusty, cohesive, or even explosive. Second, mechanical equipment must often expend a large amount of energy to create the “short-range physical forces” required. Third, the “external effects” mentioned in the definition often require another ingredient, typically either a liquid or particle binder or glue. The chemistry between a binder and the other particles in the agglomeration can often be quite tricky. Despite these difficulties, many manufacturers still choose to undertake agglomeration because of the benefits to the final product.

**Benefits of agglomeration**

Agglomeration can benefit a bulk solid final product in many ways. For example, a backyard barbecue won’t be very successful if you have only charcoal dust to cook with, but if the dust is compressed into charcoal briquettes, that same material becomes an excellent fuel source for your grill. Following are six different ways agglomeration can benefit a bulk solids manufacturing process. If your plant is having issues in any of these areas, you may want to consider adding an agglomeration step to your process.

**Formula control.** A major reason to use agglomeration is that it can allow you to have more control over your product’s formula. A product formula often contains a very small amount of an active ingredient that must be very evenly dispersed throughout the final product. This is a big challenge in pharmaceutical manufacturing. Agglomerating the product into a tablet ensures that the active ingredient remains evenly distributed and the medication doesn’t overdose or underdose the patient.

Products with multiple powder ingredients can often segregate
during or after packaging, leading to misapplication of the product. In lawn fertilizer, for example, if segregation causes one ingredient to be applied to one area of a lawn while another ingredient is applied to a separate area of the lawn, the homeowner could be left with half the lawn dead and the other half filled with weeds. Agglomeration allows the fertilizer manufacturer to provide a consistent ingredient dosage across all particles in a bag.

**Dissolution control.** Some products are designed to be dissolved in water, but fine particles can be hydrophobic and may float on top of the water or clump and form a gel ball. Flour exhibits this behavior when dumped directly into water. Agglomerating these particles using a binder can often change the chemistry and allow these fine particles to slowly disperse and dissolve in the water without floating or clumping. This can sometimes make an otherwise unsellable product viable for consumer use.

**Moisture control.** Agglomeration can protect a material from adsorbing too much moisture out of the air. A fine powder has a much greater total surface area than the same amount of an agglomerated granular material. If a fine powder is prone to moisture adsorption, solid bridges can form between the particles, causing caking. The same material in agglomerate form won’t adsorb moisture as quickly and may not cake. For example, I once needed more of a granulated instant chicken bouillon product, but all the store had was a chicken bouillon powder. While the granulated product had always stored quite well for many months, after a month on my kitchen shelf, the powder product had become so hardened that I had to scrape and chop at the brick to get some powder for a cup of broth. The granulated product had a much longer shelf life than the powder product because of the particles’ reduced moisture sorption qualities.

**Flowability.** Fine particles have much greater attractive forces between them than larger particles. These forces (called Van der Waals forces) can cause fine powders to be cohesive and resist flow. Agglomerating a poorly flowing fine powder can sometimes alleviate cohesion and improve material flow. For example, many pharmaceutical products start as fine powders, the cohesive nature of which would completely plug a tableting machine, so companies often agglomerate the fine powders into more free-flowing granules. Another example is instant coffee, which is typically brewed coffee that’s been spray dried. The spray-dried coffee particles are extremely small and very cohesive, so to make the finished product acceptable to consumers, companies agglomerate the fine spray-dried particles into granules that are much more free flowing.

**Manufacturing efficiency.** Agglomerating a powder into granules can often increase manufacturing and packaging efficiency. Most laundry detergents, for example, used to be low-density spray-dried powders. These low-density powders needed to be packaged into large boxes to achieve even a minimal number of loads per box. As fuel and packaging costs increased, detergent manufacturers looked for ways to lower production costs. In addition to introducing liquid detergents, the companies began agglomerating powdered detergents because the manufacturing process used less energy and greatly increased the finished product’s density, reducing the amount of packaging required for the same amount of detergent.

**Dust control.** Blended products often contain many ingredients of varying particle sizes. Ingredients that are very fine and dusty can become an explosion hazard if enough of the material becomes airborne. Fine particles can also cause problems during processing and packaging by segregating out of the blend and settling on processing and packaging equipment. For example, one company I’ve worked with produced a sugary product but found that fine sugar dust was becoming airborne during processing and settling on the packaging equipment. The sugar dust would then adsorb moisture from the air and become very sticky, greatly affecting equipment reliability and causing production stoppages. Agglomerating the material eliminated the dusty conditions, improving equipment reliability and increasing production.

**Reference**


**For further reading**

Find more information on this topic in articles listed under “Agglomeration” in Powder and Bulk Engineering’s article index (in the December 2016 issue and at www.powderbulk.com).

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If you have a question or agglomeration topic you’d like to see addressed here, send it to the editor (jbrenny@cscpub.com).