Low-Oxygen Systems in Cold Storage Warehouses

April 20, 2022 – 12 pm CDT
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He has over 12 years of experience in international sales and industrial engineering. As a sales engineer, he participated in fire protection projects worldwide, and currently promotes a revolutionary approach with low-oxygen systems for the cold store business in the US.
Introduction Wagner and OxyReduct

Principle behind fire prevention

Focus on case study NewCold Tacoma

Low-oxygen building standards and OSHA regulations

Investment costs of low-oxygen solution

Benefits of low-oxygen systems compared to sprinkler solutions

Drawbacks of low-oxygen systems compared to sprinkler solutions

Key takeaways
Wagner – Manufacturer of ...

- Oxygen reduction systems with OxyReduct®
- Aspirating Smoke Detection Systems with TITANUS®
Some Words about Wagner

WAGNER Group:
- Founded in 1976
- Family-owned business to 100 %
- Headquarters in Langenhagen (near Hannover – Germany)
- Worldwide business activities

Werner Wagner
General director and founder

Torsten Wagner
General director
Fire Prevention with OxyReduct®
The Principle behind Fire Prevention

Ambient atmosphere (0 % rel. humidity)

By introducing nitrogen, the mixture ratio of the atmosphere changes

Oxygen-reduced atmosphere (example)

The oxygen concentration is reduced and therefore the flammability of the fuel as well
Fire Prevention with OxyReduct®

Real fire test with ambient temperature conditions

Ignition threshold of polypropylene: 16.0 Vol.-% O₂ at 68...77°F ambient temperature
Our References in North America
Case Study – NewCold Tacoma, WA
Case Study – NewCold Tacoma, WA

General Information:
- Tacoma is NewCold's first cold storage facility in the United States
- Second low-oxygen high-bay freezer in the country
- Phase I volume with 25 million cubic feet of storage capacity (103,000 pallets), completed in 2018
- Phase II volume will double the volume and storage of Phase I
- Fully automated with Automatic Storage and Retrieval Systems (AS/RS)
- Using high bay model reduced the warehouse footprint by about 75%, from ±600,000 sf to 157,000 sf
Low-Oxygen System by Wagner Fire Safety

Active Fire Prevention with:
- OxyReduct® from Wagner Fire Safety Inc.
- 3 x VPSA (Vacuum Pressure Swing Adsorption) lines
- Full automated
- Operation concentration at 16.35 Vol.-% O2
- Aspirating smoke detection systems recommended and installed in pick floor, shipping and truck dock areas
Project Timeline for NC Tacoma

Milestones:
- Design and amount of Oxygen sensors according to prEN16750
- Oxygen operation concentration of critical materials is based on fire tests performed for similar facilities in Europe in March 2013
- Local AHJ approved AMM based on Wagner design in 2016
- Construction started in 2017 and completed in 2018

AHJ = Authorities Having Jurisdiction
AMM = Alternative Means and Methods
Low-Oxygen Components at NC Tacoma

Overview:

- Equipment room (1) with
  - Nitrogen production modules VPSA
  - PLC OxyControl
  - Electrical cabinets
- Nitrogen pipe (2)
- Oxygen sensors (3)
- Aspirating Smoke Detection Systems for adjacent areas (4)
Low-Oxygen Component Overview

**Equipment room for low-oxygen machinery**

- VPSA vessels
- VPSA compressor / vacuum pumps
- VPSA control cabinets
- Control air compressor
- Nitrogen piping incl. filter
- PLC OxyControl
Low-Oxygen Component Overview

Nitrogen pipe

- Inside equipment room
- Inside cold storage
Low-Oxygen Component Overview

Control devices

- Oxygen sensors (aspiration and SIL-2)
- O2 display and alarm displays
- Design according EN16750
Oxygen sensors according to EN16750:

- 17 oxygen sensors in cold storage installed (aspirating)
- 1 SIL-2 sensor classified
- Devices mounted at the front and end zones of cold storage
- Sensors are monitored for damaged wiring, short circuit, value tolerance, and air flow
Design Thresholds for NewCold Tacoma

Control Diagram for Oxygen Reduction, BS EN 16750

- Ignition Threshold: 17.50 Vol.-%
- Design Concentration max. / O2 max Warning: 16.60 Vol.-%
- Design Concentration min. / O2 min Alarm: 16.10 Vol.-%
- Target Value: 16.30 Vol.-%
- Nitrogen Supply on: 16.40 Vol.-%
- Nitrogen Supply off: 16.35 Vol.-%

O2 Sensor Tolerance
Design operation range
Safety Margin 0.75 %
O2 Sensor Tolerance
## Low-Oxygen Standards

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Low-Oxygen and OSHA Regulations in the US

Low-Oxygen and OSHA Regulations in Germany

Investment Costs of Low-Oxygen Solution

Depending on various variables (extract)...

- Elevation, average wind speed, shielding of building
- Operation temperature, ignition threshold of stored material and goods, O₂ operation level, air flow rate (n₅₀ value = airtightness of the building)
- Dimensions and type of openings (roller doors, vestibules, air locks), maximum and average number of openings per hour/day

... in order to calculate demand of N₂ to maintain defined O₂ operation level and compensate N₂ loss through building leakage and freezer operations.
Benefits of Low-Oxygen Systems compared to Sprinkler Solutions

- Due to reduced oxygen level in protected area, no fire is able to propagate with tested material – fire prevention
- No smoke contamination of sensitive materials and goods (i.g. frozen food, meat,...)
- No installation of sprinklers in rack systems needed during construction
- No water damages due to sprinkler malfunctions or fire incidents
- Horizontal and vertical racking runs uninterrupted throughout the length and width of the coldstore – maximizes storage density
- In combination with ASRS, low-oxygen systems enable higher-density and lower footprint configuration, which reduces energy costs of the building and land use
Drawbacks of Low-Oxygen Systems compared to Sprinkler Solutions

- OSHA regulations in the US: additional equipment for technical personnel is needed (self-contained breathing apparatus)

- Convincing local authorities about low-oxygen solutions (trips to existing facilities, time for decision making)

- Insurance industry: New technology

- Higher investment costs for smaller facilities and ambient warehouses (up to 30,000 pallets storage capacity)

- Energy costs for operation of low-oxygen system

- Preventive maintenance costs of low-oxygen system
Key Takeaways

- Fire protection in automated frozen warehouses is challenging
- Active fire prevention with low-oxygen systems is an innovative alternative in the US, and already in use in Europe for 20 years
- Design of low-oxygen system is case-by-case, depending on project variables
- Technology (Automation and/or Fire Protection) requires close collaboration between involved parties to make it happen

... and to achieve the best results!
Facilities in North Dakota and Illinois

AmeriCold Rochelle, IL

Simplot Grand Forks, ND
Any Questions?

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