

Pollution control and safety

Safety aspect's and pollution control:

General:

Hydrogen forms inflammable and explosive mixture with oxygen and other elements. The envisaged large-scale introduction of hydrogen as an energy carrier requires a comparative evaluation of safety aspects with regard to other fuel. Volumetric leakage of hydrogen gas will be 1.3 – 2.8 time as large as gaseous methane leakage and approximated four times that of air under the same conditions.

Fire hazard's:

The minimum energy for ignition of hydrogen air mixture is extremely low. However the ignition energy inherent in virtually every source is more than sufficient for ignition of any other fuel-air mixture.

Hydrogen flames are nearly invisible in day light hydrogen fires last only one fifth to one tenth of hydrocarbon fires, and the fire damage is less sever because of several characteristics.

1. High burning rate resulting from rapid mixing and high propagation velocity.
2. High buoyant velocity.
3. High rate of vapor generation of liquid hydrogen.

Although the maximum flame temperature is not much different from that of other fuels, the thermal energy radiated from the flame is only a part of that of a natural gas-flame. Smoke, inhalation, one of the major causes of injury and therefore a main parameter of fire damage is considered less serious in the case of hydrogen because the sole combustion product is water vapor.

Explosive hazards:

High laminar burning velocity as well as the high laminar flame speed of hydrogen makes the transition (DDT) than hydrocarbons hydrogen has by far the widest limits of dilatibility; detonation of sto-spaces will produce a static pressure rise of 15:1.

Explosions are rated in terms of the amount of energy released, commonly expressed as an equivalent quantity of TNT. Hydrogen is most potent on a mass basis and least potent on a volumetric basis. It has also the least theoretical explosive potential, when equivalent energy storage is taken into account

Preventive measures:

In safety concepts, distinctions are made between primary secondary and tertiary measures. Primary safety precautions aim at the exclusion of causative risks such as leakage, formation of explosive mixtures by proper conceptual design. Secondary measures consist mainly in the avoidance of ignition sources of any kind. Tertiary measures should minimize dangerous results in case fire or explosion occurs. This is achieved by installation of explosion proof or explosion relief system, hydrogen process shutdown systems and suitable fire extinguishing system.

Safety regulations:

Regulation and standards apply for the safe production, storage and handling of oxygen. They are mostly concerned with transportation, and other operations are covered by more general regulation. Safety regulation in India.

Toxicology:

Hydrogen does not show any physiological effect. It is non poisonous. Inhalation of the gas leads to sleepiness and a high-pitched voice. A danger of asphyxiation exists if the oxygen contents sink below 18-vol% because of hydrogen accumulation in the air direct skin contact with cold gaseous or whitish coloring of the skin and to frost bite. The risk is higher than e.g. with liquid nitrogen because of the greater temperature differences and the higher thermal conductivity of hydrogen.

Storage:

Conventional methods for storing hydrogen are well proven and in service. Depending on the end use. Different types of storage systems:

1. Stationary, large size storage systems,
2. Stationary, small size storage systems,
3. Mobile storage systems.

In all these types of storage systems hydrogen can be handled in the gaseous (GH_2) or liquid (LH_2) state. Now more new concept, such as absorption in metals and cry absorber storage systems are being developed with a view to future use.

Compressed hydrogen storage:

Pressure storage systems of various sizes and pressure ranges are considered state of the art. The same applies for temporary storage in pipelines. Low-pressure and high pressure systems are suitable for the storage of day or week supplies. Underground storage in caverns is expected to be possible storage pressure is up to 16Mpa, gas up to 1-3% of the storage capacity are foreseen.

Liquid hydrogen storage:

The technique for liquid Hydrogen storage is well developed it is used for storage, transport, and distribution of hydrogen. The vessels are insulated with double walls; the space between the inside and outside wall is evacuated and filled with partite.

