Flexible Bulk Container

A practical guide to flexible bulk container, covering the reader intent, the relationship to flexible bulk container, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.

levelmeter.org
Main topic: Main Page
https://www.level-meters.com/

Flexible Bulk Containers, commonly referred to as Flexible Intermediate Bulk Containers (FIBCs) or "big bags," have become the standard for transporting and storing dry, flowable products across the global supply chain. These industrial containers are designed to bridge the gap between individual 25 kg bags and full bulk tankers, typically holding between 500 kg and 2,000 kg of material. For process engineers and facility managers, the efficient use of a flexible bulk container requires not only an understanding of the bag's physical properties but also the implementation of precise level measurement technologies to manage filling and discharging cycles.

In industrial automation, managing the inventory within these containers presents unique challenges. Unlike rigid silos, the geometry of a flexible bulk container can shift during the filling process, and the dusty environments often associated with bulk solids can interfere with standard instrumentation. Selecting the correct measurement technology is essential for preventing overfills, ensuring worker safety, and optimizing logistics.

Understanding Flexible Bulk Container Types

Before selecting instrumentation for monitoring FIBCs, it is necessary to understand the classification of the containers themselves. FIBCs are categorized based on their electrostatic properties, which directly influences the type of electronic sensors that can be safely deployed near them.

Type A: Made from plain woven polypropylene. They provide no protection against static electricity and should not be used with combustible materials or in hazardous environments.

Type B: Similar to Type A but made from materials with a low breakdown voltage (less than 6 kV) to prevent brush discharges. They are not suitable for flammable vapors.

Type C: Also known as conductive FIBCs. These are made from fabrics containing conductive threads. They must be grounded during filling and emptying to safely dissipate static charges.

Type D: Constructed from antistatic fabrics that dissipate static into the atmosphere without requiring a ground connection.

When installing level sensors at a filling station for a flexible bulk container, the presence of dust or flammable vapors requires sensors with appropriate ATEX or IECEx certifications to match the container's safety rating.

Principles of Level Measurement in Bulk Solids

To effectively monitor the volume or height of material within a flexible bulk container, several measurement principles are commonly employed. Each technology interacts differently with the material's surface and the environment inside the filling spout.

Radar Level Measurement (Non-Contact)

Radar level meters operate on the Time-of-Flight (ToF) principle. The sensor emits a high-frequency electromagnetic wave—typically in the 80 GHz range for solids—which travels to the surface of the material and reflects back to the sensor. The distance is calculated based on the time interval between emission and reception.

In the context of FIBCs, 80 GHz radar is preferred because it offers a narrow beam angle (often as small as 3 degrees). This allows the signal to pass through narrow filling spouts without reflecting off the sides of the container or the filling equipment, providing an accurate reading of the material level even in confined spaces.

Ultrasonic Level Measurement

Ultrasonic sensors emit sound waves that bounce off the material surface. While cost-effective, these sensors are highly dependent on the speed of sound, which varies with temperature. Furthermore, high levels of dust generated during the rapid filling of a flexible bulk container can absorb the sound energy, leading to signal loss or "lost echoes."

Point Level Detection (Switches)

Point level sensors do not provide continuous volume data but instead indicate when the material has reached a specific height. Common technologies include:

Rotary Paddle Switches: A small motor rotates a paddle; when material covers the paddle, the torque increases and triggers a switch.

Vibrating Fork Sensors: The sensor vibrates at its resonant frequency. When submerged in solids, the vibration is dampened, triggering the alarm.

Technical Selection Criteria

Choosing the right sensor for a flexible bulk container application depends on the material characteristics and the physical constraints of the filling station. The following table provides a comparison of common technologies used in these applications.

Technology	Accuracy	Dust Tolerance	Ideal Material	Maintenance Needs
80 GHz Radar	±2 mm	Excellent	Fine powders, granules	Low (Non-contact)
Ultrasonic	±10 mm	Moderate	Large pellets, low dust	Moderate (Sensor cleaning)
Rotary Paddle	N/A (Point)	High	Heavy aggregates, grains	High (Mechanical wear)
Vibrating Fork	N/A (Point)	High	Light powders, plastics	Low (No moving parts)

For comprehensive system integration and to explore specific sensor models, engineers can Review product options and application support on the Welk Main Page.

Installation and Engineering Considerations

Successful level monitoring in a flexible bulk container requires careful attention to the installation environment. Because the top of an FIBC is flexible, sensors are typically mounted on the permanent filling head or the support framework rather than the bag itself.

Beam Angle and Obstructions

When using non-contact sensors like radar or ultrasonic, the "beam angle" is the most critical factor. The sensor must be positioned so that the signal cone does not intersect with the filling pipe or the inward-curving walls of the bag. If the beam hits these obstructions, it will create a false "high level" reading.

The Angle of Repose

Bulk solids do not sit flat like liquids; they form a cone known as the angle of repose. When filling a flexible bulk container, the material will peak in the center. If the sensor is mounted directly over the center, it will detect a full state earlier than if it were mounted toward the edge. Conversely, during discharging, a "cone of depression" forms. Calibration must account for these geometric variations to provide an accurate estimate of total volume.

Dust Management and Purging

Fine powders (such as flour, cement, or chemical additives) create significant dust clouds during the filling of a flexible bulk container. While radar can penetrate dust, heavy buildup on the sensor face can still degrade performance. In these cases, using a sensor with a plastic lens or an integrated air-purge connection—which uses compressed air to blow dust off the sensor face—is recommended.

Limitations and Operational Risks

While modern instrumentation is highly capable, there are inherent limitations to measuring levels in flexible bulk containers:

1. Bag Stretching: As an FIBC fills, the fabric may stretch or settle, changing the bottom reference point. This can lead to minor inaccuracies in distance-to-volume conversions.

2. Dielectric Constant: Radar sensors rely on the dielectric constant ($εr$) of the material. Materials with a very low dielectric constant (like certain plastic pellets) reflect weaker signals, requiring high-sensitivity radar units.

3. Static Interference: In Type A or B bags, static buildup can occasionally interfere with unshielded electronics. Ensuring that the instrumentation is properly shielded and grounded is a prerequisite for reliable operation.

4. Bridging and Rat-holing: During discharge, material may stick to the sides of the flexible bulk container, creating a hollow space or "bridge." A level sensor looking from the top may report that the bag is full when the discharge spout is actually empty.

Frequently Asked Questions (FAQ)

Q: Can I use a radar sensor to measure through the fabric of a flexible bulk container?

A: Yes, certain radar frequencies can penetrate the polypropylene fabric of an FIBC. This allows for non-invasive measurement where the sensor is mounted above the bag without an opening, though signal attenuation must be considered during calibration.

Q: What is the best way to prevent overfilling an FIBC?

A: The most reliable method is a redundant system: a continuous radar level meter for inventory tracking and a vibrating fork or rotary paddle switch as a high-level safety cutoff.

Q: How do I handle different bag heights on the same filling line?

A: If your facility uses flexible bulk containers of varying heights (e.g., 1.0 m and 1.5 m), the level sensor's 4-20mA or digital output must be scaled to the maximum possible height. Modern sensors allow for multiple parameter sets that can be switched via a PLC depending on the bag type being filled.

Q: Does the color of the material affect the measurement?

A: For radar and ultrasonic sensors, color is irrelevant. These technologies depend on electromagnetic and acoustic properties, respectively, making them superior to optical sensors in dark or dusty industrial environments.

Conclusion

The flexible bulk container is an indispensable tool in modern bulk solids handling, but its efficiency is tied to the accuracy of the instrumentation used to monitor it. By understanding the principles of radar and ultrasonic measurement, and by accounting for the unique physical properties of bulk solids—such as the angle of repose and dust generation—operators can ensure a seamless filling and discharging process. For those seeking to implement or upgrade their level measurement systems, visiting the Main Page provides access to technical specifications and expert guidance tailored to industrial automation needs.