Safety in the bag

Bulk Bags, also called Flexible Intermediate Bulk Containers (FIBCs), can move and store from 250 to 2000kg of bulk materials. Malcolm Ranson discusses some serious issues which arise when handling FIBCs containing volatile products in hazardous atmospheres.

From the first use of Flexible Intermediate Bulk Containers (FIBCs), or Big Bags, in the US during the early 1940s, their worldwide use has steadily increased in line with industry's requirement to transport and store powdered, flaked and granulated products efficiently and economically.

Originally used for comparatively low value products such as fertiliser, they are now widely employed in the food, chemical, pharmaceutical and plastics industries. This has meant that the users of FIBCs have enjoyed significant increases in productivity, having been able to dispense with 25kg bags with the associated manual handling and empty bag disposal.

Explosion risks

However, the FIBC has brought with it safety issues of vital importance to processing plant managers. Some of the products handled in FIBCs are inherently volatile and even the most innocuous products, such as flour, are liable to explode quite violently if exposed to a sufficiently high ignition source.

The problem is compounded by the fact that FIBCs are capable of attracting and holding static electricity from the bulked product. Where the processing plant has an atmosphere containing flammable gases, solvent vapours or high dust-in-air mixtures, the need for safe FIBC discharge becomes crucial. When an FIBC is filled or discharged there is a steady accumulation of charge within the product which is transferred to the walls of the bag. If left unchecked this static build-up may result in low energy discharges, known as 'corona' discharges, from the surface of the FIBC, or the charging by induction of adjacent isolated conductors, such as people or ungrounded metal.

Grounding devices, like the one shown here, help counter static build-up and improve safety

Couple this with the risk of powder being thrown into the atmosphere during the emptying process, and a brush discharge could cause the product or atmosphere to ignite resulting in a fire or an explosion.

Needless to say, such an occurence would most likely lead to injury and major damage to the plant and environment. Also, any such damage would create business interruption costs resulting from lost production, the possibility of legal action and the attendant bad publicity for the organisation.

The speed and scale of modern manufacturing processes, coupled with changes to raw materials, has increased the range of applications where electrostatic charge can accumulate.

Any organisation which stores, handles or processes flammable liquids, powders, gases or solvents is exposed to the risk of static-related ignitions.

A number of products handled in FIBCs are extremely fine and highly invasive. This makes it necessary to ensure as close to total containment as possible of the product during discharge, to prevent contamination of the local atmosphere and to maintain health and safety standards. Obviously this problem is exacerbated when the product is volatile, toxic or presents an explosion risk.

FIBC manufacturers have long been aware of these risks. Of the four basic types of bulk bag produced, two are specifically designed to dissipate static.

Four types of FIBCs are available to industry, known as Type A,B,C and D. The following classification seems to have been generally adopted by industry:

Type A - These are the standard FIBCs used by companies who are filling and discharging products with no static problems.

Type B - These are manufactured from a two-ply, woven polypropylene 'sandwich' with interwoven conductive PP monofilaments, able to withstand a breakdown voltage of up to 4kV. These are the least effective of bags made to deal with static.

Type C - These are woven with conductive yarns which interconnect to provide a network covering the entire structure of the bag, known as a Faraday cage. Grounding tabs are then attached to facilitate grounding before filling and discharge. Provided they are adequately grounded before use and the FIBC discharge fully ground bonded, such FIBCs prevent the occurrence and propagation of brush discharges and will also stop any spark discharges.

Type D - This type of FIBC is made from material such as Chromiq Blue fabric which has been designed to dissipate surface charge by a combination of ▶

This technical paper is reproduced from Process Engineering

conductive and corona discharge, dispensing with the need to ground the bag. It employs hundreds of small patches, each with minute spikes which are not connected together. The low capacitance of the individual spikes ensures constant corona discharge, but at so low energy as to prevent ignition of combustible atmospheres.

Current controversy surrounds the effectiveness of the Type D bag in comparison to the Type C. As at this stage there is no method of monitoring the operating effectiveness of the Type D FIBC, whereas there is such a system for the Type C.

One thing is certain, however: static protective FIBCs are only one element of an electrostatically safe materials handling system. There are other equally important precautions which can be taken when discharging potentially hazardous. materials. For example, has the operator correctly fitted the necessary grounding clamp for the Type C FIBC? Or has the bag lost some of its static conductive properties through previous use?

It is necessary to ensure that the FIBC to be discharged is grounded, either through the FIBC support cruciform or by connecting one of the grounding lugs to a clamp which is ground bonded to the support of the discharge unit. A specially insulated monitoring clamp is attached to the FIBC, and the system then initiates the product discharging process only when the resistance through the FIBC is within the range of 500Ω to 10MΩ. Customers using specific FIBCs, or who have different safety standards, may use alternative resistance ranges available to special order.

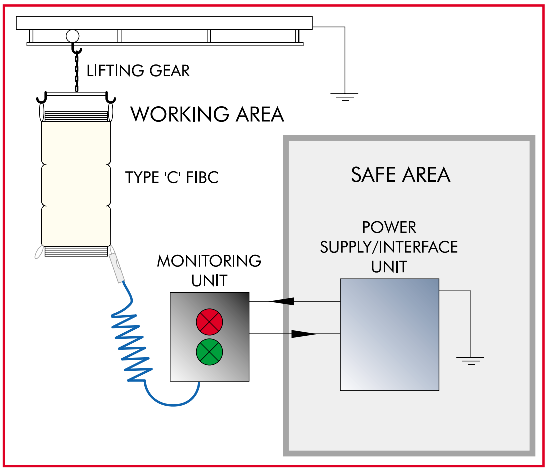
The Model T9 dischargers include a patented bag tensioner and a stretcher clamp which eliminates creases that could trap material

The static grounding system monitors the surface resistance of the FIBC to ensure that it remains grounded at all times

Once the parameters have been selected, the system will not operate until these conditions are achieved. Also, the system will immediately shut down should the parameters be exceeded at any time. This will prevent the operator from being able to fool the device by clamping the monitoring lead directly to ground. Visual indicators showing the FIBC status and its ground connection are used for ease of operation. This Static Grounding System is certified intrinsically safe which makes it suitable for use in hazardous atmospheres, such as those which contain toluene vapors and methane gas.

In order to eliminate the risk of dust emission during operation, specially designed and patented features are required to ensure safe discharge of the FIBC. The outlet spout of the FIBC should be connected to an inflatable seal which will prevent dust escape during discharging. A tensioning device should be utilised to pneumatically stretch the outlet spout, to promote a smooth and cylindrical path for the material to flow directly into the client's downstream process.

Material could still escape when the empty bag has to be removed, so total discharge of product from the bag is crucial.



FIBC massagers are positioned at every corner and two in the base. The FIBC also requires attachment to a pneumatic FIBC/Liner tensioning and an inner liner clamp. The device serves to stretch the bag during discharge to eliminate the possibility of creases being formed and holding residual material.

The discharge unit also includes a pneumatically operated pinch bar system, designed primarily to close the outlet spout of the FIBC enabling a partly discharged FIBC to be re-tied and removed from the machine.

Special containment

Where high levels of containment are needed, special tying of FIBC spouts and liners are required when removing empty FIBCs to ensure minute amounts of dust are not allowed to be released into the working environment. These procedures must be carried out before removal of the FIBC from the discharging unit.

A height adjustment facility can also be incorporated to accommodate FIBCs of different sizes, as well as an FIBC lifting frame locator to facilitate easy and correct alignment of the FIBC into the discharge unit.

To ensure correct grounding of the FIBC cruciform, copper wires were wound around the FIBC loop retaining sections which were grounded through the FIBC hoist and runway beam.

The same containment and static monitoring precautions are required during the filling of FIBCs as for when discharging. Correct connection of the FIBC filling spout and, where fitted, liner is vital to ensure no product emissions. In addition, liner inflation should be considered to ensure satisfactory inflation of loose internal liners together with satisfactory displaced air venting during the process. As with discharging, the filling head may be enclosed in a containment enclosure with venting to a centralised dust extraction system or an integral HEPA filter. The same static monitoring system may be used again, ensuring the FIBC is also grounded correctly.

Malcolm Ranson is with Spiroflow Ltd. based in Clitheroe, Lancashire, UK.

Spiroflow Ltd., Lincoln Way, Clitheroe, Lancashire BB7 1QG. Tel: 01200 422525 Fax 01200 429165
email: info@spiroflow.com website: www.spiroflow.com

Spiroflow Systems, Inc., 2806 Gray Fox Road, Monroe, NC 28110, USA. Tel: (704) 291-9595 Fax: (704) 291-9594
email: info@spiroflowsystems.com website: www.spiroflowsystems.com