

Use of Plant Air for Silo Reclaim

Gerry Lynskey

Principal, SSI Consulting

Galena, OH

glynskey@ssiconsultingllc.com

Abstract - The use of aeration to assist in reclaim of materials is standard operating practice in the cement industry. Finely ground powdery substances such as finished cement, raw meal, lime are just some of the materials that are both transported using pneumatics, but also have air inserted into silos to assist with the reclaim of them from the storage space.

In most cases where air is used to promote flow, the silo bottom is sloped to a central point. This slope varies depending on several factors. If the angle is steep, a smaller amount of air is typically required than when the angle is, say, eight degrees, where the entire floor may be aerated. This aeration typically takes the form of air pads that are attached to the hopper / bin floor. These air pads have a membrane on their top where pressurized air is forced into the storage space, which will fluidize the material to some degree. This fluidized material then more easily flows (like water / fluid, hence the term "fluidized").

In most cases, this aeration is in the four to six pounds per square inch (psi) range. This is typically delivered using blowers or compressors. There is debate in the technical world as to whether dryers are needed for this air, as it typically will take ambient air with some relative humidity, and pumps it into a material that is generally hygroscopic. Certainly, adding any level of moisture to such a material can lead to caking, which will hinder flow of the material. This is left for a future discussion.

Routinely, the writer has encountered situations where facilities are having issues with getting proper flow from their silos. This can be due to myriad problems including material caking (see above for a primer), a bad mix of cement that is more sticky, leaving the material at rest for too long, improper design of hopper slopes and finishes, "blinded" air pads (where material has caked in the air pads and the membrane will not allow proper air flow through it (subtopic – this can lead to asymmetric flow, which results in material not flowing concentrically, and can cause overstress in the silo structure)) or other causes. When material doesn't flow from these silos or flows irregularly, it has been observed that facility personnel make a knee jerk reaction and increase the air pressures used in the air pads. Sometimes the equipment itself can pump a higher pressure air, say up to 15 psi. Other times, we see facilities connect "plant air" to the inlets for the air pads, resulting in pressures in the silo over 100 psi.

These pressures will cause the material in the silo to fluidize more greatly. The result can be that they flow better, but it also changes the way the material pushes on the silo structure. This can lead to an increase in pressure of five fold! This change in stresses will almost certainly overstress a silo wall. This will lead to costly repairs and, if not caught early enough, catastrophic collapse.

Some warning signs for this condition include vertical cracking on the exterior surface of wall, typically uniformly around the perimeter, rather than concentrated in one area (the latter is a typical indicator of asymmetric flow). Also, if facility personnel have increased pressures to work with poorly flowing material, this can also be an indicator. Facility personnel will not always be forthright concerning these practices, thinking that the truth may hurt. But knowing fully operating practices and issues is the best way to solve issues.

The writer has also been involved in situations where a facility has experienced this, and other inexperienced engineers will blame the condition on high temperature material. Temperatures from most milling processes, generally 220 degrees Fahrenheit or less, will not cause significant damage to reinforced concrete silos. Don't believe someone when they say it will.

Therefore, it is recommended that, before increasing the air pressures in a silo to assist with reclaim (or for pneumatically conveying it to the silo for that matter), an engineering analysis be performed. Be on the lookout for flow problems, personnel wanting to increase air pressure, and vertical cracking in silo walls. Repairs can be costly, and typically take the form of a reinforced concrete liner.