

Technical Information: Explosion Protection

A.1 Explosion Protection

Causes of Explosion

An explosion is defined as a sudden reaction involving a rapid chemical oxidation of a flammable material with oxygen causing a simultaneous increment in pressure, energy and temperature. The explosion and fire can be occurred if the following three factors exist, in the right ratio, at the same time.

- Flammable material
- Oxygen in the air
- Source of ignition

Flammable materials may be presented in forms of gases, vapors, mists or dusts. If they are mixed with air within a certain concentration range, the explosive atmosphere will then occur. The explosive limit is a boundary between the minimum lean of fuel mixture called lower explosive limit (LEL) and the maximum rich of fuel mixture called upper explosive limit (UEL). Under the LEL or over the UEL, this mixture cannot be ignited. The explosive limit also depends on ambient pressure and level of oxygen enriched in air.

In chemical process areas and workplaces -such as oil refineries, gas separation plants, gas stations, paint workshops, spray booths, alcohol plants, petrochemical factories, mills, grains, wood and paper works- the flammable substances and oxygen in the air are normally present. If they are in sufficient quantities to form an explosive atmosphere, these shall easily be ignited by any sources of ignition. The sample of ignition sources that can cause explosion are:

- Hot surfaces of machine and equipment
- Flame and hot gas
- Arcing or sparking of electrical parts
- Mechanical and frictional spark
- Lightning strike
- Discharge of an accumulated electrostatic charge
- Electromagnetic wave
- Optical radiation
- Chemical reaction

Explosion Protection

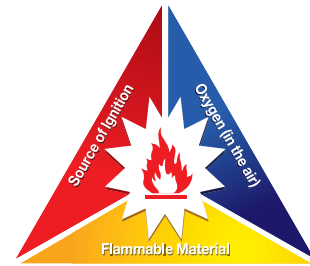
Primary explosion protection is measure to prevent the formation of an explosive atmosphere. This can be achieved by:

- Avoid or restrict the release of any flammable substances
- Increasing of air circulation, air flushing by artificial ventilation or natural ventilation
- Deactivation by adding nitrogen, carbon dioxide
- Monitoring and limiting of the flammable concentration (i.e. a gas detection system)

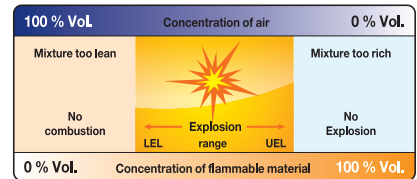
Practically, we know that it is not easy to eliminate the release of flammable substances in process areas also replacing the atmospheric oxygen is not an option for areas where people work. So the explosive atmosphere cannot be completely avoided by the primary measures.

The secondary explosion protection is then needed to prevent the ignition of explosive substances. This can be achieved by preventing any source of ignition from the explosive substances and other measures taken to reduce the effects of an explosion to a negligible or insignificant level by:

- Avoid using equipments that generates energy, directly and indirectly, in hazardous area. The energy includes arc, spark and high thermal.
- Using equipment which its surface temperature lower than the ignition temperature of flammable substance in such areas
- Limit the energy usage for electrical equipment to a safety level (i.e. intrinsic safety method)
- Limit the result of explosion which may occur within an enclosure (i.e. flameproof enclosure)
- Limit arc or spark in electrical enclosure by other measures (i.e. powder filling, encapsulation, oil immersion)



3 - Factors for fire and explosion incident



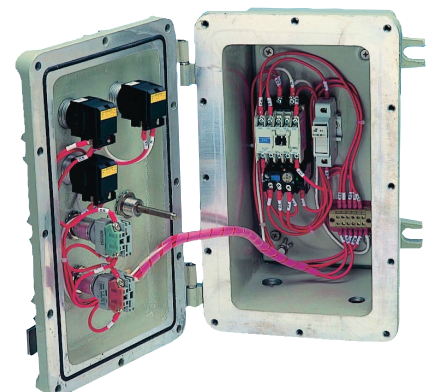
The explosive limit of flammable or combustible materials



Petrochemical plant



An explosion incident in hazardous area



Electrical equipment within the flameproof enclosure