Design of FIBC (Flexible Intermediate Bulk Container)

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Abstract

FIBCs are made of thick woven PE or PP with coated or uncoated, and generally measure between 100 to 110 cm in diameter and varies in height from 100 cm up to 200 cm. Its capacity from 1 ton to 2 ton. A bulk bag designed to transport one metric ton to two metric ton of material will itself only weigh 3- 5 Kgs. Bags are generally made with either lifting loops for easy transport. Removing material is made easy by a special discharge arrangement in the bottom such as a discharge spout. The Flexible Intermediate Bulk Containers utilized Chemicals, Pharmaceutical Drugs, Fertilizers, Food Products, Construction materials. Based on electrostatic ignition hazard Flexible Intermediate Bulk Containers are generally divided into Four groups.

Index Terms: - *flexible intermediate bulk container (FIBC), design parameter of FIBC, specification sheet, Gram per square meter (gsm), polypropylene(PP).*

I. INTRODUCTION

A flexible intermediate bulk container (FIBC) is bulk bag made of fabric that is produced for storing and transporting of products, like as rubber, animal food, Refractories, Seeds, Hazardous Waste Material and Pharmaceutical Drugs. For Transporting and loading of bag pallet is used. Bags are made with one, two or four lifting loops. for one-man handling single loop bag is produced. Emptying is made easy by a special opening in the bottom such as a discharge spout, full bottom open, or by simply cutting bag base from bottom.

II. LITERATURE REVIEW

By referring Graham Ackroyd, et.al (2015) stated that even if bag has more breakdown voltage higher than 6-kV due to FIBC fabric is thicker than liner bag generally found low breakdown strength. Petri Pekkala, et.al (2005) Concluded If experiment done on different FIBC material to find out the polarities it is observe that each material has separate polarities. Erich Jordan, et.al (2005) concluded that as safety concern FIBC Should be made with conductive material or it is grounded during material filling. If bag made without conductive fabric is not safe for use. T. Kodama, et.al (1997) state that to prevent risk of fire hazard or fire explosion flexible intermediate bulk container always contain inner liner in it. Due to inserting inner liner inside the bag risk of fire explosion is reduced.

III. OBJECTIVE

Now a day FIBC is generally used in different applications thus study different types of FIBC and their practical application is most important.

1) Study the design parameter and selection of proper type of FIBC according to dissipation of electric charge, structural form, Factor of safety, Inlet & outlet type of bag.
2) Preparation of specification sheet as per customer requirement.
3) Validation of result with specification sheet.

IV. DESIGN OF FIBC

A. Types of FIBC According Electrostatic Properties

1) FIBC Type A

It is Plain Bag with No Static Protection utilized as a part of to transport non-combustible items and No combustible solvents. Sort A FIBC are produced using plain polypropylene. Type A FIBC made without static control due to that at time of production there is no necessary to take electrostatic test. Type A FIBC produced without static protection thus for safety concern combustible or burnable material is not stored or transported. for example, sugar, flour, corn starch, drain powder etc.

2) FIBC Type B

It is Plain Bag with low Static Protection utilized as a part of to transport non-combustible items and No combustible solvents. Type B are produced from plain PP.

3) FIBC Type C

It is Interconnected Conductive Threads Dissipates Charge to Ground use in to transport combustible powders and When combustible solvents or gases are available around the pack. Type C FIBC are called conductive FIBC or ground capable FIBC. Initially, they were produced using all conductive materials. Today, ground capable Type C FIBC are produced using non-conductive polypropylene interwoven with conducting yarns.

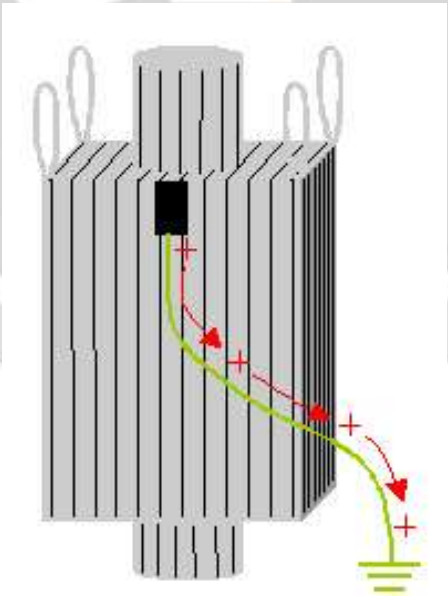

Fig. 1. Type C FIBC

4) FIBC Type D

It Does Not Require Grounding or Earthing use in to transport combustible powders and When combustible solvents or gases are available around the Bag. As shown in diagram for charge is discharge to surrounding there is no need to actual contact of balk bag to earth required.

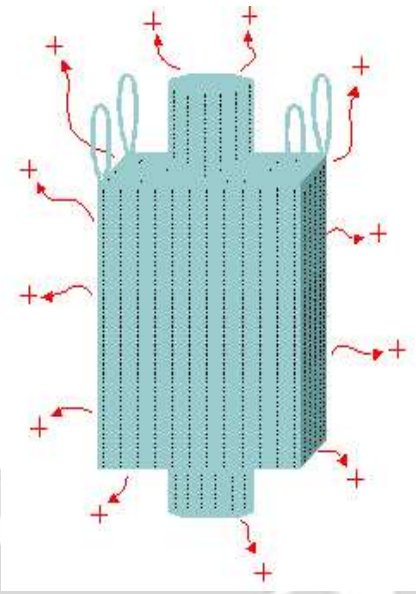

Fig. 2. Type D FIBC

B. Structural Forms Of FIBC

1) Four Panel Bulk Bags
Typically, the four-panel construction is fantastic for a variety of applications. This four-panel design requires stitches along four separate pieces of fabric sewn to create a 4-Panel Bag.

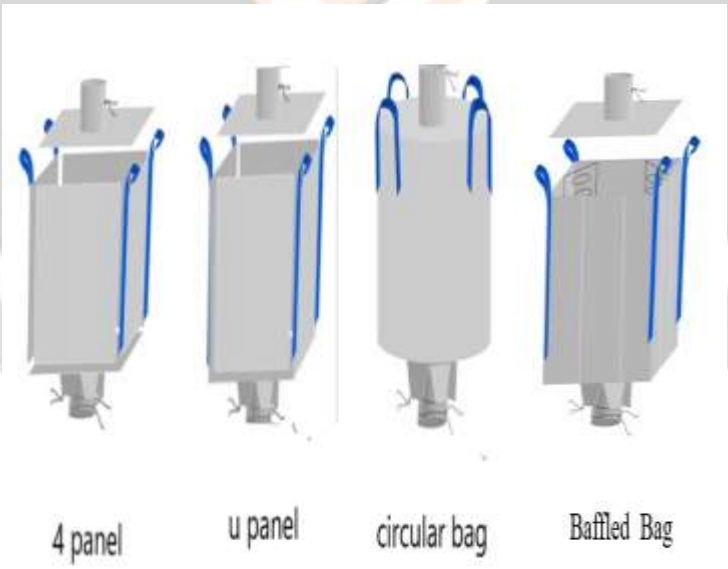

Fig. 3. Structural forms of FIBC

2) U-Panel Bulk Bags
The U-Panel FIBC consists of two side panels attached to a single ‘u-shaped’ (side-bottom-side) unit. This type of bag is also called as three-piece construction.
3) Circular Bulk Bags
Circular bulk bags produced by using circular type of fabric thus it is a seamless, Due to seamless construction this type of bag is suitable for fine powder application.

4) Baffled Bulk Bags
This type of FIBC bag are constructed with four internal baffles stitched from one side panel to an adjacent panel. Any practical application required to maintain square shape of bag this type of bag is good choice.

C. Inlet Top Style

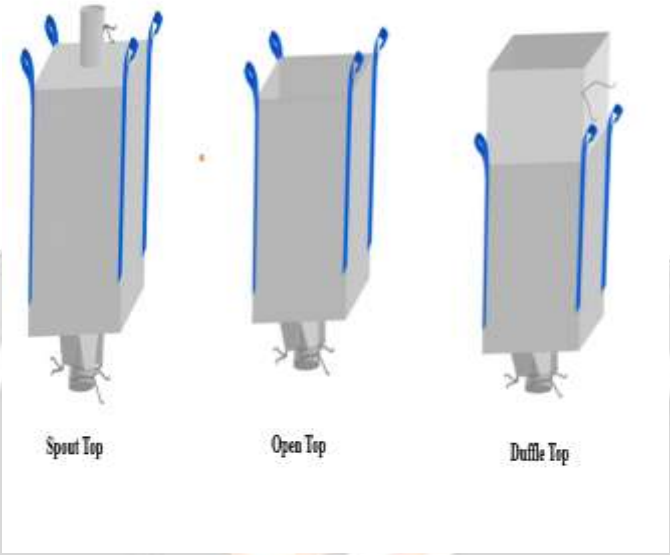

Fig. 4. Inlet Top Style

1) Spout Top
For filling the material inside the bag spout swan at top panel shown in above diagram. This type of inlet spout bag is more refer in automatic filling machine.
2) Open Top
This type of bag produced without top panel.
3) Duffle Top
Duffle top bulk bags (FIBC) have a fill opening that is the same length and width as the bulk bag. Inlet Tie Style contains web, cord or wire.

D. Bottom Style

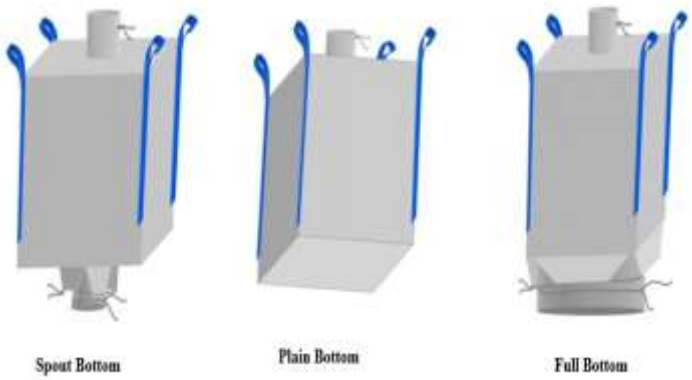

fig. 5. Bottom Style

1. Spout Bottom Bulk Bags
   It is Similarly to inlet spout only swan at bottom side to easy of material removal.
2. Plain Bottom Bulk Bags
   This type of FIBC bag no provision is kept for removal of material from bottom.
3. Full Bottom Discharge Bag
   it has a discharge spout with Full bottom discharge. such bags are ideal for Quick removing material from bag. Bottom Tie Style contains web, cord or wire.

E. Types of Lift Loop

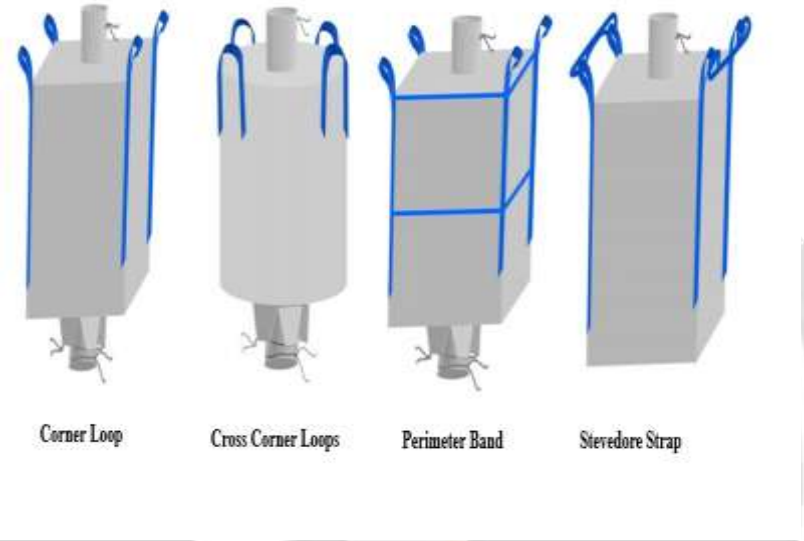

Fig. 6. Lift Loop

1) Corner Loop
   corner loops bulk bag produced when both piece of loop sewn at point where two side panels fabric piece are meet. This type of loop arrangement suitable in U panel & four panel bag.
2) Cross Corner Loop
   This type of loop arrangement is formed by attaching one piece of the loop to one side panel and another piece of the loop to an adjacent side panel.
3) Perimeter Band Bulk Bags
   Perimeter band have a woven PP reinforcement band added to the bag generally for increase the strength of bag.
4) Stevedore Strap Bulk Bags

F. *Liner*

liner for FIBC is a Low-density polyethylene liner which is suited to products which require that the product inside is not damaged by moisture or condensation. Liner is generally use to avoid leakage of very fine materials in powder form. These liners can be ordered for all of our FIBC and are available in thicknesses of 70-150 microns.

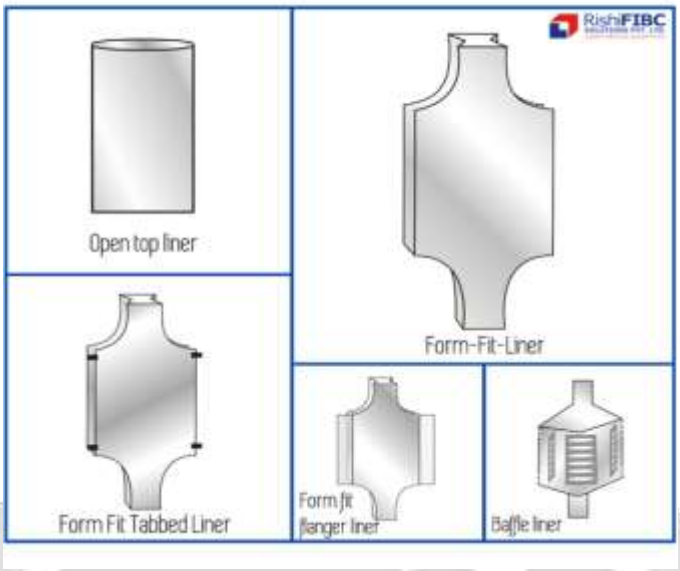

Fig. 7. liner Styles

Below are four common types of bag liners

1) Lay-Flat Liners
Lay-flat polyethylene liners are the most common type of liners with cylindrical in shape from top to bottom. Some features of Lay-Flat liners include Oxygen and Moisture barrier, good Chemical resistance and High strength.
2) Form-Fit Liners
Form-fit bulk bag liners is exact shape of the bag including the spout inlet and outlet. Types of Form Fit Liners Is Both Side Spout Liner, One Side Spout and Bottom Sealed Liner, Both Side Spout with Side Sealing Liner and Both Side Spout Without Side Sealing.
3) Baffle Liners
Same to baffle bag the form-fit baffle liner is design to reduce shipping costs. features of baffle liners Increased bag stack-ability, can hold up to 30% more product in a same space, Protection from contamination.
4) Aluminum Foil Liners
It also known as foil liners. Generally used to improve filling, discharging, handling and stability of the outside of the bag. Foil liners offer great protection against moisture, oxygen and UV. They are compatible with a wide variety of bags. It prevents product damage contamination. It is Available with top and bottom spouts for safe filling and discharge and safeguard against moisture and oxygen.

G. SWL And Safety Factor

The SWL (Safe Working Load) and SF (Safety Factor) Normally, the SF is given as 5:1 or 6:1. Safety factor of 5:1 means that the filled bag when subjected to hydraulic pressure of minimum of 5 times the SWL after 30 cycles of twice the SWL. Example if the SWL is 150 kgs with SF of 5:1, the bag when subjected to the cyclic test and peak load test is considered passed only if it breaks after 750 kgs pressure. Safety factor of 6:1 means that the filled bag when subjected to hydraulic pressure minimum of 6 times the SWL after 70 cycles of thrice the SWL. If the bag breaks before 6 times the SWL pressure then it is not suitable for the required duty condition. example, if the SWL is 200 kgs with SF of 6:1, the bag when subjected to the cyclic test and peak load test is considered passed only if it breaks after 1200kgs pressure. Generally, SF with 5:1 is single use and SF with 6:1 is multiple use.

H. Bulk Bags and The UN Code

UN 13H3 / Y / mmyy / USA / InterBULK / 1800 / 1000

UN 13H3 is the UN code. Where H1 is woven plastic without coating or liner, H2 is woven plastic with coated fabric, H3 is woven plastic with liner, H4 is coated woven plastic with a liner. X, Y, Z is Packing Group with X mains most dangerous material, Y mains medium danger and Z mains less dangerous. Next mmyy is representing the date of manufacture. InterBULK is company name. 1800 is the stack load test and 1000 represents the safe working load in kilograms.

I. *Material used in FIBC*

1) Polypropylene :-It is a thermoplastic polymer and density is between 0.895 and 0.92 g/cm³ and the melting point of polypropylene is 171 °C. polypropylene is generally low-density polyethylene (LDPE) and high-density polyethylene (HDPE).
2) Titanium dioxide : Titanium dioxide is naturally occurring oxide of titanium, chemical formula TiO2. When used as a pigment then it called titanium white. The molecular Weight of TiO2 is 79.865 g/mol and boiling point is 2500 to 3000 deg C.it is Odorless white powder, Tasteless and pH 7.5.
3) Calcium carbonate: - Its commonly known as limestone, chalk or marble with odorless, fine white powder. Its melting point of 1,339 °C

J. FIBC Specification Sheet

1) Bag Body
Body Construction: - U Panel. Type A
Bag Size (L x W x H) (cm): - 90 x 95 x 100
(External Dimension).
SWL (kg): 1019, FOS: 6.
Body, Bottom Fabric & Top Panel gsm: - 230
Reinforcement feature,
Seam & Stitch style: - J fold with Over lock + safety.

2) Inlet Spout & Outlet spout
Inlet Spout Dimension (D x H) (cm)= 30 x 50
outlet Spout Dimension (D x H) (cm)= 30 x 50
Inlet Spout & Outlet spout gsm: - 150 including coating.

3) Lift Loop
Lift Loop Density(g/m): - 40
L x W (cm): - 7.0 x 25
Loop attachment Style: - 4-point corner

4) Liner
Loose liner with open top & close bottom form fit, 75 Micron.

Lay flat: - (DIA.*3.14)/2

V. RESULT

A. Gsm Result

1) Body Without Reinforcement Fabric gsm: - 233.75
2) Top Spout & Bottom Spout Fabric gsm: - 156.25
3) Loop g/m: - 45
4) Perimeter band: - 30

VI. CONCLUSION.

- Selection of bag design parameter like as bag type according to electrostatic properties, structural form of bag, size of bag, factor of safety, gsm and also lift loop type is most effects the durability, handling as well as material fill inside the bag.
- The result of work indicates that, gsm of bag is hart of bag thus selection of gsm as per standard at the time design is most important and checking of fabric gsm after completion of production is first priority of engineer.

Acknowledgment

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