N2 OXYGEN REDUCTION SYSTEM

CASE HISTORY

N2 ORS® for the National Library of Israel

Isolcell
CONTROLLED ATMOSPHERE SINCE 1958

01 Active fire prevention to protect millions of books in Jerusalem

Fire risk analysis

For a fire to ignite three elements are needed: heat, combustibles, and an oxidizing agent, usually oxygen. Books are dry materials and cannot ignite themselves. However, being the books stored inside an automated archive, the electrical equipment used e.g., stacker crane, can become such a source of trigger. The National Library decided to use ISOLCELL's oxygen reduction solution to protect over 5 million books stored inside the brand-new automated archive.

The protection objective

Fire prevention measures aim to protect property from damage. Once a fire starts, even with efficient suppression efforts, there can be extensive property loss. Therefore, traditional fire suppression system like for example sprinkler, was never taken into consideration by the National Library of Israel management.

The fire prevention solution

The N2 Oxygen Reduction System® actively prevents the combustion process to get started by uninterruptedly reducing the amount of oxygen. The OR-System, which acts as primary and only fire protection system (supported also by an Aspiration Smoke Detection system), has been designed to keep a lower oxygen content compared to normal breathing air (which contains 20,95 vol. %).

Technology applied

The oxygen-reduced air is generated through molecular separation using **ADOX**® oxygen adsobers with VPSA (Vacuum Pressure Swing Adsorber) technology. In addition 10 **N2 ORS OXYGEN SENSORS** with high redundancy features, alongside as many smoke detectors, monitor continuously the oxygen concentration within the protected area.

The National Library of Israel

The National Library of Israel, formerly Jewish National and University Library is the library dedicated to collecting the cultural treasures of Israel and of Jewish heritage. The library holds more than 5 million books. The National Library owns the world's largest collections of Hebraica and Judaica, and is the repository of many rare and unique manuscripts, books and artifacts.

In 2014, the project for a new home of the Library in Jerusalem was unveiled. The over 40.000 square meters building, designed by the Basel-based architecture firm Herzog & de Meuron, is located on Kaplan Street 1, Jerusalem, Israel.

02

Designed according to ISO 20338

The fire prevention system has been designed according to the general requirement **ISO 20338:2019(E**) Oxygen reduction systems for fire prevention – Design, installation, planning and maintenance. ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies).

Prevent fires actively 24/7

Oxygen reduction systems are designed to prevent fires from starting or spreading, by means of the introduction of oxygen reduced air and creating an atmosphere in an area which is having lower permanent oxygen concentration in respect to ambient condition.

Oxygen reduction systems are not designed to extinguish fires. The design and installation are based on detailed knowledge of the protected area, its occupancy, and the materials in questions. It is important to suit the fire protection measures to the hazard as a whole.

03 The NLI automated archive “data in hand”

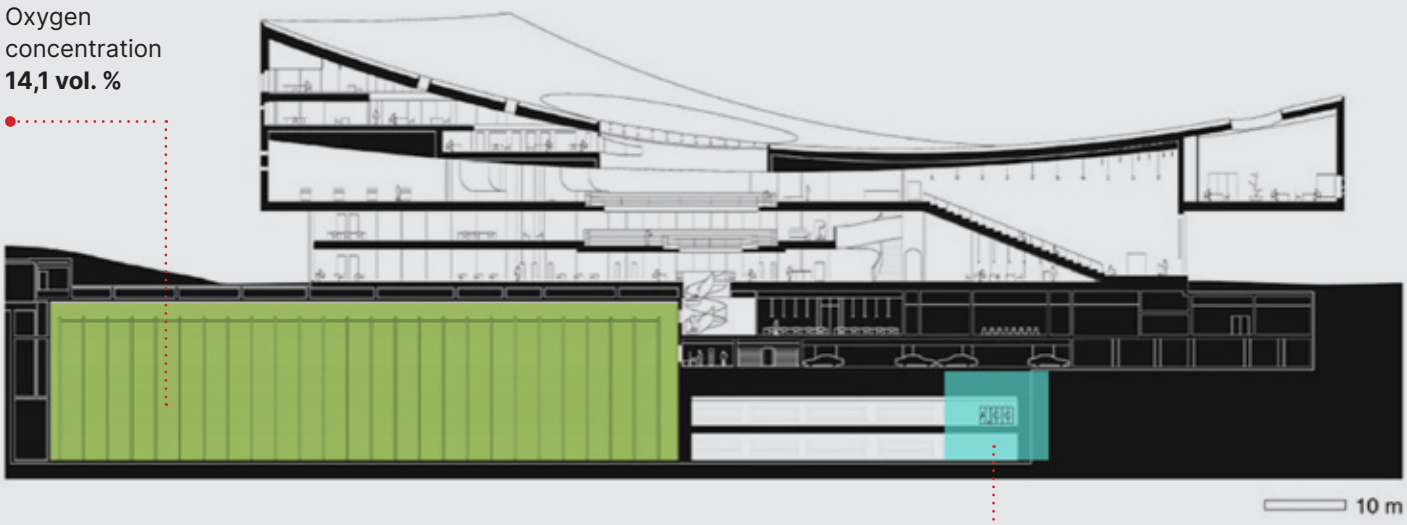
Store goods: books, paper documents
Given protection level according to the standard: 14,1 vol.%

Automated Archive

Type of building: concrete
Building dimensions: 74,70 × 24,50 × 18,85 m
Volume: 34.500 m³
Temperature within the archive: 18°C
Temperature within the protected area: 2° C... 17° C
Air conditioning system: closed-circuit
Air-leakage n50 value: 0,04

Openings data

Door's type: air-permeability fast acting shutter doors
Airlock system: yes
Quantity: 2
Opening size: 1 m2 each
Opening duration: 7 seconds during goods passage
Opening h/max: 100 In & 100 Out
Operation: 7 hours per 7 days week



ORS machinery room

Automated archive area
to be protected with ORS amd ASD

Modular ADOX®
VPSA technology

ISOLCELL Fire Prevention Division

Our innovative role in fire prevention

With the creation of the **fire-prevention division** in 2005, Isolcell was one of the first Italian companies in the **fire-fighting and fire-protection** sector to talk about **prevention** in the pure sense. Until that time, the sector focused only on fire-suppression technologies, which were intended to reduce response times as much as possible and thus **limit the associated damage**. The technology that we have developed, however, makes it impossible for a fire to develop in a protected environment. In other words, it **avoids the damage** created by the fire and by suppression systems, protecting people and property. Because of the specific characteristics of our systems and our solutions, we alone are able to boast unparalleled **reliability and safety**. This is also demonstrated by the fact that, with our **N2 ORS®** system, we were the first company to obtain **certifications** such as VdS, ÖNORM, EN 16750, IEC 61508 and ISO 20338.

From 20.95 vol.- O2 % to 14,1 vol - O2%

The oxygen concentration inside the automated archive at the National Library of Israel has been decreased to 14,1 vol. %.

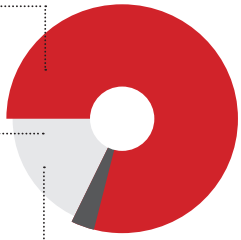
The given safety level is according to the general requirement ISO 20338 Annex A: ignition thresholds for oxygen reduction using nitrogen enriched air in fire prevention.

The materials flammability test has been done according to VdS Test report.

Nitrogen
78,09 vol.%

Oxygen
20,95 vol.%

Others
0,96 vol.%

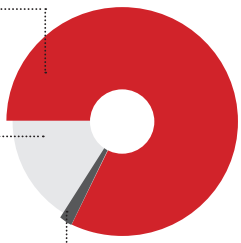


N2
N2
N2

Nitrogen
85,16 vol.%

Oxygen
14,1 vol.%

Others
0,74 vol.%



04 N2 ORS design

The Isolcell's modular **ADOX® XL2 VPSA** system has been installed. The designed machine consists of three individual modules, capable to work independently, thus ensuring high redundancy. For that reason, the machine has been certified SIL-3 by Tüv (IEC 61508) The XL2 machine reduces the oxygen content by introducing oxygen-reduced air to the NLI automated archive, at a rate of 270 m3/h.

The machinery room is equipped with:

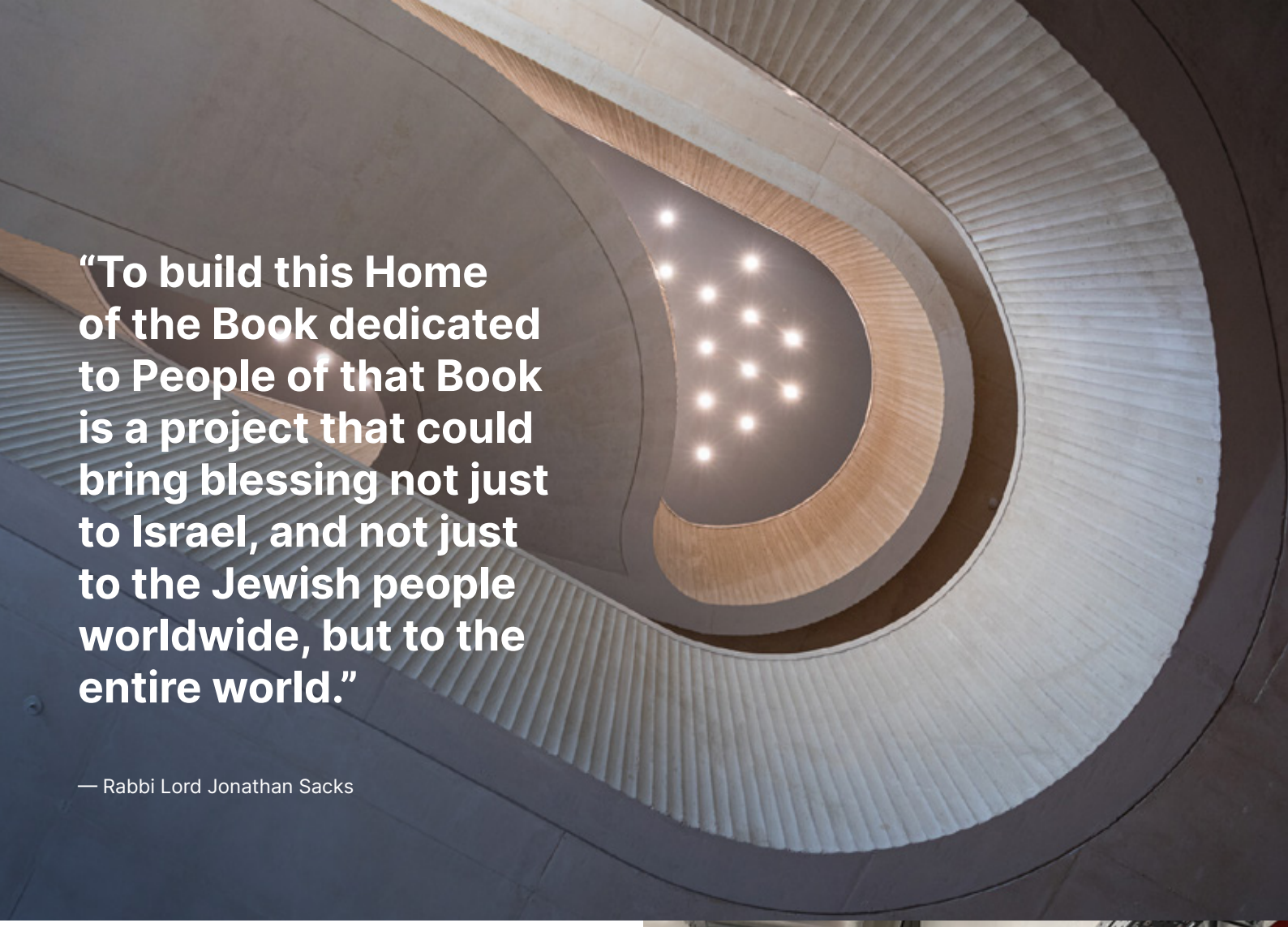
- No. 1 ADOX VPSA XL2 machine with modular technology (3 x modules) **SIL-3**
- Buffer - process tanks

- 2 x Aircompressors Kaeser (redundancy)
- Compressed air tank
- Oil-water separator
- Electrical cabinet
- Temperature and humidity sensors
- Galvanized steel pipes
- Manifold 1 + 8 + 1 positions and redundant electrical valves **SIL-3**
- Connector for external nitrogen supply
- I/O modules **SIL-3**
- Exhaust steel pipes for oxygen enriched air
- Cabling
- 2 x ORS Main Control Unit – C.I.E. (Master + Slave) **SIL-3**

Modular ADOX® VPSA technology

Low-pressure system = low-energy consumption and wear

ADOX® systems (VPSA technology) are the most high-performance: these are **modular systems** developed specifically for fire prevention using oxygen reduction and guarantee greater **safety**, because they operate on the basis of redundancy. Thanks to its exclusive technology, ADOX® can operate at low pressure, significantly reducing energy consumption and wear. Unlike high-pressure systems (PSA or membrane), which require a series of elements necessary for the compressed-air chain, ADOX® systems operate using low pressure and thus **consume less energy** compared to the two other technologies and require **less maintenance**. Furthermore, they are ready to use (plug & play) because they contain within them everything they need to operate.



“To build this Home of the Book dedicated to People of that Book is a project that could bring blessing not just to Israel, and not just to the Jewish people worldwide, but to the entire world.”

— Rabbi Lord Jonathan Sacks

05

Oxygen reduced air distribution system

- Steel galvanized pipes have been installed from machinery room (manifold) upon reaching the protected area i.e., automated archive. The steel pipes were installed on the floor.
- The oxygen-reduced air is injected through 21 steel nozzle, accurately positioned according to ISOLCELL’s virtual grid system.

Automated archive is equipped with:

- **SIL-3** and **VdS** certified
- Air filters
- 10 x aspirating smoke detectors
- ABS pipes for oxygen analysis
- Power supplies
- Back-up batteries (24 hours)
- Cables, redundancy
- Double communication cable CANBUS 1 CANBUS 2
- Double power supply cable POWER 1 POWER 2
- 3 x touchscreen digital display oxygen level
- Set of alarm devices
- I/O modules SIL-3
- Galvanized steel pipes

VdS approved N2 ORS oxygen sensors

The oxygen content in the automated archive is measured using the ISOLCELL N2 ORS® variable-step virtual grid. Analysis ensures that a possible failure in an individual measurement element does not influence the results of the overall measurement operations. ISOLCELL has developed a **highly reliable** measurement instrument. Each N2 ORS OXYGEN SENSOR is in fact equipped with **three individual sensors**, supported by reciprocal measurement diagnostics with a triplicated architecture with majority redundancy. This means that the values measured are processed using a 2oo3 (two-out-of-three) voting design, thus providing a precise and unequivocal value and a high level of safety, as can be seen from the fact that even our oxygen sensors are IEC 61508:2010 certified with the significant reliability level of **SIL-3**.

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Fire Prevention Division

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