

Gas explosions



TNO offers expertise in all aspects related to safety of dangerous goods.

- Production
- Processing
- Storage
- Transport

Ignition of a mixture of a flammable gas or vapour with air can lead to a devastating explosion. Whether or not a certain mixture can explode depends on the type and the concentration of the gas or vapour involved. When these characteristics are known, measures can be taken to prevent a flammable mixture from exploding.

If preventive measures are not adequate an explosion may occur resulting in considerable damage to property and possibly in injuries and fatalities as well.

The destructive power of a gas/vapour explosion depends to a large extent upon:

- confinement inside a building;
- the presence of obstacles such as equipment, vessels, pipe systems and other installations.

Explosion mechanism

The overpressure in an exploding gas cloud is generated either by confinement of the expanding gases or by an increase in burning rate, i.e. the increase of the flame surface and/or flame speed.

Confinement, for instance, occurs inside a building or in a vessel. If no vent openings are available, pressure may at least increase by eight to ten times the initial pressure.

Increase of flame speed and flame surface occurs due to friction with pipes, walls and the turbulence generated in the wake of obstacles that stand in the way of the expanding flow ahead of the flame.

A self-enhancing mechanism is created, which is responsible for very high overpressures.

Explosion characteristics

Test facilities are available for determining the characteristics of gases and vapours or mixtures at various initial conditions.

These characteristics include :

- explosive properties;
- minimum ignition energy;
- auto ignition temperature;
- flammability limits;
- maximum explosion pressure;
- maximum rate of pressure rise;
- minimum oxygen concentration;
- inertisation requirements.

The tests are performed in compliance with accepted international standards.



Full scale test set-up of an off-shore platform.

Explosion protection

Combining facilities and expertise we are able to assist you with:

- advice on required vent area and vent location in rooms for storage of flammables or for gas heating installations;
- testing the explosion safety of machines and equipment;
- testing and design of vent and blast relief panels;
- testing and design of blast-resistant panels;
- calculation of explosion loads in all possible environments;
- audits of process installation regarding explosion safety;
- accident analysis;
- advice on preventive and protective measures.

Research

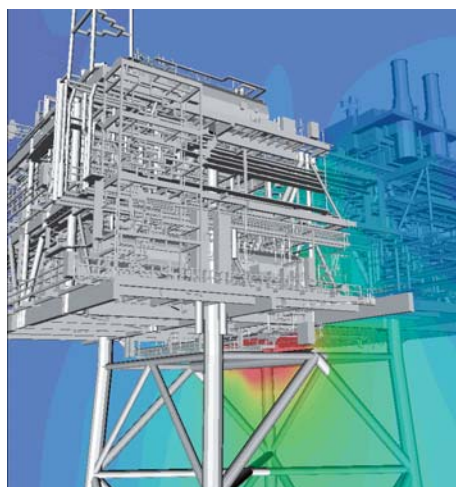
Research is being carried out continuously to maintain TNO's knowledge position.

In order to do so, we participate in international research projects.

Experimental research is performed on scaled-down models or on a realistic geometrical scale.

Theoretical research has led to a comprehensive understanding of the basic physics of gas/vapour cloud explosions. The complexity of all phenomena involved required the development of a computer code in order to be able to simulate an explosion.

This resulted in the three-dimensional Reactive Computational Fluid Dynamics code AutoReaGas™.



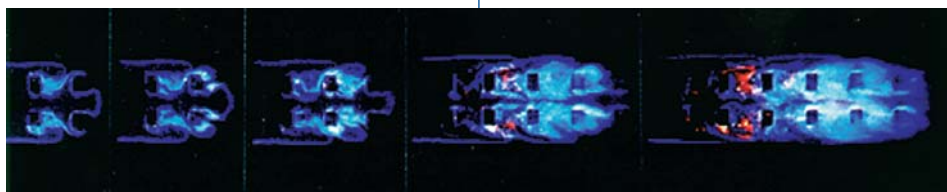
Simulation of a gas explosion in a specific environment with AutoReaGas™.

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Composition of successive pictures from a high-speed film showing the acceleration of the flame due to the presence of obstacles.

Process Safety and Dangerous Goods

Within the field of safety of dangerous goods and industrial processes, we offer services on:

- Process safety
- Product safety
- Explosion safety and control
- Product and process optimisation

Whenever possible, we endeavour to give added value to your investment in safety by combining safety with (economic) optimisation of design, maintenance, control and production. A team of specialists is available to apply the expertise for finding a solution to your problem.

Please visit our website at: www.tno.nl/prosafe