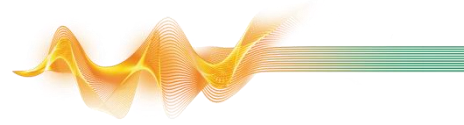


Low-Oxygen Systems in Cold Storage Warehouses

April 20, 2022 – 12 pm CDT

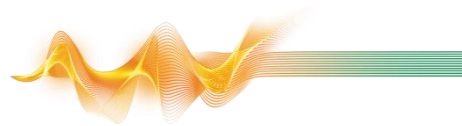
Today's Presenter



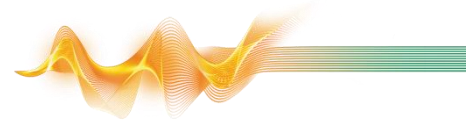
Florian Buchner, Wagner Fire Safety Inc.

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.

Agenda



- 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

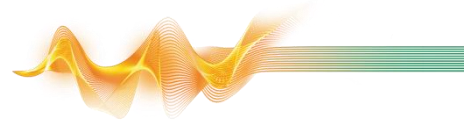


Oxygen reduction systems with OxyReduct®



Aspirating Smoke Detection Systems with TITANUS®

Some Words about Wagner



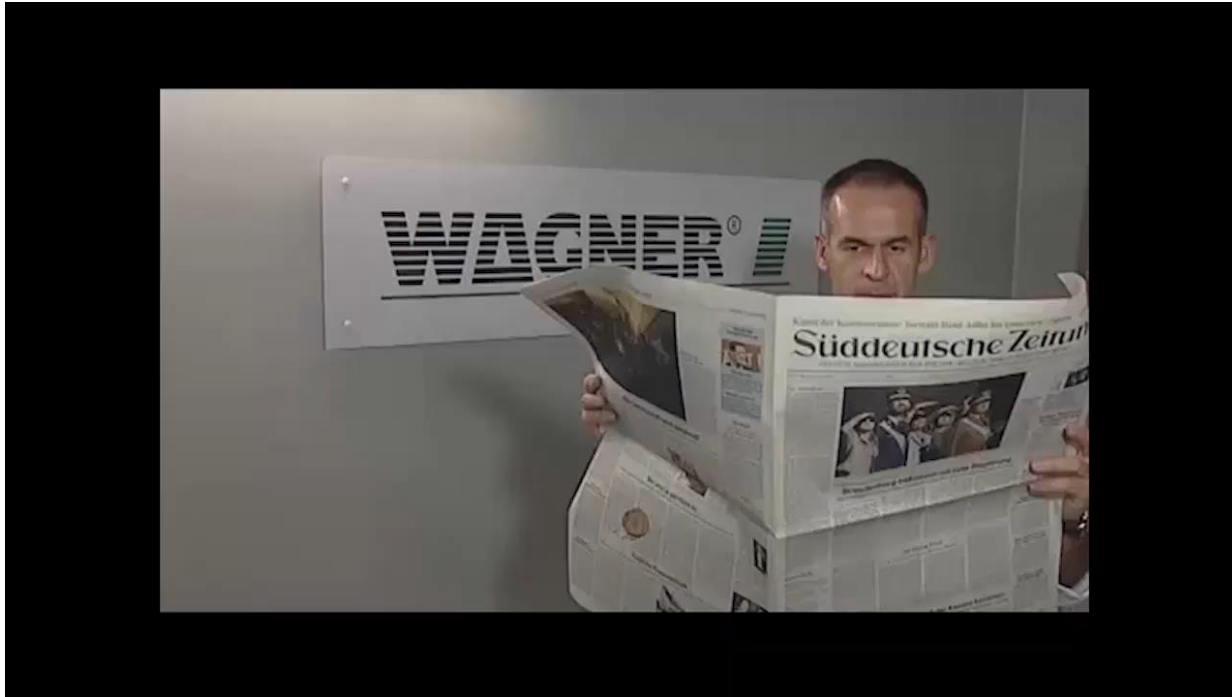
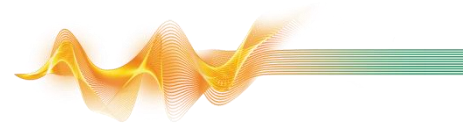
WAGNER Group:

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

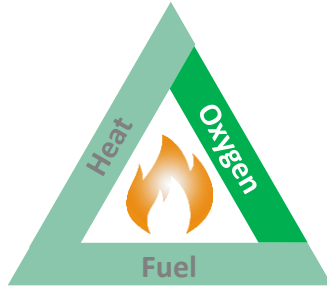
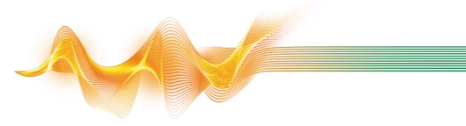


Werner Wagner
General director
and founder

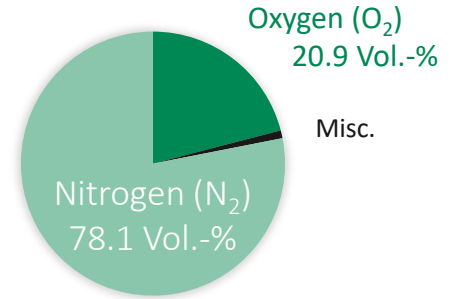
Torsten Wagner
General director



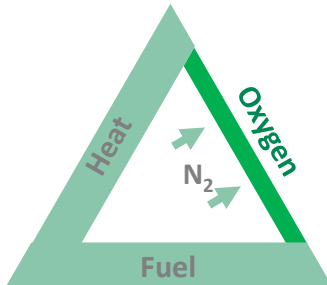
The Principle behind Fire Prevention



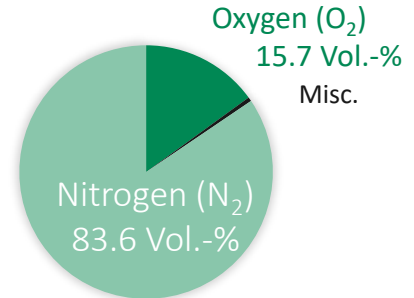
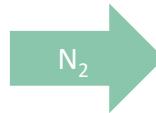
Ambient atmosphere
(0 % rel. humidity)



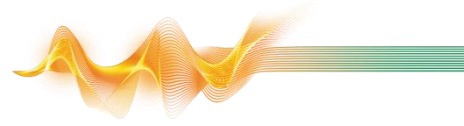
By introducing nitrogen, the mixture ratio of the atmosphere changes



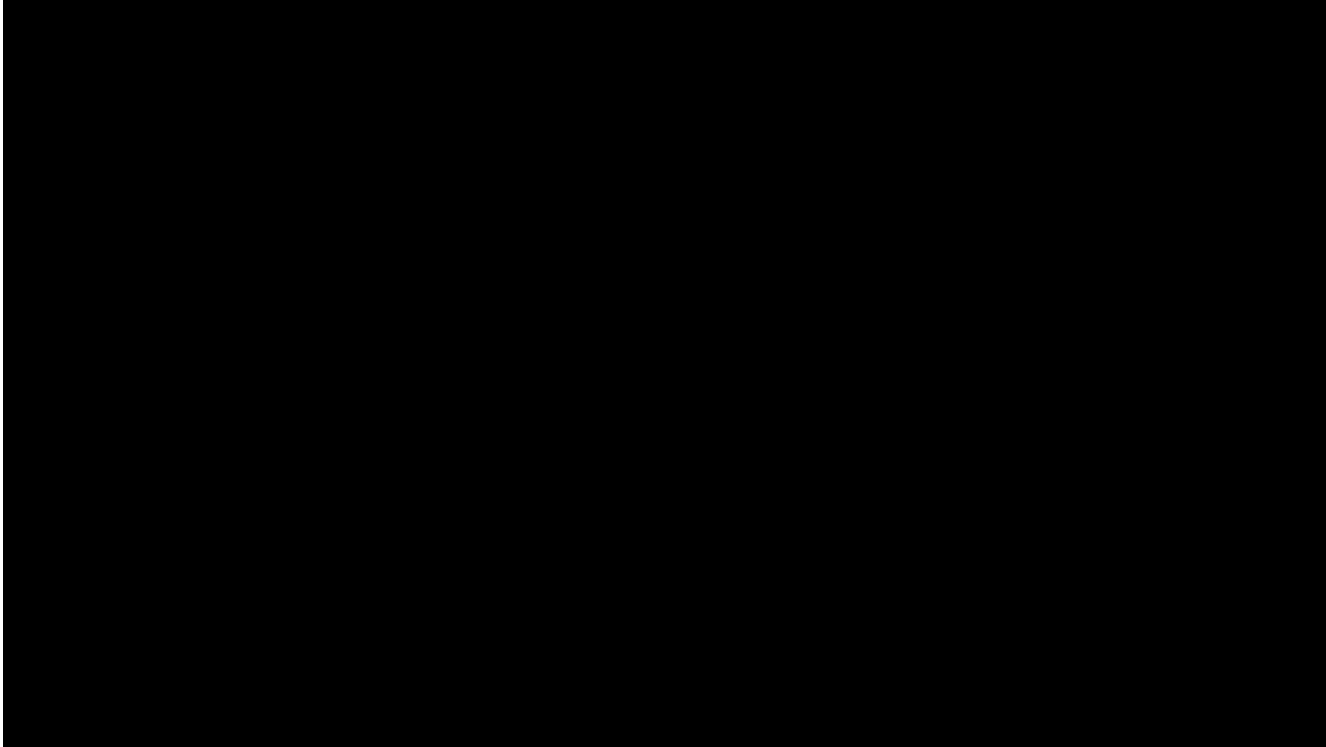
Oxygen-reduced atmosphere
(example)



The oxygen concentration is reduced and therefore the flammability of the fuel as well

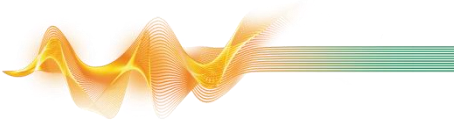


Real fire test with ambient temperature conditions

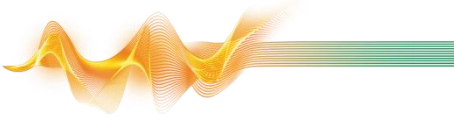


Ignition threshold
of polypropylene:
16.0 Vol.-% O₂ at
68...77°F ambient
temperature

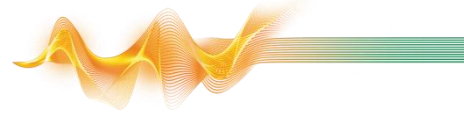
Our References in North America



Case Study – NewCold Tacoma, WA



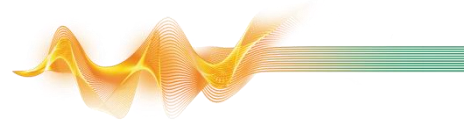
Case Study – NewCold Tacoma, WA



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

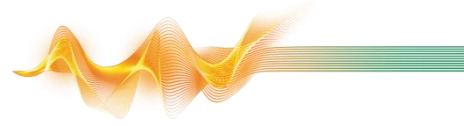
Low-Oxygen System by Wagner Fire Safety



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



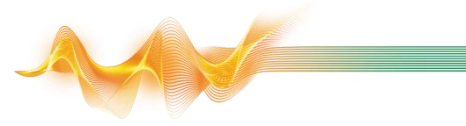
Milestones:

- 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

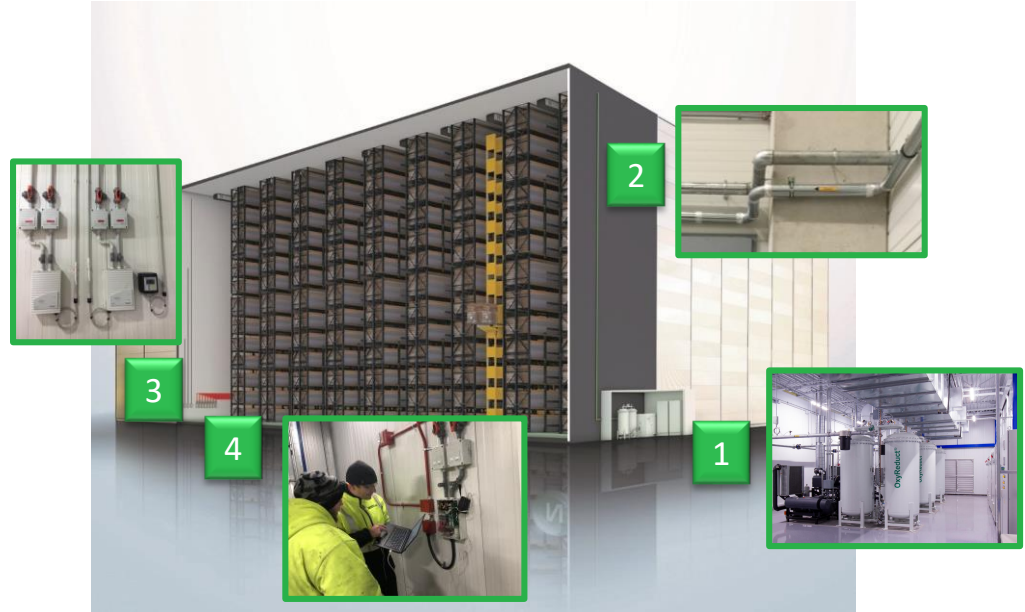
AMM = Alternative Means and Methods

Low-Oxygen Components at NC Tacoma

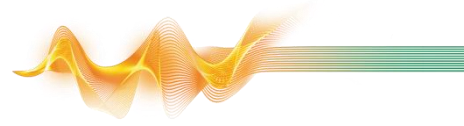


Overview:

- 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

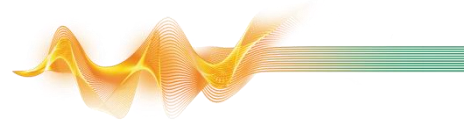


Equipment room for low-oxygen machinery

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



Low-Oxygen Component Overview

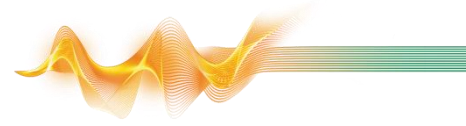


Nitrogen pipe

- Inside equipment room
- Inside cold storage



Low-Oxygen Component Overview

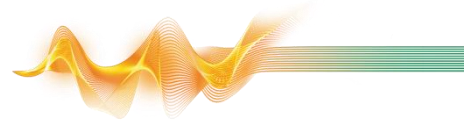


Control devices

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

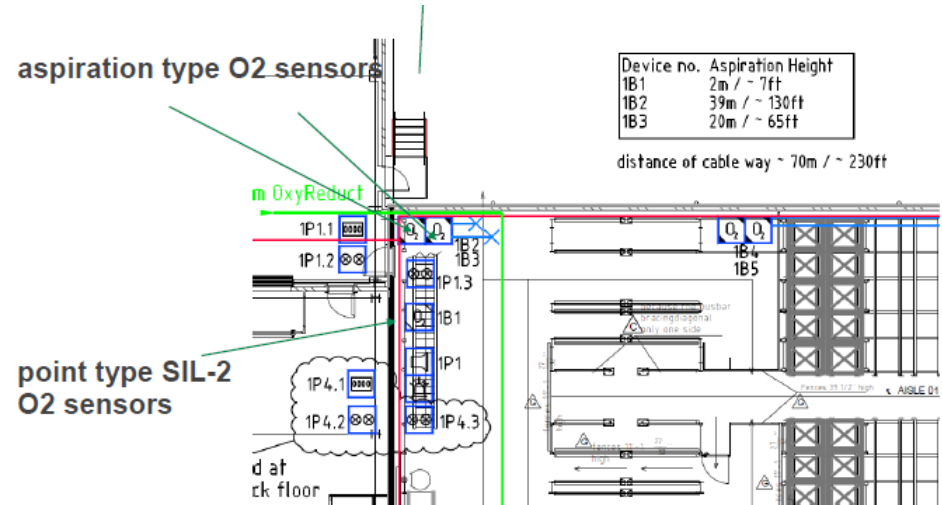


Low-Oxygen Component Overview

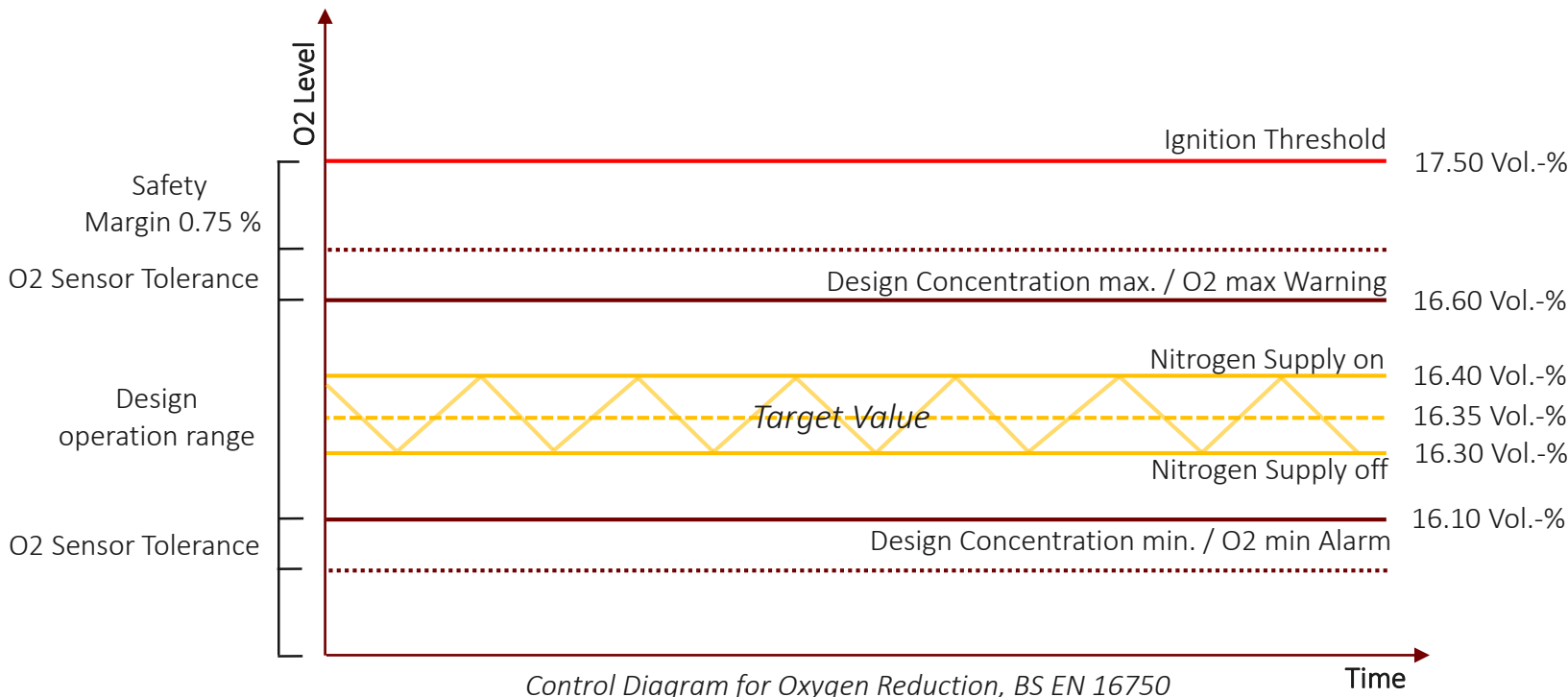
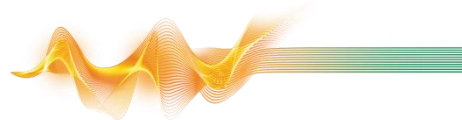


Oxygen sensors according to EN16750:

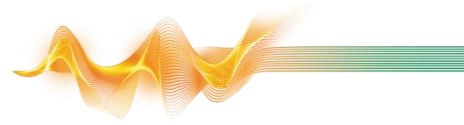
- 17 oxygen sensors in cold storage installed (aspirating)
- 1 SIL-2 sensor classified
- Devices mounted at the front and end zones of cold storage
- Sensors are monitored for damaged wiring, short circuit, value tolerance, and air flow



Design Thresholds for NewCold Tacoma

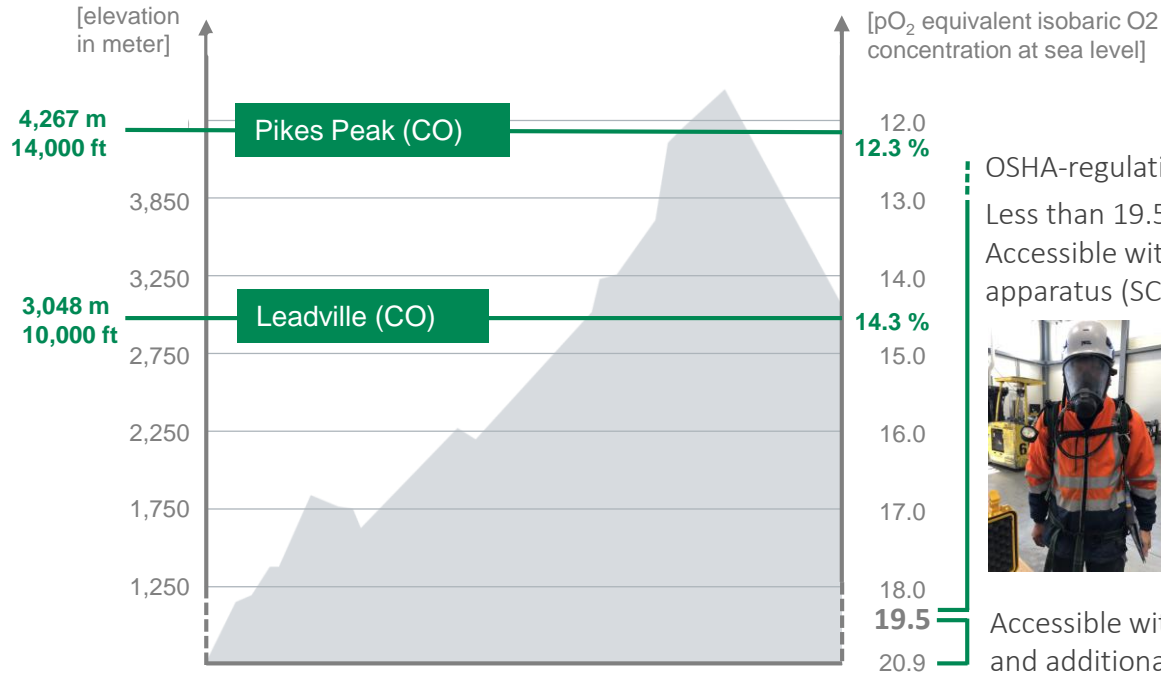
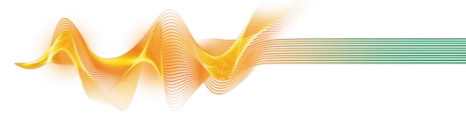


Low-Oxygen Standards



Country	Organization	Reference	Issued in year
Germany	VdS	VdS 3527 (01)	2007
		VdS 3527 (02)	2015
Austria	Fire brigades	TRVB S 155 08	2008
	ASI – Austrian Standards Institute	OENORM F 3073	2010
Switzerland	SNV	SN 123456	2009
The Netherlands	KIWA	BRL-K21017	2009
UK	BSI - British Standards Institute	PAS 95	2011
Europe	CEN - European Committee for Standardization	EN 16750	2017
USA	UL	UL 67377 #1	2016
	Underwriter Laboratories	UL 67377 #2 Outline of Investigation for Oxygen Reduction ...	2016
USA	FM Global	Examination Standard for Oxygen Reduction Systems #5800	Aug 2021
		Property Loss Prevention Sheets	Oct 2021

Low-Oxygen and OSHA Regulations in the US



OSHA-regulation in the US:

Less than 19.5%:

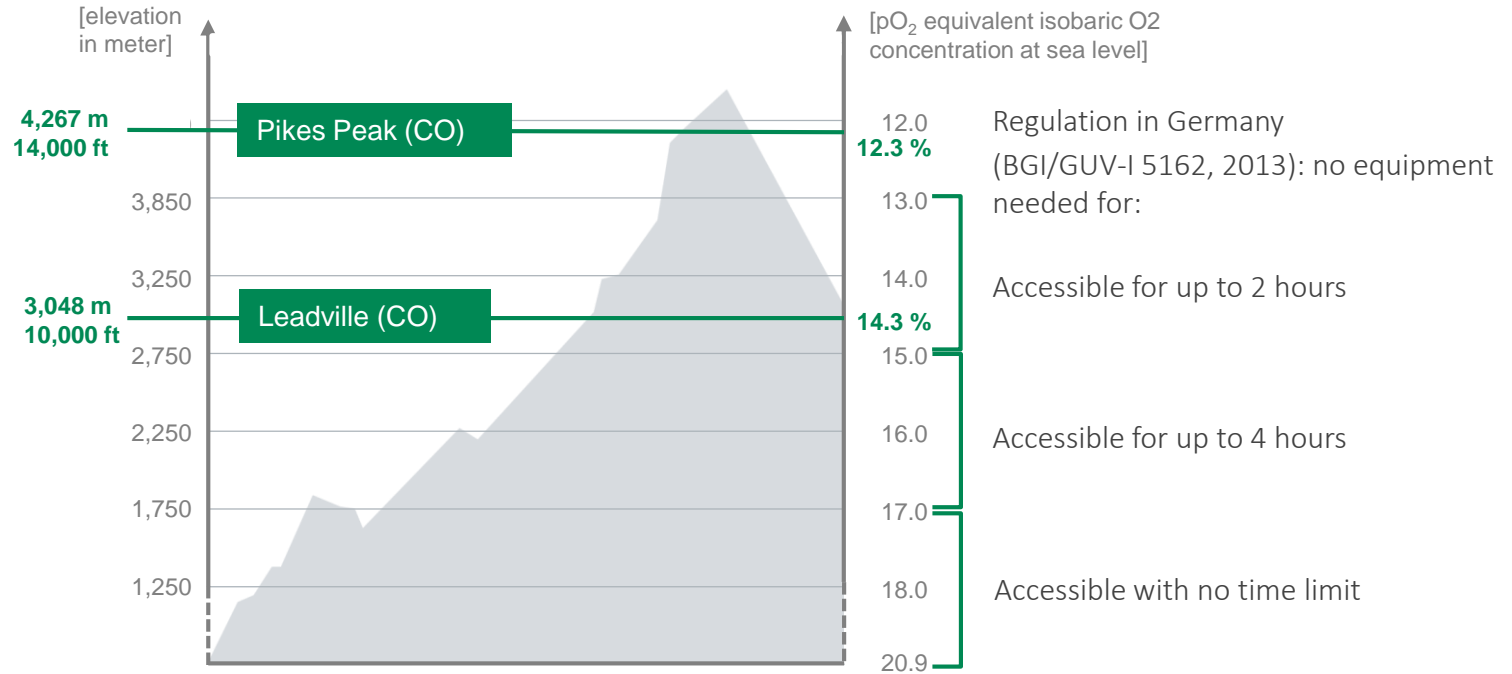
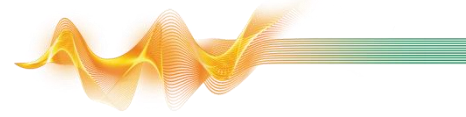
Accessible with self-contained breathing apparatus (SCBA)



Accessible with no time limit and additional equipment

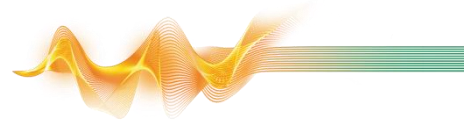
Source: Küpper, T. et al. (2015); Recommendation of the UIAA Medical Commission. Vol. 15. Work in Hypoxic Conditions. p 6ff.

Low-Oxygen and OSHA Regulations in Germany



Source: Küpper, T. et al. (2015); Recommendation of the UIAA Medical Commission. Vol. 15. Work in Hypoxic Conditions. p 6ff.

Investment Costs of Low-Oxygen Solution

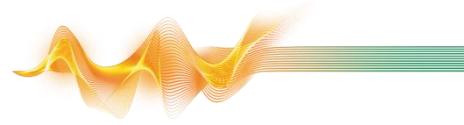


Depending on various variables (extract)...

- Elevation, average wind speed, shielding of building
- Operation temperature, ignition threshold of stored material and goods, O_2 operation level, air flow rate (n_{50} value = airtightness of the building)
- Dimensions and type of openings (roller doors, vestibules, air locks), maximum and average number of openings per hour/day

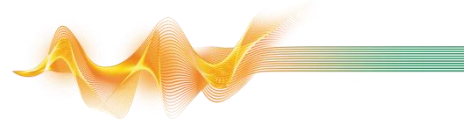
... in order to calculate **demand of N_2** to maintain defined O_2 operation level and compensate N_2 loss through building leakage and freezer operations.

Benefits of Low-Oxygen Systems compared to Sprinkler Solutions



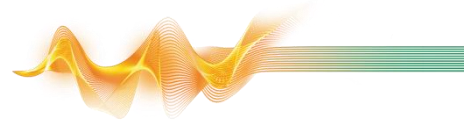
- Due to reduced oxygen level in protected area, no fire is able to propagate with tested material – fire prevention
- No smoke contamination of sensitive materials and goods (i.g. frozen food, meat,...)
- No installation of sprinklers in rack systems needed during construction
- No water damages due 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



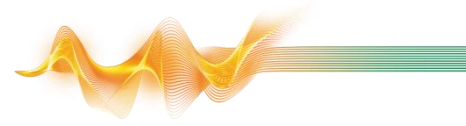
- OSHA regulations in the US: additional equipment for technical personnel is needed (self-contained breathing apparatus)
- Convincing local authorities about low-oxygen solutions (trips to existing facilities, time for decision making)
- Insurance industry: New technology
- Higher investment costs for 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!

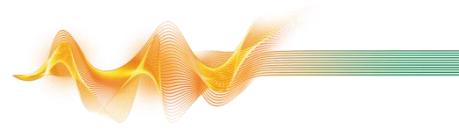
Facilities in North Dakota and Illinois



Americold Rochelle, IL



Simplot Grand Forks, ND



Any Questions?

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