FIBC Filling & Selection

White Paper 001

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Companies that are considering the use of Flexible Intermediate Bulk Containers, (FIBCs) as a packaging unit fall into one of the following categories:

- Suppliers/Manufacturers of products to be filled into FIBCs.
- End Users/Buyers of products supplied in FIBCs.
- Companies using FIBCs as a handling unit within their own plant.
- Custom Packers receiving products in bulk for packing into FIBCs.
- Transportation/Shipping/Storage companies handling FIBCs.

Each of the above is interested in safe and easy handling, reduced costs and minimum risk of damage or loss. As more products are supplied in FIBCs questions and concerns are being raised about all aspects of the Bulk Bag system of packaging. This article addresses these concerns.

FIBC Design

Sizing the FIBC

The following criteria must be taken into account:

- The weight of the product in the FIBC and its tamped bulk density.
- The internal dimensions of the shipping container or road vehicle where the filled FIBC is to be placed.
- The net filled height of the FIBCs after filling.

Most FIBCs with a square or rectangular base will round out during filling in their mid section. Squared or panel bags do not round out as much. To arrive at the correct base size, the internal dimensions of the container/road trailer to carry the FIBCs should be looked at closely to insure as near as possible a 'push fit'. ISO containers are usually 7 ' 6" wide internally. The following formula applies when wishing to place two FIBCs side by side across the container/trailer.

FIBC Base width is calculated from:

$$\frac{\text{Internal Width Container/Trailer} \times 3.14}{8 \times \text{Stretch Factor}}$$

An FIBC rounded out diameter is calculated from:

$$\frac{(\text{Base Length} + \text{Base Width}) \times 2 \times \text{Stretch Factor}}{3.14}$$

The stretch factor can vary depending on the tightness of the weave of the FIBC fabric being used and the density of the filled product. Generally a figure of 1.03 should be used. To arrive at the base size to fit the selected transport, a close liaison with the FIBC manufacturer is required to insure that they are able to supply the correct size. The height of the bag depends on the filled density, the weight required and any height restrictions placed on the FIBC by the user. Where storage of filled FIBCs plays an important cost factor for both the filler and the discharger, the following suggestions have a bearing on the height required:

- For safe stacking of FIBCs it is not advisable to stack bags two high if the bags are over 5' high and three high if they are over 4' high - regardless of whether they are on pallets or not. FIBCs should not be higher than twice the base plus width.

- The filled height of product in the FIBC after filling can vary considerably depending on the type of filling machine used and the characteristics of the product. It is therefore important to get the product tested on the selected filling machine before ordering FIBCs. Filling machines that have the capability of densifying the product during filling, save on FIBC height and make a more safe and stable FIBC for stacking and handling.

Lifting Loops, filling Spouts & Outlets

Lifting Loops: These are usually located at the top four comers of the FIBC. They may also be of the 'Cross Corner' type. The length of the loop is generally 10" but may increase to 12" if the FIBC is to be picked up and moved by fork lift truck tines. 'Pop Up' loops help to enable a fork lift truck to engage the loops without additional labor, but they do incur additional costs.

Filling Spouts: These are tailored to fit the filling machine head. When liners are used, some machines clamp only the liner, in which case the diameter of the filling spout can be increased to 20 - 24" to allow the product to reach the 'shoulders of the FIBC' and not bridge in its neck. This is most important with powders. A 15" diameter is the most common filling spout diameter.

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Outlet Spouts: The diameter should be sufficient to insure the easy discharge of filled product. Ease of discharge is also assisted by the correct design of the discharge machine. Most modern day discharge units can handle poor flowing products, depending on their design and choice of product flow promotion device. Diameters tend to vary between 10" and 24". Outlet spout length should be sufficient to insure that it can be tied off and in most cases goose necked. The length can vary from 16-36" dependant on the diameter.

Other FIBC Outlet Systems: These are many and various, but all are designed to accommodate a particular product or discharger type that cannot be overcome by a standard outlet spout.

- Flat Bottom
- Conical Bottom
- Hygiene Flaps and Hygiene System
- Fully Opening Bottom Bags

FIBC Liners

Lined FIBCs are usually used for fine powders, food and pharmaceutical products. Liners are only rated as moisture proof and not water proof. Polythene will allow the ingress of moisture over a period of time and require attention being paid to tying off after filling. Standard design liners are normally extruded in a tube. The circumference of the extruded tube should be equal to the base perimeter of the FIBC plus 2% to eliminate over stretching. Liners are normally manufactured from linear blend polythene as it is stronger than low density polythene and reduces the risk of shredding or crumbing when it is cut. Liners are between 5/16" thick dependent on the product and the protection required. These liners are only suitable for product being filled with a temperature not greater than 176°F as they will start to plasticize above this temperature. For temperatures above this, special liners should be used.

FIBC Construction & Quality

FIBCs are designed to be lifted by their loops when filled and strength is built into the FIBC to give a safety factor of 5:1 for single trip bags and 6:1 for multi-trip (used more than once) bags. UN Chapter 16 FIBCs arc tested to a safety factor of 8:1.

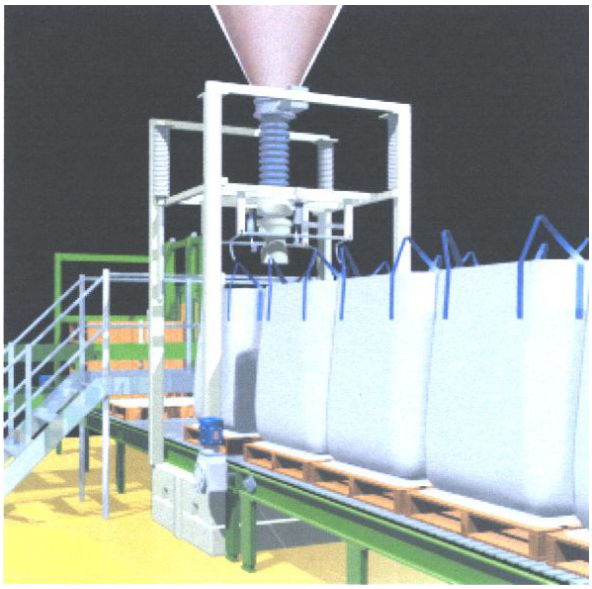
FIBCs designed to hold food or pharmaceutical products should be manufactured in such a fashion to insure loose cotton ends or frayed material from hand cut areas do not occur. Outlet spouts should be hemmed and tie cords should have 'flames' ends.

HANDLING FIBCs

Pallets

Pallets are by far the easiest method of moving filled FIBCs, subject to the following considerations:

- The correct size of pallet should allow the rounded section of the FIBC to overlap the edges of the pallet so that when two palletized bags are placed side by side, the bags touch and not the pallets. This increases stability of the bags when packed in containers/trailers.
- The FIBC should be positioned as close to a central position on the pallet as possible, especially after filling. A wide range of mechanical devices to assist the fork lift truck driver to achieve this are available as well as side shift on the truck itself.
- If the FIBCs are to be stacked, close slatted pallets, both top and bottom should be used to stop 'pinching' of the bag by allowing the top and the bottom of the FIBCs to protrude through the slats. These tend to be expensive and may only be financially justified for 'in plant' use unless return of them can be guaranteed.



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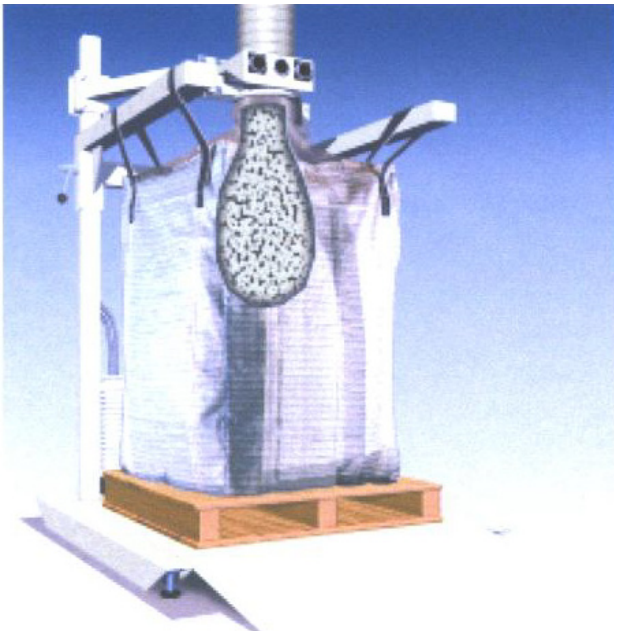
Skid/Slip Sheets

If the plant handling the FIBCs has skid/slip sheet handling facilities available, these can be used instead of pallets with the following restrictions. When stacking with skid/slip sheets, stability is reduced and stacking bags three high should not be done with FIBCs that have seam heights greater than 39" and two high with seam heights greater than 4' 3". The same restrictions apply with regards to having the sheets central as with pallets.

FIBC Stability

Well filled FIBCs that have been correctly sized and properly filled are stable and safe to handle and stack, but stability must be maintained, not just after filling but during stacking, unstacking, transportation and restacking. A good fork lift truck driver should always try to restack the FIBCs in their original positions. The bottom FIBC, which has a more compressed base will be best positioned on the bottom of a new stack.

FIBCs that lean to one side or have become 'banana' shaped cannot be corrected once they have been filled. These are dangerous and expensive to handle.



FIBC Filling

Untamped versus Tamped Bulk Density

To achieve good filling of an FIBC it is necessary to understand these two bulk densities fully and their effect on sizing of the FIBC and on its stability. Untamped bulk density is the density of a product collected from its free fall through the filling head. It will include entrained air. Tamped bulk density is the density achieved from a sample of product after it has been vibrated for several minutes and the entrained air has been removed.
Some examples are :

	Tamped Bulk Density lb/ft^3	Untamped Bulk Density lb/ft^3	Ratio % %
Aluminum Chips	15	7	47
Aluminum Oxide	120	60	50
Ammonium Nitrate	62	45	72
Baking Soda	55	40	73
Barium Soda	180	120	67
Portland Cement	94	60	64
Wheat Flour	40	33	83
Talc	60	50	83

Particle shape as well as size plays an important part in the time it takes to remove entrained air. Plate shaped particles, of clays for instance, take three to four times the amount of vibration to remove entrained air than a similar sized round particle. Granular particles will lose their entrained air quickly under their own weight. The larger the granule the shorter the time it takes to get to a tamped bulk density. Even then vibration will insure added stability is achieved. Vibration will only act on the weight of the material above the weight of

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the vibration platform. Therefore vibration should not be commenced until a minimum weight of 450 lb is in the FIBC.

Principles of Filling

During the development of FIBC filling machines, certain basics have been identified that must not be overlooked when filling FIBCs. These are:

- Correct position of empty FIBC in relation to machine base - All woven polypropylene bags will stretch to some extent during filling when hung by their loops. The FIBC should be positioned so that the seams of the FIBC can stretch down during the filling cycle, with the actual comers of the bag only touching the base when the fill cycle is complete.
- Base Vibration for Densification - The bulk density of the product in the filled bag should be as near as possible to its tamped bulk density. This should be achieved while the FIBC is awaiting removal from the filling machine.
- Fill Rate Control and Displaced Air Exhaust - Complete control of the product passing through the filling head must be maintained to facilitate a steady filling rate. The filling head must also allow for the exhaust of displaced air to prevent dust and pressurization of the FIBC during filling.
- Liner Inflation & Attachment to the Filling Head (Slip Seal) - For FIBCs with liners, inflation is particularly necessary prior to filling. The liner needs to be sealed to the filling head to insure there is no dust release. However, during inflation and filling the liner must also be free to move inside the FIBC and take up the shape of the bag without stretching.
- Robust construction - to insure long life and protection from potential damage from fork lift trucks.
- Operator Access - Ease of access to:
  1. Attach the loops to the FIBC Support Arms.
  2. Connect the Filling spout/liner to the filling head.
  3. Disengage the Filling Spout/liner from the filling head.
  4. 'Tie off' the filling spout. The operator should be able to carry out all of these functions at shoulder height without the need to climb on the machine.
  5. Electrical controls - preferably microprocessor based (compact) and easily accessible by the operator. All bag filling functions should be able to be performed manually (as required by the operator) and automatically (once the filling cycle is initiated).

These basic principles have also been augmented by various options designed to further automate the filling operation and reduce operator involvement.

These are:

- Pallet Magazine/Stacker - Several pallets can be placed ready for the filling operation to commence. This equipment then selects a lone pallet from the stack to be sent to the filling machine.
- Slip Sheet Dispenser - A slip sheet is then placed on the pallet automatically prior to filling.
- Automatic Bag Loop Release - Once the bag is filled it is automatically released from the filling machine ready for automatic removal. Take Off/Accumulation Conveyor - The filled bag is then conveyed away, allowing a new bag to be placed ready for filling.
- Spinning Head - This is an attachment to the filling head suitable for use with 'baffle' bags and granules where vibration alone is not capable of both deaerating and dispersing the product. The Spinning Head disperses the product stream as it enters the bag to achieve an even fill.

These developments have enabled an increasing number of products to be handled in FIBCs, leaving the future open for many more companies to benefit from the many advantages offered by this form of packaging.

Summary

The choice of FIBC is critical, both with regards to design and size as the most expensive part of an FIBC packaging system is the FIBC itself. The wrong choice is not only expensive in terms of waste product and high labor costs but could also lead to a loss of customers confidence in FIBCs.

To choose a standard size at a reduced price that does not suit the exact needs and those of a customer can lead to disaster. Trials should always be conducted on the chosen filling equipment and also on the chosen discharger. Filling an FIBC is relatively easy, discharging it may not be if incorrectly filled or if the wrong type of bag is used.

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