

Fire Protection of at Risk Groups by IG-541 and Water Based Sprinklers: Full Scale Tests

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Abstract

The IG-541 consists of gases nitrogen, argon and CO₂ in the 5:4:1 ratio. It works by reducing the oxygen concentration to below 15 volume% in the fire room and adds CO₂ for stimulating the respiratory system to increase the breathing, thereby reducing the impact of the reduced oxygen concentration. Thus, the personnel risk normally associated with reduced oxygen concentration is mitigated while the fire is extinguished by the reduced oxygen level^{1 2}.

In Norway, IG-541 fire extinguishing systems are increasingly used for protecting historical buildings (made of wood with precious interiors), warehouses, buildings for vital infrastructure³, etc.

A new trend is that IG-541 is also used in housing for at risk groups, e.g. an asylum applicant center, hotels and a psychiatric institution.

Currently there are plans to install IG-541 in day care senior homes. The two main reasons for choosing IG-541 instead of sprinkler are:

- Long response time from the local fire brigade
- The lack of water capacity

Mobile stand-alone IG-541 based fire extinguishing systems have been developed by a supplier⁴. The aim of these systems is to protect a person, not able to evacuate by own means, in case of a fire until the arrival of the fire brigade unit.

The use of IG-541 in these new types of buildings is heavily discussed in Norway. Many stakeholders dislike the introduction of IG-541 based fire extinguishing systems in buildings where people live, work and sleep.

As part of three bachelor thesis projects, 7 students have conducted full scale fire tests to compare the performance of a sprinkler system and an IG-541 system. The tests are carried out in a full scale resident room / apartment. The IG-541

configuration consists of 1 cylinder 80 liter 300 bar, a constant flow valve and an low noise nozzle.

The custom made building consists of a combined living room/bedroom and a bathroom. The building is equipped with a balanced ventilation system. The ceiling height of the test facility is adjustable to comply with different heights in residential buildings, institutional buildings and senior homes. The IG-541 is manually activated 30 seconds after smoke detector alarm. The following setups are tested with IG-541 and sprinkler system:

1) Psychiatric institute, high ceiling (3.0 meters) low fire load, fire scenario's: focus on arson by the resident, e.g. a start fire in a closet, fire load: hanging clothing+ wood crib and 1/3 of an institutional mattress+ wood crib in a bed. Sprinkler type: Raven K80 Institutional sprinkler

2) Elderly home, normal ceiling (2.4 meters) high fire load, fire scenario's: focus on fire in clothing of a person sitting in a chair, and fire in bed (duvet, clothing, curtain) caused by candle. Sprinkler type: Residential sprinkler

3) At risk group person living at home
The performance of mobile extinguishing systems, mobile watermist and mobile IG-541 system is tested. Fire scenario's: pizza in electrical oven and kitchen items on hot plate.

Data collected

The following parameters are measured:
Temperatures in the enclosure at different heights, visibility, CO and O₂ levels, noise, time to activation of smoke alarm, time to activation of sprinkler nozzle, time to extinguishing.

Results

Sprinkler; in all tests, except Psychiatric 1/3 mattress fire, one sprinkler head was activated.
IG-541 in all tests the fire was being extinguished within 100 sec. after activation. Upon release of IG-541, combustion is reduced, temperatures are reduced and CO yield is limited. The CO yield was generally lower in IG-541 tests compared to sprinkler tests. Even with ventilation on and an open

entrance door, IG-541 had a significant effect on the fire.
Noise is measured to be low (maks. 81,6 dBA).

References

- [1] White paper ANSUL; The physiology of INERGEN fire extinguishing Agent, 2016
- [2] Personikkerhet ved opphold i atmosfære med redusert oksygeninnvå kompensert med økt karbondioksidnivå. En medisinsk gjennomgang av allmenn tilgjengelig vitenskapelig litteratur om emnet opp mot brannslukkesystem. Erlend Johan Skraastad, anesthesiologist St. Olavs Hospital HF Trondheim. (in Norwegian)
- [3] A. Kraaijeveld, Rapport vedrørende anvendelse av IG-541 som alternative til sprinkleranlegg, Western Norway University of Applied Sciences, 2018
- [4] <http://www.fire-eater.com/da/nyheder/606-fire-eater-flex>