Scanners take Volume to a New Level

Acoustics-based sensors can help accurately measure the volume of powders in vessels

By Jenny Christensen, BinMaster Level Controls

MANY DEVICES are available on the market today for detecting the level of materials in bins, tanks and silos. However, for calculating what's in inventory sometimes level data just isn't enough. To estimate the amount of material on hand and the dollar value of that inventory, a single measurement point might not contain enough data to provide the accuracy needed. Due to their tendency to form irregular topography in the silo, this can be especially true in powders because most don't tend to flow freely. If inventory volume is based upon a single measurement from a single point in the silo, the volume estimate has the potential of being very inaccurate.

MULTIPLE POINTS REALLY MATTER

Acoustics-based technology used in sensors referred to as 3DLevelScanners, or generically called scanners, is very different from other types of sensors. Like the name implies, these devices scan the material surface to take multiple measurements, taking into account the high and low spots in the silo. Scanning the surface also detects conditions such as cone up or cone down as well as buildup that may be present along the sidewall of the vessel. The data from multiple measuring points

is processed using advanced firmware and algorithms, and when combined with the silo's parameters loaded into the software, a highly accurate volume estimate can be provided. Additional data, such as the highest, lowest and average level of the material also is supplied.

Figure 1. The RL model detects level in a narrow beam and is ideal for bins of all size where a single measurement point is adequate.

Figure 2. The S model measures multiple points within a 30° beam angle and is ideal for smaller silos.

PERFORMS RELIABLY IN HEAVY DUST

One of the greatest challenges powders present is the presence of excessive amounts of dust, which can render some types of sensors inaccurate or unreliable until the dust settles. By operating at very low frequencies, a scanner isn't bothered by dust and can perform consistently and reliably regardless of the conditions in the vessel. This technology has been proven in many different challenging materials such as alumina powder, carbon black, detergents, polyethylene powder, silica granules, fly ash and talc powder.

SELF-CLEANING SENSOR MINIMIZES MAINTENANCE

The unique design and materials used to manufacture scanners ensure that the surface resists the buildup of powders that are suspended in the air at the top of the vessel. Plus, the acoustic pulses make a "chirping" sound that resonates and creates an almost imperceptible vibration that helps keep the inside of the scanner clean. This way, the sensor stays clean and operational without the need for running an air purge to the top of the vessel, which can be costly.

STANDS UP TO CORROSIVE MATERIALS

When a silo is filled with highly corrosive materials, it's important to outfit the silo with a sensor that can stand up in the toughest industrial environments. For this type of specialized application a scanner that has a HALAR coating on the mechanical parts, VITON for the o-rings and stainless steel for any parts exposed to the material will work reliably over a long period of time. This option is recommended when the sensor is being used to measure corrosive materials such as quick lime, sodium chlorite, potassium hydroxide or other materials on the U.S. DOT Class 8 material list.

NON-CONTACT SENSOR PREVENTS CONTAMINATION

With an acoustic sensor, there's nothing that comes into contact with the material, making it very safe to use in powders, granules or other solids of all types. There's no risk of equipment being stuck in deep material or becoming

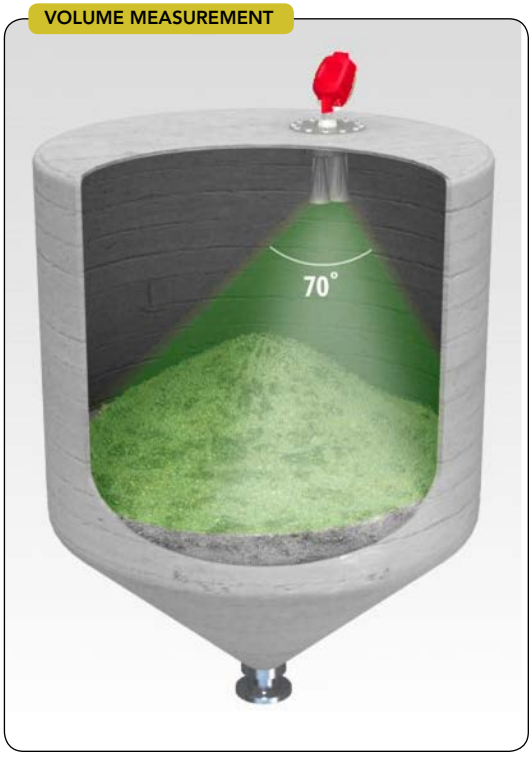

Figure 3. For larger silos, the M model measures multiple points within a 70° beam angle to accurately calculate volume.

detached and potentially damaging structure or equipment in the bottom of the silo. There's no need to replace probes or cables that can wear out over time. Eliminating contact with material helps ensure long life with minimal preventive maintenance or cost.

SAFETY INCENTIVES

When inventory monitoring is completely automated, there's no need to climb silos to take measurements. This not only saves time, it eliminates the risk of falls and the resulting injuries and the hassles of insurance and paperwork that comes with accidents. Plants today deal with rigorous OSHA requirements pertaining to climbing and entering silos and risk hefty fines when found in violation. Installing an automated inventory monitoring system allows for material management to be performed from a personal computer in the safety of an office.

LEVEL AND VOLUME MEASUREMENT

3DLevelScanners, like most other measurement devices, come in a variety of models and offer a wide range of options to tailor the device to the application. To select the right model for an application, it's extremely important to communicate your expectations of the technology and how you plan to use the data that you get from the device. Many plants are focused upon having a very high level of inventory accuracy. Accuracy of the scanner is driven by a number of variables, starting with information about the size of the vessel, the presence of structure inside it, and the material that's being measured. The installation location also is important as scanner technology measures multiple points, so the device needs to have a clear view of the material surface.

The most basic model of a scanner is referred to as an RL, which is short for reliable level. This model measures material in a narrow beam directly below the device, penetrating high levels of dust and performing where other types of level sensors become unreliable or inaccurate. This model is most often used when highly reliable level measurement data is needed on a continual basis. This model is frequently applied in materials that are less prone to excessive buildup and in narrow or smaller silos.

When more than simple level data is needed, the S model is designed to determine volume based upon an average level in the bin from multiple measurements taken within a 30° beam angle. This model often is used in narrow silos with diameters up to 16 ft and heights up to 200 ft. This model can also be used in wider silos, but with diminished accuracy as the 30° beam angle may not cover the entire material surface.

The M model takes measurements from a broader 70° beam angle making it appropriate for larger diameter silos and silos with uneven material topography. It also generates additional data including the lowest, highest and average distances based upon multiple measurements. Due to its ability to scan the material surface and take into account irregularities, it can provide a very high level of volume accuracy from between one and three percent.

At the top of the model spectrum is the model MV, which does everything the M does, plus adds a unique visualization feature. Using complex algorithms and a lot of processing power, this model generates a 3D image that indicates where the high and low spots are in the silo, shows if the cone is up or down, and detects sidewall buildup. This additional feature can be used to help manage filling and emptying points as well as detect if maintenance is needed to clean out buildup. This model is often used in large silos and in flour-like powders and other types of materials that tend to pile up unevenly.

OTHER MEASURES TO IMPROVE ACCURACY

If a bin is very wide or large, two or more scanners can be combined into a multiple-scanner system. By adding a controller that synchronizes the measurements from all of the scanners on a silo, the MVL model is able to provide very high volume accuracy in some of the largest silos. The number of scanners needed on the silo is determined by how large the silo is and the desired level of accuracy. The MVL also can generate a 3D visualization of the material surface from the measurements taken from all scanners. If visualization is not a requirement, an ML model supplies the same level of accuracy without the visual, making it more economical choice when budgets are tight.

Silos can be challenging structures to measure and often they come with some surprises that need a little "work around." For example, sometimes there is structure in the top of the silo, so a measurement device might try to measure the structure instead of the material. Neck extensions have been designed for scanners that allow them to clear structure and see beyond it to get an accurate measurement of the material. Angled mounting flanges are designed to keep the device level, while angled mounting adaptors can be used when it's necessary to aim the device in a problematic silo.

Although they have only been in the North American market for about five years, acoustic sensors have already revolutionized inventory management by adding the ability to accurately estimate the volume in a silo without ever leaving the safety of an office. The data derived from these devices improves operations in so many ways by allowing for timely replenishment and purchasing, reducing safety stock, and making inventory valuation far more accurate. For plant personnel, the scanner has been a game changer, keeping personnel safe from climbing silos and making them more efficient. Scanners truly have taken volume to a new level.

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SELF-CLEANING SENSORS

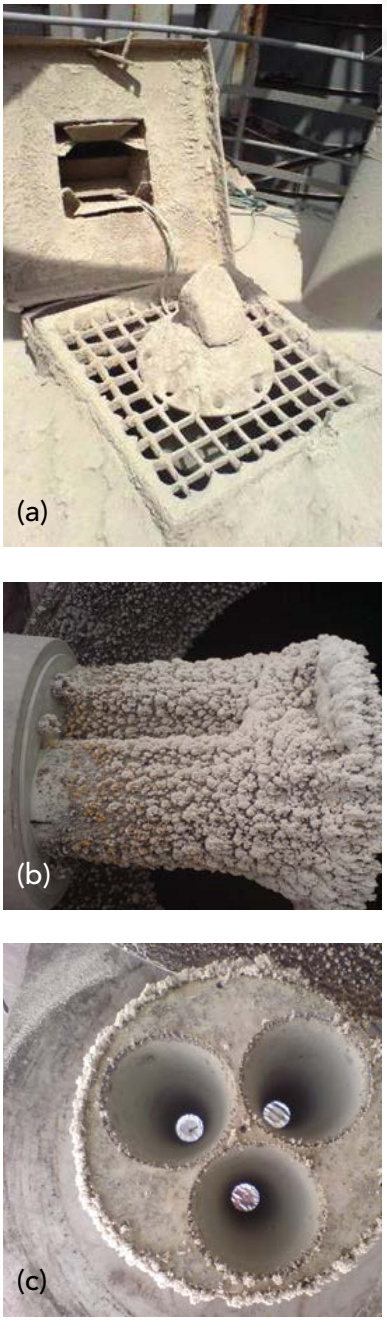

Figure 5. The scanner on a powder silo is covered with dust (a). Inside of the silo, the outside of the unit also is coated with dust (b). However, the self-cleaning sensors inside the unit are clean and fully functional (c).