Technical Advisory Bulletin

Controlling the increased fire risks of intermediate bulk containers (IBCs)

In an effort to reduce handling costs the storage industry has developed a variety of larger portable containers and tanks, known collectively as intermediate bulk containers (IBCs). Handling fluids in IBCs can yield significant cost savings and operating efficiencies as well as reduce the risk of boiling liquid expansion vapor explosion BLEVE. However, IBCs also pose a significantly greater fire spill fire hazard than the classic 55-gallon drum or smaller containers.

The greater amount of flammable liquid means that a leak in an IBC can result in a fire that generates too much heat for traditional fire sprinkler protection systems. An uncontrolled fire involving IBCs is that much more likely to destroy a manufacturing or warehouse facility, resulting in significant property damage and business interruption. Another risk of IBCs is that the nonmetallic varieties may be more prone to failure.

The ABCs of IBCs

The National Fire Protection Association (NFPA) Flammable and Combustible Liquids Code (NFPA 30) defines an intermediate bulk container (IBC) as any closed vessel intended for storing and transporting liquids with a liquid capacity not exceeding 793 gallons (3,000 liters). IBCs vary in size but are generally between 46 inches to 52 inches in height (between 1168 mm and 1320 mm). They range in fluid capacity from 119 to 793 gallons (450 to 3,000 liters) with more common volumes in the range of 300 to 400 gallons (U.S.).

IBCs are categorized by NFPA 30 under the headings of metallic or nonmetallic (glass, plastic, fiber – any material other than metal). Various types of IBC containers are currently on the market, including:

- Steel
- Stainless steel
- Rigid nonmetallic/composite
- Foldable (collapsible)

Rigid nonmetallic IBCs feature a plastic vessel that serves as the primary liquid-holding component. This vessel can be encased in a steel cage, a single-wall metal or plastic enclosure, or a double wall of foamed or solid plastic. These are often called composite IBCs (the term used by U.S. Department of Transportation [DOT]). The term rigid nonmetallic IBC also denotes an all-plastic single-wall IBC that may or may not have a separate plastic base and for which the containment vessel also serves as the support structure. IBCs that have a liquid-tight outer metal structure are considered metal IBCs or metal portable tanks by DOT.

One of the main areas of concern regarding IBCs is that composite IBC containers will fail quickly in a fire as the plastic vessel melts, releasing its contents and adding a large amount of additional fuel to the fire. Also, composite containers may be stored outside, but it should be recognized they may suffer UV degradation from the sun and be more apt to fail, exposing adjacent buildings even more.

Rigid nonmetallic intermediate bulk containers
(Picture courtesy of Chemical Specialties, Inc.)

Listed containers

NFPA 30 requires that nonmetallic or composite IBC containers be listed and labeled when used in protected buildings. The listing and labeling requirements are set by UL 2368 (Standard for Fire Exposure Testing of Intermediate Bulk Containers for Flammable and Combustible Liquids). Storage of liquids in non-listed IBC containers is classified by NFPA 30 as unprotected storage.

There is currently one known UL listed nonmetallic or composite plastic IBC container (Ecobulk SX-D) that is manufactured by SCHÜTZ Container Systems Inc. Additional information can be found on their website. This may represent a solution for many insurers concerned with the issue, but without Factory Mutual (FM) Approval, this may not ameliorate FM policyholder engineering recommendations on the matter of ignitable liquids in composite IBCs.

DOT approves nonmetallic or composite IBC containers as Packing Group II containers UN 31H1 and UN 31H2 (rigid plastics) or UN 31HZ1 (composites). Containers must pass physical tests, e.g., pressure tests, drop tests, etc. It should be noted that explicit fire testing of containers is not performed for DOT approval.

With the Globally Harmonized System (GHS) in hazard communication, it will be easier to identify pictograms signifying the level of fire hazard on composite IBCs that are not UL Listed. Still, it is prudent to examine safety data sheets (SDS) to determine all pertinent flammability characteristics. Viscosity is often also an important characteristic to examine in determining the risk of a spill fire hazard.

Liquid evaluation

Flammable liquids, mixtures, emulsions or semi-solids stored in IBCs must have their flash points and/or fire points measured. Classifications per NFPA 30 are:

- Class I (Flammable Liquid) flashpoint below 100°F (37.8°C)
- Class II (Combustible Liquid) flashpoint at or above 100°F (37.8°C) and below 140°F (60°C)
- Class IIIA (Combustible Liquid) flashpoint at or above 140°F (60°C), but below 200°F (93°C)
- Class IIIB (Combustible Liquid) flashpoint at or above 200°F (93°C)

Fire tests

A fire test project was previously initiated by the National Fire Protection Research Foundation (NFPRP) with the aim of improving fire protection associated with the storage of flammable and combustible liquids in non-metallic IBCs. Phases I and II of the project were conducted to develop protection designs for the palletized storage of flammable and combustible liquids.

The objective of Phase I was to identify where and in what time period would commercially available IBCs fail when exposed to a hydrocarbon fire. The fire tests were conducted with a 10-gallon heptane spill fire and a 2-gpm heptane running fuel fire. The tests were conducted with a 30-minute fire exposure. The tests showed that non-listed non-metallic IBC units may fail rapidly *(in as little as three minutes)* when protected by water sprinklers and subjected to a pan fire.

A follow-up effort (Phase II) was initiated to conduct large-scale fire tests representing real-world storage/use scenarios. The objective was to investigate fire control/suppression capabilities of fixed fire suppression systems on an array of IBCs stacked both one and two containers high. The variables investigated included the design of the fire suppression system, the storage configuration array and the type of IBCs in the array.

The results of the Phase II tests suggested that combining fire resistant IBC design with appropriate water sprinkler protection can control a fire in the tested storage array.

Protection

NFPA 30 addresses the requirements for the protection of metal, rigid nonmetallic and composite IBCs stored either palletized and/or in single and/or double row racks. The standard does not allow the *protected* storage of Class I flammable liquids (flashpoint below 100°F (37.8°C)) in rigid nonmetallic or composite containers. NFPA 30 contains protection schemes only for the storage of Class II and III combustible liquid materials in *listed* rigid nonmetallic or composite type IBCs.

Factory Mutual (FM) provides protection requirements for *metal* IBCs, either palletized, in solid pile storage and/or in storage racks, depending upon the material flash point.

FM also provides protection requirements for *plastic containers*, depending on the material flash point and container size. The FM standard does not allow the *protected* storage of Class I flammable, Class II combustible or Class IIIA combustible liquids (flashpoints below 200°F [93°C]) in rigid nonmetallic or composite IBC containers. Factory Mutual Loss Prevention Data Sheet 7-29 contains protection schemes for the storage of Class IIIB (only with flashpoints at or above 450°F [232°C]) combustible liquid materials in *listed* rigid nonmetallic or composite type IBCs

For *unprotected* storage using rigid nonmetallic or composite IBC containers, NFPA 30 poses storage limitations as to the maximum storage height, maximum gallons per pile and maximum total storage quantity. See Table 12.6.2.2 of NFPA 30 (2018).

For *protected palletized storage* of listed rigid nonmetallic IBC containers containing Class II and III combustible liquids, NFPA 30 provides sprinkler protection design criteria for both one and two container high storage in Table 16.5.2.9 NFPA 30 (2018).

For *protected single and/or double rack storage of listed* rigid nonmetallic IBC containers containing Class II and III combustible liquids, NFPA 30 provides sprinkler protection design criteria for maximum 25-foot storage in a building with maximum ceiling height of 30 ft. Please refer to Table 16.5.2.10 NFPA 30 (2018). Protection includes ceiling sprinkler design criteria as well as the installation of horizontal barriers within the racks and in-rack sprinklers.

Protection alternatives

Protection alternatives should always be investigated (i.e., possible use of off-site IBC storage facilities, etc.). The following suggestions should be reviewed:

- The indoor storage of flammable or combustible liquids in nonmetallic or composite IBCs in plant production or warehouse storage areas should be prohibited.
- Attempt to arrange to store IBCs at a supplier location and receive the materials on a just-in-time basis.
- Consider such alternatives as designing and installing a properly protected bulk storage and piping system.
- Consider the use of steel 55-gallon drums or steel IBCs.
- Determine if nonmetallic or composite IBCs are the only method for receiving and storing flammable and combustible liquids in your plant.
- If the storage of nonmetallic or composite IBCs is necessary, they should be stored off-site or in detached, contained storage areas away from the plant or in commercially available flammable or combustible liquids storage structures designed for handling IBCs.

Detached storage building
(Picture courtesy of Chemical Specialties, Inc.)

- If the only option is storage of nonmetallic or composite IBCs in the plant, consider minimizing the storage within the key areas of the plant to one IBC tote in widely separated dispensing or end-use areas. Provide adequately sized containment areas or high-sided steel containment designed to prevent the sudden release of liquid. IBC totes should be provided with a double block to provide spill protection from potential damage to the dispensing valve.
- Isolate the storage of nonmetallic or composite IBCs from steel drums containing other combustible or flammable liquids.
- If necessary, the interior storage of IBCs should be limited to rooms with minimum two-hour fire resistance-rated construction and equipped as flammable or combustible liquids rooms as outlined in NFPA 30 and FM Data Sheet 7-29. Such rooms typically include adequate spill containment and/or drainage, automatic sprinkler protection and perhaps the use of aqueous film forming foam (AFFF) protection.

Note: A recently developed floor assembly and IBC storage product by Safespill Sytems provides spill containment and removal to eliminate a spill pool fire potential with the interior storage of the IBCs. The grated floor drainage assembly has been tested and approved by FM Global. FM Global has also developed a new Approval Standard 6090, *Ignitible Liquid Drainage Floor Assemblies* (May 2017), based on research results and test protocols. There is potential here to negate the need for constructing flammable liquids rooms or larger drainage retention schemes which could conflict with environmental regulations. If it is necessary to locate the storage of nonmetallic or composite IBCs with flammable and/or combustible liquids located inside a building, consideration could be given to the use of the above storage, spill containment and removal floor assembly product.

Interior protected IBC storage unit
(Picture courtesy of Safespill Systems)

In addition to the above, several mobile prefabricated metal IBC storage units are manufactured by Denios, Minimax Mobile Services and others that provide spray protection and spill containment inside the storage unit.

Mobile prefabricated metal IBC storage unit
(Picture courtesy of Minimax Mobile Services)

We recommend that you consult with your local Willis Towers Watson Property Risk Control consultant, or insurance property risk control representative prior to product purchase and installation.

Additional information

For additional information on the storage and handling of flammable and combustible liquids, please refer to the following:

- National Fire Protection Association (NFPA) Flammable and Combustible Liquids Code (NFPA 30)
- Factory Mutual Loss Prevention Data Sheet 7-29 (Flammable Liquid Storage in Portable Containers)

Cost vs. safety

As previously noted, the handling of liquids in IBCs can yield significant cost savings and operating efficiency; however, the fire hazard posed by such large volumes of flammable and combustible liquids has been determined by fire tests to be more severe than the hazard posed by the storage and handling of traditional 55-gallon drum and/or smaller capacity containers. In addition, recent video evidence of industry accidents seem to reveal increased potential for flash fire threatening injury to workers involved in activity at or nearby composite IBCs. It is rare to see grounding and bonding of composite IBCs, but these may still be involved in dispensing operations on factory or warehouse floors. Please discuss any proposed plans or existing storage situations for flammable and combustible liquids with a property risk control consultant before reaching a final decision.

Contacts

If you would like additional information on this or other risk control topics, contact your Willis Towers Watson client relationship manager, property risk control consultant or:

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