

INVENTORY MANAGEMENT BEYOND THE BIN

Monitoring and measuring bulk solids in piles, bunkers, and warehouses is necessary for many facilities. This article explains how software and cameras can help make inventory management more accurate in these locations.

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Not all bulk solids are stored in bins, tanks, or silos. Bulk solids manufacturing and processing operations are often challenged to measure and monitor material inventory in structures such as flat storage warehouses, bunkers, or domes or in free-standing piles.

Significantly under- or overestimating these material inventory amounts can lead to inaccurate financial reporting of the value of these materials, which can lead to financial write-offs and necessitate significant adjustments to a company's balance sheet — and, as a result, affect the operation's ultimate profitability.

Combining the use of level sensors, cameras, and software can accurately map and monitor the amount of these materials stored indoors or outdoors. Sophisticated software technology considers random piling, making inventory estimates more accurate than measuring a single height or distance. These technologies often are also simple to set up, easy to use, and can provide short- and long-term reporting capabilities to meet the needs of production, processing, and finance personnel.

Using a software subscription service

Facility operators have a variety of options to simplify the inventory-monitoring process. Web-based subscription services (software-as-a-service or SaaS) are one such option that can help improve the precision and reliability of measuring the volume and tonnage in free-standing piles.

New software technology helps reduce guesswork, inventory write-offs, and bad valuations while saving time and hassle. For example, pile measurement can be automated using images uploaded from an iPhone or drone and automatically processed in the cloud. Data can then be accessed on a smartphone, tablet, or computer and shared through a web portal.

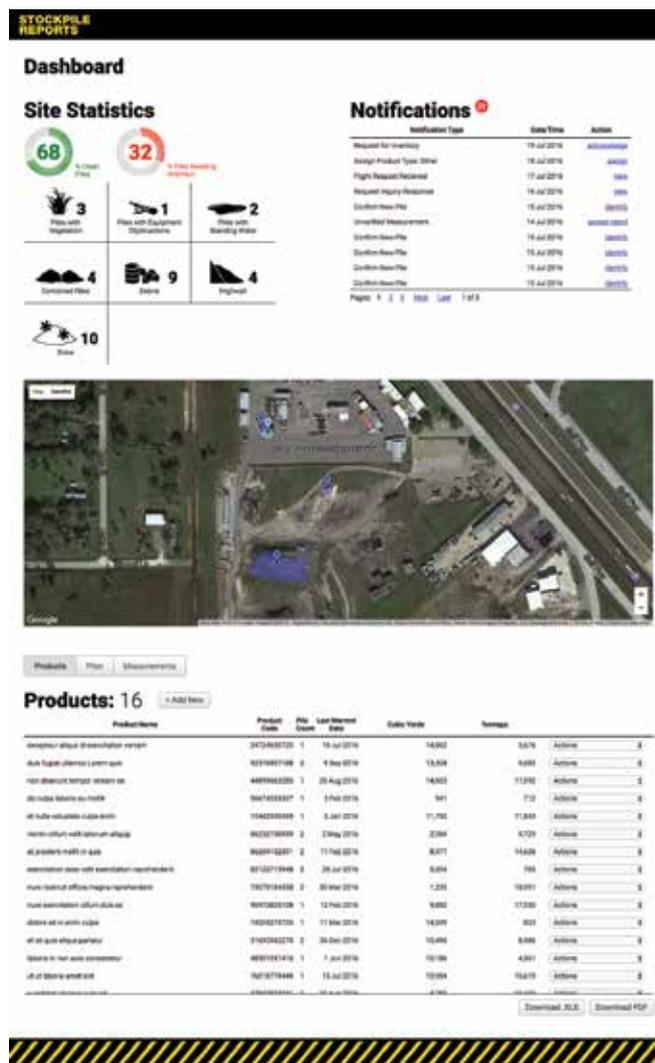
The goal of this technology is to completely digitize material management. Instead of looking over spreadsheets, users access dashboards populated with photographs, video, site statistics, and material measurement data, as shown in Figure 1. Reports on vital information such as material volume, tonnage, and condition risks can be generated for each pile. Potential impediments to accurate

pile measurements are flagged. These can include snow, standing water, vegetation, trees, and more.

SaaS subscriptions allow bulk solids inventory pile tracking on a monthly, weekly, or daily basis as needed by each location. In the case of Stockpile Reports, one online subscription service, no special hardware is required and operations are scalable. Users pay by the

FIGURE 1

Example of SaaS data dashboard.



pile, and the number of piles can range from as few as five to up to thousands at multiple locations, which would be useful for a global operation. Subscribers control costs by determining which piles are “active” and retiring piles that no longer need to be measured.

Pile imagery methods

Monitoring a pile involves automated pile measurements using images from either the ground or the air, recorded and uploaded using cell phones, drones, or fixed cameras.

- **Cell phones.** Pile measurement with a cell phone is done using an app. Operators physically walk around the pile and take photos of the pile surface. This method works well for companies with smaller piles of 4,000 cubic yards or less or when a quick pile measurement is needed, such as for verifying tonnage upon delivery.

- **Drones.** Drone imagery is becoming a popular method for pile management. Companies can use their own drones and pilots or can contract with licensed drone pilots to periodically capture images at a facility. Some SaaS services incorporate options for pilot contracting into the service, allowing plant personnel to schedule flights and request pilots. Contracting for drone flights is convenient for companies that have multiple locations (regional, national, or international) or that need to conduct inventory measurements at scale. The drone automatically flies a specific pattern each time, ensuring that all piles are accounted for and that reporting history is consistent and comparable.

- **Fixed-cameras.** Fixed cameras are the solution for measuring inventory in two and three-sided storage bunkers, domes, or warehouses. Measuring in these structures is notoriously difficult. Loaders, trucks, or trip conveyors deposit material in these buildings, causing it to pile erratically and allowing personnel little access to the back of the pile. New solutions using fixed cameras can remotely record material movement and create a visual inventory inside the structure. Topographical information about the material is processed using the same complex algorithms used for free-standing outdoor piles.

The goal of a fixed camera solution is to eliminate the need for people to manually generate images needed to calculate inventory. There’s no need to purchase a drone, get a drone pilot license, or arrange for third party drone services. No employee time or safety risk is required to walk around a pile to photograph it with an iPhone. Inventory can be completed without going outdoors or dealing with inclement weather.

Fixed cameras also allow for updating inventory measurements more frequently. Operators choose time intervals from once a day to once an hour. Infrared cameras can be used in low light conditions, which is a common condition in these structures. Some fixed camera solutions are weather-rated for harsh conditions — including high precipitation or



Workers use cell phones to record images and monitor inventory.



Drones fly the same pattern on each inventory photo mission, making changes obvious.



Fixed-camera poles enable bulk solids inventory monitoring in structures.

extreme temperatures — making the cameras useful for both indoor and outdoor applications.

Fixed cameras also can be used in a non-attended situation and work well for operations that store piles in storage domes or silos in many different locations. Cameras are typically mounted on top of a pole, which can accommodate up to two cameras, and require electricity or another power source as well as wireless network communication to handle the data transfer. The number of cameras necessary is based on the pile size. Multiple stands are placed strategically around a pile to ensure that its entire image, base to top, is recorded. A modem in the master stand collects all data and sends it via cellular, wi-fi, or hard-wired ethernet, to the service provider — in this case, Stockpile Reports — for processing. Other cameras in the system also send images to the master stand, which serves as the central point for data collection.

Detailed data in one location

With manual systems and spreadsheets, inventory can take a huge amount of time — even after initial measurements are complete. Pile measurement is normally followed by a series of emails, meetings, and file swapping. With an automated system, all data is available through a central portal, eliminating extra steps to get data to and from a location, person, or team. Accounting and regional managers can log in via any web-enabled device, and the information is there if they need to evaluate a site issue. All parties can log in and access the same data which can help speed up an issue's resolution.

Some secured, automated services also provide verified, audit-ready results that can't be interfered with by humans. These reports can then be downloaded and provided to financial management personnel. In addition, external auditors can be provided with temporary access to the data so they can delve deeper into an inventory question on their own instead of needing to ask plant personnel to track down reports and justify documentation. Audit documents are kept factual and unbiased, ensuring greater confidence in their information.

Using an automated SaaS to measure and monitor bulk solids inventory can significantly reduce the amount of time spent scheduling, traveling, and working in the field to conduct measurements at each site. Staff time spent performing calculations and generating and sharing inventory reports is virtually eliminated, and sign-offs and approvals can be accomplished simply. But perhaps the greatest relief is the time saved reviewing and disputing the data and preparing for audits. Depending on the number of sites, the time spent on inventory can be reduced by more than 95 percent.

With the number of company consolidations and the global scope of many businesses, being able to access data for any site, anywhere in the world, has become more important than in the past. Advanced

software solutions are highly scalable for hundreds of sites and can ensure inventory is reported consistently, using the same best practices at all locations. Because computer software performs all calculations, no human intervention or assumptions are necessary. This data can then be confidently used to make key decisions that improve business processes — from purchasing to pricing — while allowing accurate recording and reporting of inventory. **PBE**

For further reading

Find more information on this topic in articles listed under "Storage" in *Powder and Bulk Engineering's* article index in the December 2018 issue or the Article Archive at PBE's website, www.powderbulk.com. (All articles listed in the archive are available for free download to registered users.)

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