

FLAMMABLE/COMBUSTIBLE LIQUID STORAGE IN INTERMEDIATE BULK CONTAINERS

ALLIANZ RISK CONSULTING



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This Tech Talk focuses on the fire hazards associated with intermediate bulk containers (IBCs) containing flammable or combustible liquids and ARC fire protection recommendations.

AT-A-GLANCE

- Facilities that use IBCs for flammable or combustible storage are often unaware of the severe fire hazard.
- There are only a limited number of accepted fire protection schemes for flammable and combustible liquids in plastic IBCs.
- The client and Allianz Risk Consulting should work closely together to develop a loss mitigation strategy when there are no fire protection options available for flammable or combustible liquids in plastic IBCs.



Composite IBC

INTRODUCTION

Intermediate bulk containers (IBCs) are closed vessels used to store and transport liquids with a capacity from 450 to 3,000 liters (120 to 795 gallons), with the typical size being approximately 1,000 liters (275 gallons). These containers are popular for shipping large quantities of liquids to industrial locations.

TYPES OF IBCS

IBCs are typically constructed of metal and/or plastic.

Metal IBCs are typically a one-piece steel body with a single-seam weld. They can be constructed from stainless or carbon steel. If a relief valve is installed, it is considered a relieving-style container, which is designed to release excess internal pressure when exposed to fire.

Plastic IBCs are typically a combination of blow-molded plastic containers within a plastic frame or a steel cage. Plastic containers in a steel cage are often referred to as composite IBCs. There is no concept of a relieving-style plastic IBC due to the very nature of the construction materials.

All IBCs are provided with a discharge valve for dispensing and a pallet frame made of wood, plastic or metal that is needed to transport the IBC by lift truck.

HAZARDS

FIRE

When exposed to fire, metal IBCs without a pressure relief device can dramatically build pressure within the container. This can lead to a phenomenon very similar to a boiling liquid expanding vapor explosion (BLEVE), which can cause significant damage.

Plastic or composite IBCs will melt quickly in a fire, allowing large quantities of liquid to spill and rapidly spread over a large area. Most of the time, the failure occurs at the IBCs' weakest point which is where the discharge valve is welded to the body of the container. If combustible or flammable, the liquid may spread on the floor and ignite, creating what is called a pool fire. Depending on the viscosity of the liquid and the slope of the floor, 1 m³ (265 gallons) of liquid can spread across more than 300 m² (3,230 ft²) of floor area. A pool fire of this size can quickly overtax any sprinkler system.

Rigid plastic or composite IBCs can be UL Listed, which are designed to resist fire exposure for a duration of 20 minutes without breaching or leakage. The listing and labeling requirements are set by UL 2368, *Standard for Fire Exposure Testing of Intermediate Bulk Containers for Flammable and Combustible Liquids*, and FM 6020, *Approval Standard for Intermediate Bulk Containers*. It is important to note that the liquid used during the UL 2368 test is mineral oil, which is a Class IIIB liquid with a flashpoint far above 93°C (200°F). While it is known that listed IBCs have better fire performance than IBCs that are not listed, there is no information regarding their performance when filled with liquids with a lower flashpoint. The storage of flammable or combustible liquids in plastic IBCs, whether listed or not, is a serious fire hazard that is often misunderstood and underestimating this hazard can result in a major fire loss.



Pool fire during a test with an IBC filled with flammable liquid. Allianz ©

THERMAL DECOMPOSITION

Thermal decomposition can occur in either metal or plastic/composite IBCs. The decomposition temperature of a liquid is the temperature at which it chemically decomposes into other compounds. The reaction is usually endothermic, which absorbs heat that can create a thermal runaway and possibly an explosion.



Example of a fireball created by a 900 L (238 gal) composite IBC (thermal decomposition phenomenon)

STATIC ELECTRICITY

While the static electricity hazard with metal IBCs can be easily managed by proper grounding, plastic IBCs are nonconductive or insulating by nature. They can resist the flow of an electric charge which can cause the accumulation of static charge (charge retention). Filling operations, flow through pipes or mechanical agitation (mixing) in the IBC can generate and accumulate a charge of approximately 25 mJ for low conductivity liquids. Based on the minimum ignition energy for most flammable liquid vapors being less than 1 mJ, the potential for ignition is quite high.

There are current developments to make plastic IBCs electrically conductive by adding a compound to the outer layer of the container which can dissipate the static charge that accumulates.

CODES/STANDARDS/REGULATIONS

United Nations (UN) Regulation states that any liquid with a flashpoint below 60°C (140°F) must be electrostatically discharge protected, but there are no restrictions regarding the use of plastic IBCs with flammable liquids.

The US Department of Transportation (DOT) permits the shipping of combustible and flammable liquids in a large range of IBCs, including plastic IBCs. This creates confusion because many companies believe this regulation allows IBCs to be used in industrial storage or process occupancies. Adding to the confusion, NFPA 30, *Flammable and Combustible Liquids Code*, doesn't specifically prohibit the storage of combustible liquids in plastic IBCs, even though there are no acceptable fire protection schemes for IBCs that are not listed.

Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) is a regulation of the European Union (EU), adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, but it does not address IBCs. The EU Classification, Labeling, and Packaging (CLP) regulation does not address IBCs. Nevertheless, it is understood that to comply with the regulation, companies must identify and manage the risks linked to the substances they manufacture and market in the EU. They must demonstrate how the substance can be safely used and communicate the risk management measures to the users.

LOSS EXPERIENCE

Magnablend, Waxahachie, Texas USA: On October 3, 2011, this 12,000 m² (100,000 ft²) chemical facility suffered a fire involving plastic IBCs containing mineral oil that burned for four days, consuming most of the premises. While the plant was equipped with adequately designed sprinkler systems, the fire could not be controlled due to the pool fire behavior of the flammable and combustible liquids. During the fire, firefighters were forced to quickly pull back. During the retreat, a fire engine was engulfed by the fire and destroyed as the flames and liquid spread quickly across the ground.



Magnablend fire in 2011

Cosmetic facility, France, 2016: While transporting a metal IBC containing flammable liquid to a 600 m² (6,500 ft²) storage room, the forklift operator dropped the IBC on the ground. The fill cap wasn't fully closed, allowing the flammable liquid to spill onto the floor. The flammable vapors encountered an ignition source and a fire ensued. The sprinkler system activated, but was quickly overwhelmed. More than 70 sprinklers operated at the ceiling and more than 90 sprinklers operated in the racks.



Storage room after the fire

These events demonstrate how quickly a pool fire involving flammable and combustible liquids from IBCs can spread and damage a facility.

ARC RECOMMENDATIONS

The use of IBCs is very common in industrial locations and will continue to be for the foreseeable future. Due to the serious fire hazards associated with combustible and flammable liquids in IBCs, our best advice is to store them outside in a detached structure, a minimum of 15 m (50 ft.) from any important buildings or equipment.

When this is not possible, metal IBCs containing flammable or combustible liquids can be stored in properly designed fire cutoff rooms provided with protection features outlined in NFPA 30, *Flammable and Combustible Liquids Code*, or FMDS 7-29, *Ignitable Liquid Storage in Portable Containers*, FMDS 7-32, *Ignitable Liquid Operations*, and FMDS 7-83, *Drainage and Containment Systems for Ignitable Liquids*. Relieving-style metal IBCs are always preferred. When metal IBCs cannot be utilized for flammable and combustible liquids, the following recommendations should be considered:

1. Prohibit the storage of Class I flammable liquids (any liquid that has a flash point below 38°C (100°F)) in plastic or composite IBCs. This is a very serious fire hazard which should be addressed immediately by removing these IBCs from the facility.
2. Store Class II (any liquid that has a flash point at or above 38°C (100°F) and below 60°C (140°F)) and Class III (any liquid that has a flash point at or above 60°C (140°F)) combustible liquids in UL Listed IBCs and store in a fire cutoff room provided with protection features outlined in NFPA 30 or the above FM Global Data Sheets. It is important to note that listed IBCs represent less than 0.01% of the IBC market. There are only two listed IBCs in the UL Directory and none currently referenced in the FM Approval Guide.
3. When listed IBCs cannot be used for the storage of Class II and Class III combustible liquids, the hazard should be discussed with the local ARC engineer and a strategy for loss mitigation should be developed. It is important to understand that flammable and combustible liquids in plastic or composite IBCs that are not listed cannot be properly protected and any strategy that is employed will assume inadequate protection. There are some international standards which provide protection strategies for plastic and composite IBCs, but they are not based on documented fire testing and should not be used. The following should be considered when listed IBCs are not available:
 - a. For a single plastic or composite IBC, install a large spill control apparatus that is FM Approved per Class Number 6086, *Approval Standard for Storage Containers for IBCs*. These storage units are intended to capture the majority of a liquid release within a footprint designed to limit the size of a potential pool fire. Limiting the size of the pool fire within the storage unit is expected to greatly limit the damage to the surrounding area in a fire. These units are approved to house a single IBC that contains a combustible liquid when located within a manufacturing or industrial environment. This is a good alternative for a facility that uses a small number of plastic or composite IBCs.



MINIMAX Fire Protection Trough for IBCs. Minimax ©



Alternative storage system including active drainage and fire protection system. Safespill Systems ©

- b. Store these liquids in a 4-hour fire rated cutoff room adequately designed with drainage, containment and sprinkler protection. The 4 hour fire walls should be designed and constructed as a High Challenge Fire Wall in accordance with NFPA 221, *High Challenge Fire Walls, Fire Walls and Fire Barrier Walls*. The fire walls and protection systems should be specifically designed to prevent the fire from spreading into adjacent areas, understanding that the fire involving the IBCs in the cutoff room will not be controlled. A loss of the entire cutoff room and its contents is expected with this strategy.
- c. Employ the use of an active drainage system based on FM Class Number 6090, *Standard for Ignitable Liquid Drainage Flooring Assemblies*. This testing approval is focused on the reliability, effectiveness, and robustness of the system and was written in a way that it can be used for several different applications. In some cases, this requires additional performance testing witnessed by key stakeholders. This is a new type of fire protection approach based on the removal of fuel. The system uses a hollow aluminum floor with sensors to detect a liquid spill. If liquid is detected, it is quickly removed by pressurized water jets and a pumping system for transfer to a separate containment system. The liquid is actively removed, thus ARC considers it an active drainage system. These active drainage systems are currently limited to 120 IBCs. This technology is clearly new, so care should be taken when considering this as an option.

REFERENCES

- NFPA 30, *Flammable and Combustible Liquids Code*
- FM Global Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*
- FM Global Data Sheet 7-32, *Ignitable Liquid Operations*
- FM Global Data Sheet 7-83, *Drainage and Containment Systems for Ignitable Liquids*
- FM Class Number 6090, *Approval Standard for Ignitable Liquid Drainage Floor Assemblies*
- FM Class Number 6086, *Approval Standard for Storage Containers for IBCs*
- Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

QUESTIONS OR COMMENTS?

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