BRANDFORSK
2018:6

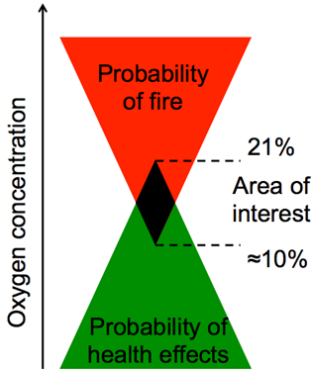
Fire behaviour and occurrence of fire in enclosures protected by oxygen reduction systems

Hypoxic air systems or ORS (oxygen reductions systems) are used to reduce the occurrence of ignition and possibly to reduce the fire growth by means of a lower oxygen level in the ambient air. Usually a system with an oxygen content of about 15% is installed as a compromise between the level of fire protection achieved and health aspects. This study shows that current methods to determine the oxygen level of ORS are not sufficient to determine the correct oxygen levels and as such the overall fire risks when applying these systems.

Background of the projekct

The primary purpose of oxygen reduction systems (ORS) for fire safety applications is to create an environment of sufficiently low oxygen concentration to prevent, or significantly inhibit, fire initiation, development and spread. The basic operating principle of ORS for fire safety applications is to displace the ambient oxygen in an enclosed environment with one or more nitrogen generators.

In practice, however, the level of protection obtained depends on the selected oxygen concentration. The lower the oxygen content, the higher the fire protection level. This, in turn, must be weighed against the negative health effect that a reduction in oxygen content means for persons staying in the protected area, see below.



Usually a system with an oxygen content of about 15% is installed as a compromise between the level of fire protection achieved and health aspects. However, an oxygen content of 15% does not generally prevent the onset of fire. Usually, fire can still occur and further spread at these oxygen levels. For this reason, more information is needed on the behaviour of materials and products at these levels of oxygen.

Objectives

The overall objective of the project is to obtain such information, which allows the effects of installing a system of reduced oxygen content to be assessed and quantified, which, with today's knowledge mode, is not possible. This means that the system's effect on fire safety and fire protection in a protected area can be determined and quantified, ensuring that the correct level of protection against fire is obtained.

Methods and Content of the project

In order to achieve the objectives of the project, the following methods were used: literature studies, interviews, fire experiments and technical analysis.

The project contained the following subprojects:

1. Literature study (complemented by a study done for NFPA Research Foundation)
2. Experimental Data
3. Risk Analysis

Results

The research in this study confirmed once more that the test methods in EN 16750:2017 and VdS 3527 may not be sufficient to cover all real-scale scenarios and that a considerable overall risk analysis is needed before the ORS can be implemented. Especially when ignition is tried to be prevented in the real-scale scenarios, the oxygen concentrations determined in EN 16570:2017 and VdS 3527 may result in too high values. Both tests in cone calorimeter and FPA on a number of typical materials used in enclosures were conducted. The results show that the ignition concentrations are lower when radiative heat source are involved and this should be considered when determining the final oxygen level.

The project shows that both the cone calorimeter (CACC) and the FPA apparatus are much more suitable to use for determining a realistic oxygen level in the ORS. For full set-ups with complex systems even full-scale tests might be necessary.

The project also gives some guidance to determine the oxygen levels. Here it is proposed to separate this selection from buildings with or without occupancy and make a risk evaluation whether fire prevention or protection is used.

Further project results can be found in LTH report 3220 and NFPA report on "Review of Oxygen Reduction Systems for Warehouse Storage Applications" by Van Hees, Barton, Nilsson and Meachem.

SPONSORER & PARTNERS:

Brandforsk
STYRELSEN FÖR SVENSK BRANDFORSKNING

LUNDS UNIVERSITET

NFPA RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION