

Environmentally Sound Alternatives in Fixed Fire Protection Systems

Halons can be substituted nowadays by alternative extinguishers in nearly every application. Experience in recent years has shown that most fields of application can do without halogen-based fire extinguishers entirely, and use of these substances has become state of the art. The only limitations on their use are in some applications in aviation and certain military equipment. However, mere replacement of extinguishing agent is not always possible. Instead, a coordination of fire protection measures in terms of both construction and technology is required. Good construction planning and fire protection concepts adapted to individual situations can ensure equal safety standards in both new and old buildings.

Overview

As yet there is no fire extinguishing agent which can be used as a drop-in replacement for halons in fixed systems. However, the state of the art enables system solutions to achieve a comparable safety standard. Use of system solutions requires an overall assessment of the options on hand in each individual case with respect to construction, on-site technology and organisation.

There are currently many cases where HFCs have been eliminated entirely - also in sensitive areas - or where volume can be significantly reduced in its application through a combination of measures.

A case in point are water mist extinguishing systems that are used for fire protection in e.g. engine rooms, emergency power systems, computer rooms, hotels, offices, metro networks, and historical buildings.

Special small extinguishing systems with integrated fire detection technology whose extinguishing agent is nitrogen, argon or carbon dioxide were developed especially for server racks (1).

Relevance

Emissions from fixed fire extinguishing systems are not the greatest source of emissions of fluorinated greenhouse gases worldwide. However, the long life time of these systems results in a considerable stockpile that could potentially produce emissions over the course of many years. Besides potential false alarms the issue of disposal upon end of system life must be considered.

The diagram illustrates the expected growth of extinguishing agents if no further measures are taken. We assume that halon volumes (2) will partly be replaced by HFCs. In consideration of the growth in building stock to be equipped with fire protection systems, for industrialised countries (INDC) and developed countries (DC) an annual growth rate of 3 % until 2020 is expected (3). Thereafter, the growth market for HFC-based fire protection systems is expected in developing countries only because of the growing demand in these countries. More examples from actual practice with non-halogen extinguishing systems in place are detailed below.

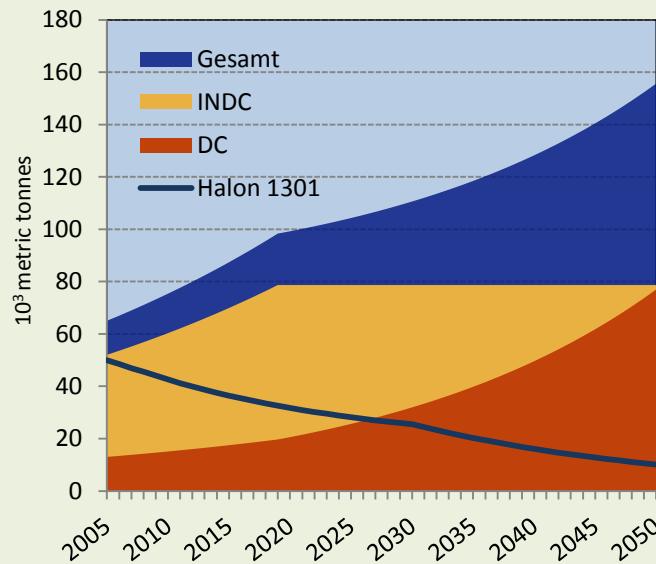


Fig. 1: Development of global stock of extinguishing agents in fixed fire protection systems (3)

Requirements of total flooding agents:

- High efficiency
- Minimal extinguishing concentration
- Little space for stockpiling
- Low pressure compensation
- Uncomplicated lead
- No chemical side-effects
- No toxic effects
- Climate friendly
- low extinguishing costs (9)

Fire protection in the steel industry might include:

- Portable fire extinguishers for early response
- Water mist extinguishing systems for cable channels
- Sprinkler systems for pumps and premises
- Fine water spray systems for stains
- Gas extinguishing systems for rolling mills
- Fire prevention systems for electrical switchgear stations
- Fire-resistant compartments for cables and pipe leads
- Fire doors, fire-resistant cable channels and other structural measures (4)(5)

Fire protection at power plants might include:

- Sealing of cables and pipe leads
- Water mist extinguishing systems for cable lines and transformers
- CO₂ low pressure systems for switchgears and turbines
- Foam extinguishing systems for coal storage silos and fuel tanks
- Water mist fire protection systems for generators and cable channel
- Gas extinguishing systems for control rooms
- Water mist extinguishing systems for conveyor belts
- Portable and wheeled fire extinguishers (6)

Possibilities for different applications

High foot traffic areas

Areas with a high rate of foot traffic such as event locations, airports, and fairgrounds pose a special challenge to fire protection efforts. Many fixed gas extinguishing systems must make provisions for forecast lead times. Sprinkler systems together with a combination of fire protection measures



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Allianz Arena in Munich

related to construction and organisation have proven themselves in practice, notably the Düsseldorf airport (Germany), the Nuremberg fairgrounds (Germany), and the Allianz Arena in Munich (Germany) (1).

Fire protection in the steel industry

There were at least nine fires in the steel industry worldwide during the last eight years, with total casualties amounting to 18, plus many more injured. Special risks exist in the steel industry. The extreme heat, complex production processes, the great number of synthetic materials, oil hydraulic lines, and stockpiles of oil make for a high degree of fire hazard. However, coordination of different extinguishing technologies can ensure optimal protection (4).

Portable or wheeled extinguishers based on powder, foam and CO₂ have proven themselves in the initial stage of a fire. Fire alarm systems detect fires round the clock. Sprinkler systems with foam additives can provide protection for production halls and oil storage space. Welding tools, rolling mills, stains and other machinery can be protected effectively by fine water spray extinguishing systems. Inert gas extinguishing systems provide protection of computer equipment and electrical enclosures (4)(5).

Complex fire protection systems tailored to meet the specific needs of a particular site have been installed, e. g. at HKM Hüttenwerke Krupp Mannesmann GmbH and the Elbe-Stahlwerk Feralpi steel mill in Riesa.

Fire protection in power plants

Depending on type of fuel the risk for a fire at a power plant is especially high. Fire safety schemes are very rigorous depending on power plant type and sector. Some parts of the power plants such as transformers are well-suited to be outfitted with water spray extinguishing systems. In contrast to sprinkler systems they spray water so finely and evenly as to virtually surround the burning object. The large extinguishing water surface makes for a great cooling effect, and the resulting steam reduces oxygen supply (6).

MORE EXAMPLES:

Explosion suppression

Halon was once commonly used to suppress explosions in refineries, grain silos, aircraft hangars, or storage space for solvents (7). Common alternatives are carbon dioxide and water-based systems(2)(7).

Libraries, Museums

As a rule, hand-held fire extinguishers are in place at libraries and museums to fight a fire in its initial stage. The extinguishing agent is CO₂. The particular problem at these locations is the timely identification of a fire that occurs at night. Without installed fire detection systems fires are in most cases only discovered at a relatively late stage. Since libraries and museums are often located in old historic buildings, rapid spread of a fire may occur as a result of how the building was constructed or what building materials were used.



Anna-Amalia library in Weimar

The most well-known incident is the fire at the Anna-Amalia library in 2004. A fine water spray extinguishing system with minimal water use is now installed at the library (8).

In addition to sprinkler systems, fixed fire protection systems may also include those that use CO₂ or inert gases (9). The advantage of CO₂ is that it can also successfully extinguish embers at adequate extinguishing concentrations. The drawback is that they must ensure there is ample advance warning for all persons to evacuate the flooding area.

Archives

Fire protection systems tailored to comply with the specific fire safety requirements of building codes and which combine hand-held extinguishers and automatic extinguishing systems can usually also provide extensive protection to archives with halogen-free chemicals. One option is the controlled introduction of nitrogen as a means to reduce ambient oxygen content. The risk of an open fire is thus ruled out, and the ageing process of old documents can be slowed as a result of oxygen reduction. Areas protected by such active fire avoidance systems remain accessible (8).

USA

Protection by oxygen reduced atmosphere in the Smithsonian Institute in 2008 (10)

GERMANY

- More than 40 high-profile objects are sprinkler protected. (14)
- Low-pressure water mist extinguishing system located in the seats of the plenary chamber of the Reichstag in Berlin (1)
- Inert gas extinguishing system to protect documents in the Office of the Federal President (14)
- High pressure water mist system in 17th-century Wedding building in Hameln (8)
- Spray water extinguishing system in lignite-fired power plant in Grevenbroich-Neurath (6)
- Sprinkler system in the German Museum of Technology (14)

POLAND

Argon extinguishing system in the archive of the library of the university, Warsaw (14)

CZECH REPUBLIC

High pressure water mist system in National Technical Library, Prague (8)

DENMARK

Gas (N₂)/ Water (Fine spray extinguishing system) – combined extinguishing system in new wing of Royal Library, Copenhagen (8)

SWEDEN

Protection by high-pressure water mist in the Swedish Institute for Infectious Disease Control (12)

AUSTRIA

Inert gas extinguishing system in the National Library, Wien (14)

Possible applications for water-based extinguishing systems (11):

Sprinkler systems:

- Industrial facilities
- Production halls
- High-bay warehouses
- Warehouses
- Parking garages
- Retail outlets
- Event locations
- High-rise buildings
- Fairgrounds
- Hotels
- Hospitals

Water mist/Fine water spray systems:

- Theatre stages
- Chip silos
- Foam-rubber stores
- Aircraft hangars
- Transformers
- Cable ducts
- Rolling mills
- Power plant installations
- Fireworks plants and ammunition factories
- Solid waste bins

Foam extinguishing systems:

- Refineries
- Power plants
- Production plants
- Chemical plants
- Fuel tanks
- Aircraft hangars
- Storage space for flammable liquids
- Loading and unloading stations for tanker vehicles
- Pipeline pump stations
- Port facilities
- Waste incineration plants

Outlook

The future of fire protection lies in individual well-designed fire protection systems that combine structural, technical and organisational measures in fire protection. Only this will provide solutions that guarantee the best fire protection in a long time frame. Comprehensive fire protection schemes are more easily integrated in buildings in the planning stage. As the examples illustrate, however, this can also be achieved in historical buildings. Fluorinated fire extinguishing agents such as FK-5-1-12 or HFC 227ea should be used as less as possible. With combinations of measures their volumes can be minimised. Use of HFCs with extremely high global warming potential (e. g. HFC 23) need not be used at all.

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