With a pneumatic blender, you can mix batches of dry bulk materials in the conical hopper of a storage vessel or dense-phase pneumatic conveying transporter rather than in a mechanical mixer, yielding real savings in time, labor, and capital equipment costs. After explaining how the pneumatic blender works, this article reviews some of the applications and benefits of pneumatic batch blending.

Pneumatic blending in a bin or silo — that is, aerating materials with compressed air to mix them within the vessel — has been used for decades as a way to homogenize large production runs of a single material. For instance, cement producers inject compressed air through the floor of a flat-bottom silo to aerate various sections of the stored cement in sequence, changing the cement’s bulk density to ensure that the discharged cement represents a wide range of the entire production run. Plastic pellet producers often continuously recirculate pellets from a silo’s discharge area to the silo’s top to mix pellets from yesterday’s production run with today’s pellets.

You can use the same pneumatic aeration technique to actively blend an entire batch in one mixing cycle by integrating a pneumatic blender (also called an air blender) into your material handling system. By mixing in your vessel or dense-phase pneumatic conveying transporter, this blending method eliminates the need for a separate mechanical mixer. This type of blending also minimizes material handling, reducing labor and equipment costs.

How the pneumatic blender works

Unlike a mechanical batch mixer in which ingredients are measured and loaded into the mixer, mixed by a mechanical agitator or other mechanical means, and discharged from the mixer to a material handling system, the pneumatic blender is generally integrated with the material handling system.

The pneumatic blender is mounted at the bottom of the conical discharge hopper of a storage vessel, as shown in Figure 1, or dense-phase pneumatic conveying transporter. The blender consists of a conical housing called a blending cone (or cone casting) that’s mounted with several aeration valve assemblies. Each valve assembly includes an air cylinder and valve air seal and is connected to a compressed-air supply. The supply pressure to the valve assemblies is controlled by a regulator on the compressed-air supply’s manifold. The valve assemblies are installed around the blending cone at different angles so they can inject compressed air upward into various areas in the hopper. An outlet valve, most often a pneumatically operated butterfly valve that’s linked to the blender controls, is at the blending cone’s bottom.

In operation, ingredients for the batch are fed one at a time by gravity or pneumatically into the vessel, forming layers. When the controls activate the blender, the aeration valve assemblies inject gentle pulses of compressed air through the blending cone into the center of the vessel’s hopper section. The injected air expands in volume, aerating the material in the hopper bottom and gently lifting it. This aerated material now has a lighter bulk density than the material above it, causing the lighter material to migrate upward while gravity draws the heavier material downward (Figure 1). The interaction of the upward- and downward-flowing materials mixes the entire batch. The blending action is controlled by the air pulses’ frequency, duration, and pressure. Because these pulse variables depend on the characteristics of each batch ingredient and the batch size, they must be determined by testing in the blender supplier’s lab.

Once blending is complete, the outlet valve opens and the batch discharges by gravity into the downstream handling system or process. When the blender is used on a storage vessel, the outlet valve is often connected to a dense-phase conveying system because the system’s low transport velocity will convey the blended batch without segregating it.
**Controls.** Depending on the application, the blender can be controlled from a control panel at the blender or a remotely located PLC. Either can be preprogrammed with pulse settings for individual batches.

**Optional aeration gas.** The aeration valve assemblies can also inject an inert gas, such as nitrogen, rather than air in blending applications with explosible materials, with materials that are sensitive to excessive amounts of oxygen, or in which the gas must contain no moisture.

**Suitable applications**

The pneumatic blender can be installed in the conical hopper of either a new or existing vessel. However, for a retrofit application, the existing vessel must have a hopper cone angle 60 degrees or steeper and must be structurally capable of withstanding the blending cone’s weight and the pressure loading applied during blending.

The pneumatic blender is best-suited to materials with an average particle size under 1⁄8 inch because these materials aerate easily. The pneumatic blender’s gentle mixing action makes it especially suitable for blending batches containing friable materials, such as glass bubbles and spray-dried milk, whey, and clay powders. The blender is also well-suited to mixing abrasive materials; the unit’s gentle action and few moving parts in contact with the material (including only the valve air seals in the aeration valve assemblies and the outlet valve) minimize the material’s abrasive effects.

However, the blender’s gentle action also typically makes the unit unsuitable for materials that require shear to become fully mixed. Some cohesive materials, such as titanium dioxide or iron oxide, aren’t candidates for pneumatic blending because they don’t aerate easily despite their fine particle size; the blender will simply blow holes through the material unless it’s mixed with another material that promotes aeration. To determine whether the pneumatic blender can mix your difficult-to-aerate material, you’ll need to have the material tested in the supplier’s lab.

**Pneumatic blending benefits**

**Minimizing needed equipment, floor space, material handling, and costs.** One of the greatest pneumatic blender benefits is that it uses a storage vessel or transporter as the blending vessel, so it requires no separate piece of equipment for mixing and no floor space for that equipment, as a mechanical batch mixer would. The pneumatic blender also allows you to mix a large batch in the storage vessel or transporter, saving the time required to transfer the batch into and out of a separate mixer. This also reduces the amount of handling the batch requires, conserving labor and reducing your capital equipment costs, especially when the blender is used in a transporter.

**Blending gently and rapidly.** In addition to being well-suited to handling friable and abrasive materials, the pneumatic blender’s gentle mixing action minimizes material attrition and maintains the batch’s overall integrity without segregating ingredients. For easily aerated ingredients, the pneumatic blender’s cycle time is typically much shorter than that of a comparable mechanical mixer.

**Flexibility.** Mixing with the pneumatic blender can be controlled to meet your batch blending requirements by adjusting the frequency, duration, and pressure of the air pulses. Your operator can manually change these settings on the controls or, when batches of different ingredients will be blended in the same vessel, can simply select the desired batch settings from those preprogrammed into the controls. The blender can also be adjusted for your vessel size. If your blending application requires liquid addition, the blending cone can be fitted with atomizers for spraying a small amount of liquid into the batch.

**Minimizing maintenance and cleaning.** The pneumatic blender provides a long service life with little
maintenance because it has few moving parts in contact with the material, unlike a mechanical mixer with agitators. The pneumatic blender’s gentle mixing action also minimizes blender wear.

The blending cone and aeration valve assemblies are accessible from outside the vessel, making service easy and fast. As a result, the pneumatic blender costs less to maintain than a mechanical mixer in the same application.

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Another benefit of having few moving parts in contact with the material is that, in most applications, the pneumatic blender requires little or no cleaning. In applications that require complete cleanout between batches, a “cleanout batch” of scrap or low-cost material (such as sand, limestone, or fly ash) can be run through the blender and discarded before the new batch is blended. For instance, when the blending vessel in a cement mix plant switches from running a dark cement mix to a light mix, the plant can run a cleanout batch of cement that has no colorant to remove the dark pigment from the vessel. For applications that require more thorough cleaning, the blending vessel can be equipped with a clean-in-place system that uses an appropriate cleaning liquid to wash down the interior walls.

For further reading

Find more information on this topic in articles listed under “Mixing and blending” and “Pneumatic conveying” in Powder and Bulk Engineering’s article index in the December 2017 issue or the Article Archive on PBE’s website, www.powderbulk.com. (All articles listed in the archive are available for free download to registered users.)

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