Static electricity is a commonly known fire hazard, which can originate disruptive discharges (sparks) capable of igniting flammable atmospheres. This risk topic deals specifically with the aspects related to flammable liquids’ dispensing and summarizes the main preventive measures that can effectively contribute to the reduction or avoidance of these risks.

Generation of electrostatic charges

Static electricity is an uneven distribution of electrical charges on the surface of two materials that are in contact. It is caused by the transfer of electrons between materials, which creates an electric potential difference. If this difference is high enough, it can originate a disruptive discharge (spark) between the materials and, when a flammable atmosphere is present, a fire could be started.

Static electricity generation during flammable liquids transfer operations can be due to multiple causes:

- movement of flammable/combustible liquids through pipes, hoses or valves;
- projection of the liquid though the discharge point;
- turbulence generated by the liquid falling into the container;
- mixing and stirring, etc.

The rate of electrostatic charges’ generation depends on the materials used (on pipes, containers, hoses), the physical properties of the flammable liquids (conductivity), the filling speed, the environmental conditions (humidity), etc.
Bonding and grounding

The use of bonding connections between equipment allows the electrostatic charges generated during the dispensing operations to dissipate, avoiding their accumulation. Grounding dissipates the excess charges of the system to earth.

Figure 1 represents an example of equipotential connections and grounding in a flammable liquids transfer system. It is possible to observe that all containers are connected by a conductive copper wire that is at the same time connected to a common earth/ground (having separate grounds could imply differing potentials).

Containers must be connected even if they are in contact with each other, as paints and other coatings may reduce the conductivity. The simple contact between equipment/containers does not guarantee an effective connection. On the other hand, it is possible to create an effective connection if the hose is conductive and the nozzle is in contact with the container. However, systematic use of bonding techniques is highly recommended.

All connections must be made before the transfer operation begins, taking care of locating the connection points away from the containers openings.

As mentioned before, paints, coatings or product accumulation can be in some occasions thick enough as to avoid electrostatic charges dispersion. The solution in this case is to use grounding clamps connected to a monitoring electrical circuit that confirms the low resistance connection is working. Additionally, these devices can be equipped with a blocking system that interlocks with the pumps, valves, etc. preventing the system from operating if safe conditions are not present.
If the transfer operations usually take place in a specific area of the facility, the risk of accident can be reduced by installing fixed grounding connections, etc.

Containers

Paying attention to the materials of the containers ensures safer operation. The use of conductive materials (low electrical resistance) contributes to a better distribution of charges between the containers. It is possible to use dissipative materials too (materials difficult to charge and with a low charge transfer speed), that are adequate for flammable liquid transfers if the connections are well placed.

Insulating/ non-conductive materials have to be avoided for this type of operation.

Other preventive measures

The use of bonding and grounding techniques is key to reducing the risk of fire. There are, however, other safety measures that can contribute to minimize electrostatic charges or increase their dissipation rate. Some of them are listed below.

- Control of the filling speed. The higher the speed of the liquids, the higher the generation of charges will be. Sprinkling, spraying, etc. should be avoided, for instance, with the use of discharging pipes or funnels which reach the bottom of the containers (at least up to 25 cm from the container bottom).

- Flammable atmosphere control. The use of forced ventilation (to avoid reaching the lower flammability level) or the creation of inert atmospheres using nitrogen or carbon dioxide can be of use in the handling of highly flammable liquids.

- Use of Ex-proof equipment. Electrical installations in the loading/unloading areas, portable pumps and electrical equipment should correspond with the adequate electrical protection category.

- Control of relaxation times. Once the dispensing operation is finished, it is advisable to wait some time before opening or closing lids, taking samples, etc. This relaxation time is established basically depending on the product, although one minute is considered acceptable for most of the liquids.
• Control of humidity. It is advisable maintaining a relative humidity above 60% in flammable environments. At these humidity rates, the formation of superficial water films that help to dissipate electrostatic charges is favored.

Figure 3. Electrostatic discharge of people. Courtesy of Newson Gale Ltd.

• Adequate working clothes and shoes. Personnel working in the dispensing areas should avoid synthetic fibers’ clothing and use cotton instead. Shoes should have conductive soles (it is recommended that the floor in these areas has conductive properties too).

• Use of antistatic additives. In some cases it is possible to add antistatic additives to the liquid that increase its conductivity, reducing the electrostatic charges formation.

• Adequate maintenance of equipment. All equipment used for the loading/unloading of flammable materials have to be inspected, tested and maintained regularly, and these operations should be registered. Where plastic or rubber pipe has to be used to absorb vibration grounding wires have to be provided to join the metal pipe at either end. Plastic pipe is available with an integral grounding wire, it is very important that this is connected correctly.

• Electrostatic discharge of personnel. There are devices designed for the electrostatic discharge of people available in the market, as a previous step to the dispensing operations.

• Personnel training and procedures. Personnel doing these operations should know and comprehend the characteristics and risk of the products and the necessary safety measures. The existence of written protocols, procedures and instructions favors the fulfillment of these measures.
References

- NFPA 30. Flammable and combustible liquids code
- OSHA (Occupational Safety and Health Administration, USA). Standard 1910.106. “Flammable and combustible liquids”.
- CCPS Process Safety Beacons
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