



Static

Electricity

The Hidden Danger in Hazardous Areas

National Fire Protection Association (NFPA) codes and guidelines highlight safe working practices in hazardous areas, and specifically how to control static electricity, which in many cases is capable of providing the ignition source for a fire or explosion. All of us responsible for, or working in, potentially explosive atmospheres are aware of the fact that we must eliminate all potential sources of ignition, including naked flames, hot surfaces and electrical sparking (Figure 1). However, many plant fires and personnel injuries can be directly linked to a static spark igniting a vapor, gaseous or dust atmosphere. In the United States, the NFPA reports an average of 280 serious “static-caused” incidents reported to fire departments annually, resulting in direct property damage, injury or fatalities, lost production and environmental impact. Furthermore in today’s news-hungry world, bad news travels fast, and such incidents can have an extremely negative effect on an organization’s good name and even stock price. Recent incidents in the chemical processing sector have intensified the general awareness of the hazards arising from static electricity, particularly in operations involving flammable solvents and many other flammable, low-conductivity materials.

Static Electricity

The phenomenon of static electricity is ever-present, and is generated continuously through relative motion – in other words whenever surfaces of materials come into contact and separate. Typical examples of this from the workplace could include liquids flowing through pipelines or filling into drums and tanks, powder dropping down a chute – and even a person walking across an insulating floor.

However the generated charge only becomes a problem in hazardous areas when it is allowed to accumu-

late on objects that are not at ground (earth) potential. In these cases, a significant potential (voltage) can develop and, depending on the characteristics of the ungrounded object, this may have many times the minimum ignition energy (MIE) of the surrounding flammable atmosphere. In spite of these characteristics, provided proper working practices are observed, there are effective ways to deal with this unseen danger.

Grounding and Bonding

Grounding and bonding techniques work on the assumption that if conductive or static dissipative plant, equipment and materials are used, and providing these materials are properly “bonded and grounded,” it will be impossible for dangerous levels of static electricity to accumulate and eventually result in an uncontrolled discharge.

Many national and industry codes of practice and technical standards exist, including NFPA77 (Recommended Practice on Static Electricity) and NFPA30 (Flammable and Combustible Liquids Code). These codes are extremely useful in that they provide us with practical examples of common operations, and detail effective ways to eliminate, control or mitigate the problem. Where all the recommendations tend to converge is in the advice to always use conductive or static dissipative materials, and to ensure effective bonding and grounding. In this context, the term “conductive” would apply to metal materials such as carbon or stainless steel, aluminum, etc., and “static dissipative” may indicate rubber or plastics with some added semi-conductive element. “Bonding” means linking together these objects by means of a suitably strong conductor (wire), and “grounding” refers to a true “ground/earth” connection applied to one or more of the bonded objects. One or both of these techniques are typically applied, and in doing this while maintaining a low-resistance connection between the

objects and ground, we prevent dangerous levels of static charge from accumulating (Figure 2).

However what if the organization has elected to use non-conductive (insulating) materials in the hazardous area – perhaps in the form of drums, containers, pipes, hoses, IBCs and more? The drivers for this decision may be unit cost, weight, product compatibility, or just plain ignorance of the inherent dangers.

Bulk Containers

The need to improve efficiency and reduce costs has often led to materials being stored, loaded and moved in larger (intermediate) bulk containers. Today, it is quite common for liquids to be transported in IBCs in excess of 500 gallons, and powdered/loose solid materials in FIBC “supersacks” exceeding 5,000 lbs. In addition to fully conductive (metal) constructions, these larger containers may be produced from molded plastic, as with rigid IBCs and polypropylene fabric in the case of FIBCs. Addi-

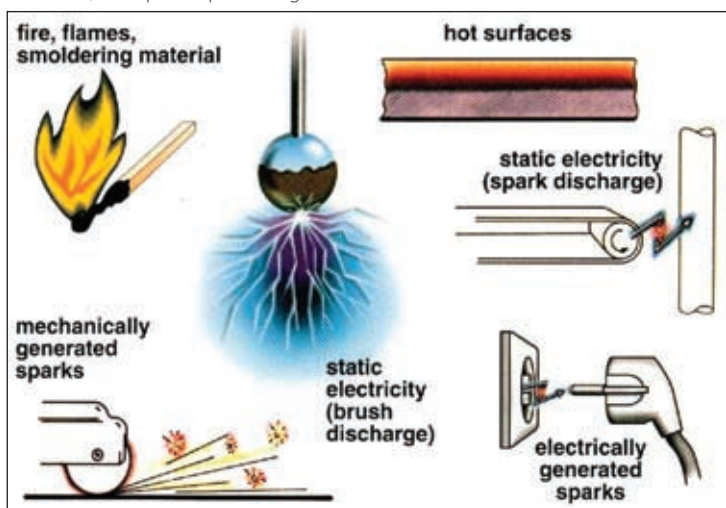
tionally, pipes and ductwork used to transfer these products are sometimes lined with insulating materials such as PTFE, for corrosion resistance, hygiene or avoidance of contamination. Furthermore it is still quite common to see flammable or combustible liquids shipped inside plastic 55-gallon drums. This use of insulating materials presents three areas of risk in flammable atmospheres.

1. The liquid or powder in the container is quite likely to have built up an electrostatic charge during transfer or mixing operations; even a conductive liquid will retain its charge, as the insulating container or pipe will prevent it from dissipating to ground. This could lead to a static discharge from the surface of the material if, for example, it was approached (for instance) by someone holding a conductive sampling container that may be grounded or simply at a lower electrical potential.

2. An insulating container will accumulate a static charge on its surface during filling, in a similar manner to a non-grounded conductive (metal) one. When the electro-static field reaches the breakdown strength of air, a brush discharge could occur at the container surface. While likely to be less energetic than a spark from ungrounded metal, it can still ignite many solvent vapors and occasionally, certain dust clouds, particularly the low MIE powders used in modern pharmaceutical operations.

3. The insulating container could allow a metal part, such as a discharge valve, to become an “isolated conductor,” which could give rise to energetic spark discharges. Even a metal tool placed on top of a plastic IBC could become charged and spark to the unit’s metal strengthening frame. Large plastic containers can also cause a charge to be induced on nearby objects or personnel. This is particularly true of insulating FIBCs.

FIGURE 1 | Examples of possible ignition sources.



Warning!

There is a common misconception that simply attaching a grounding lead to an insulating plastic container will make it safe. This is certainly not the case, as the insulating properties of the container will prevent charge moving towards the lead and down to ground. Likewise, a lead attached to the metal frame of a regular plastic IBC will only discharge static electricity from the cage itself – not from surface areas of the plastic “bottle” away from direct contact with the frame.

It should also be noted that even when conductive or dissipative containers are correctly grounded, any low-conductivity (liquid) or resistive (powdered) contents may retain charge for some considerable time. Liquids that are conductive will lose their charge rapidly if the correct grounding conditions are met, but many powders tend to be highly resistive.

If there is still a need to move away from metal (conductive) packaging, owing to recent developments in modern materials technology, it is now possible to obtain static dissipative plastic drums, kegs, IBCs, FIBCs, hoses and piping materials specifically designed for use in hazardous areas.

Rigid IBCs

Large plastic (Rigid) IBCs are now available with a complete steel shroud, in addition to their strengthening cage, which will prevent discharges from their surface, providing they have been suitably grounded using a bonding lead and clamp. They may use a conductive valve, protruding into the liquid, to give a reliable static dissipation path. Using a different approach, but giving a similar result, kegs are now being produced from plastics that contain a conductive substance,

(usually carbon). These should have an electrical resistance of less than 1×10^8 ohms, and are designed to dissipate static electricity. This will prevent the risk of brush discharges from their surface, and will give a path for controlled static electrical discharge of their contents. In all cases, these type of containers should be suitably grounded using a bonding lead and clamp, or some other reliable way of imposing a bonding and grounding connection (Figure 3).

Flexible IBCs

Flexible IBCs are categorized into four categories; A, B, C and D by International codes of practice, and of these Types C and D are intended for use in hazardous areas. The type C variety typically contains thin conductive strips spaced closely together in the polypropylene weave. All these strips are interconnected at the seams, and via the lifting handles and a labeled grounding point. These conductive parts will carry away any static electricity on the surface of the bag, and provide a path to dissipate static electricity from the powders within. Type C bags proved to be safe for use in flammable atmospheres, providing they have been grounded using a suitable bonding lead and clamp.

A common concern with these bags is the uncertainty of whether or not a proper ground path has actually been achieved, and a solution to this problem may be found in Static Ground Indicating Systems, specially designed to work with static-dissipative plastics, including type C FIBCs. Besides monitoring the ground connection, these systems have the added benefit of ensuring that the correct type of IBC, keg or conductive liner is being used, and importantly, that it is working within its specification.

The Type D container uses a different method to dissipate static electricity, usually by emitting many low-energy corona discharges from its surface, with insufficient energy to ignite the surrounding atmosphere. These containers do not require grounding in themselves, but all adjacent metalwork (and operating personnel) must be properly grounded to prevent an induced charge from accumulating. In both cases, the ignition energy of the flammable area and the operational factors should be carefully considered before deciding on which of these containers to use.

Recent developments have also seen the introduction of static dissipating plastic drums, offering a compromise to those organizations that cannot use steel or stainless steel for reasons of corrosion, contamination or weight loading. In addition to static dissipating drums, conductive linings may be used in conjunction with conductive (steel) drums. When properly bonded and grounded, these linings provide an effective path to dissipate static electricity, while at the same time protecting the product and drum against corrosion, contamination or residue.

Care should be taken to ensure truly conductive lin-

FIGURE 2 | Drum grounding during flammable product transfer.



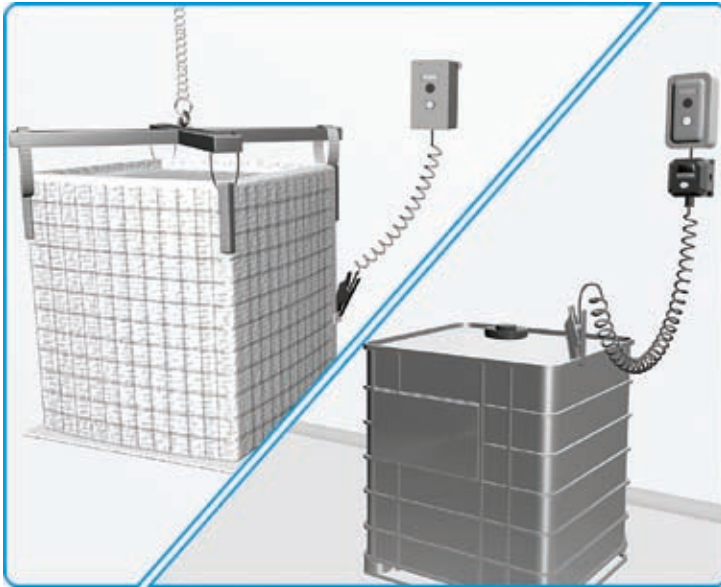
ings are used, as opposed to anti-static, the latter of which is only capable of preventing a significant charge build up on the lining itself, but which may still render the contents insulated from the outside container.

If a pipeline or flexible hose is made from insulating plastic or lined metal without any specific bonding mechanism, its contents will be prevented from dissipating static electricity through the pipe wall to ground. However, by introducing a static-dissipative “Grounding Paddle” between flange connections, with an external bond to the grounded metal pipe or other suitable ground, several static dissipation paths along the length of the pipe are provided, enabling charge to relax from even low-conductivity solvents. Grounding paddles are available for all common pipe diameters to ensure that the contents of lined pipes can dissipate their static, while flowing along the pipe.

Conclusion

The reasons that motivate an organization to use plastic (insulating) materials in hazardous areas, or to ship flammable or combustible materials in plastic non-conductive containers may be a result of any combination of cost, efficiency and technical factors. However the organization should always be aware and conduct a thorough study on the likely impact to plant and personnel safety during the entire handling or processing cycle. In general, conductive and static dissipative materials are recommended by all common national and industry guidelines. Under no circumstances should the decision be based on ignorance of the inherent dangers as the consequences for the safety of people, damage to property and lost production could be catastrophic, as a number of organizations have found to their cost in recent years.

FIGURE 3 | Static Ground Indication with IBC and FIBC.



The following is a checklist for effective static control in hazardous areas:

- Identify hazardous areas and processes where static electricity may accumulate.
- Specify conductive or static dissipative items of plant, equipment and packaging. Only use insulating plastics after carrying out risk assessment/hazard evaluation.
- Ensure that correct grounding and bonding, and other prevention techniques are in place, and are properly maintained.
- Provide on-going training and awareness for employees and contractors into safe working practices in hazardous areas.

Reference Sources

1. NFPA 77 – Recommended Practice on Static Electricity – 2007 edition.
2. NFPA 30 – Flammable and Combustible Liquids Code – 2003 edition.
3. British Standard 5958 Control of Undesirable Static Electricity (1991).
4. Cenelec Report TR 50404 Avoidance of Hazards due to Static Electricity (1999).

Newson Gale is dedicated towards preventing fires and explosions in industrial hazardous locations through effective control of static electricity. As leaders in the field, we are committed to providing customers with sound technical expertise when evaluating potential risk.

Newson Gale's Cenelectrex® line of products prevents static charge accumulation through practical and innovative design, offering customers a full range of static control solutions. These include intrinsically safe monitoring, interlock and indication systems, as well as grounding and bonding clamps, cables and devices, designed to control these risks and provide optimum safety in hazardous operating environments.

For further information contact Graham Tyers at graham@newson-gale.com, phone 732/987.7715, or visit the website at www.newson-gale.com.

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