WE DISRUPT HYDROGEN INFRASTRUCTURE.
THE LOHC COMPANY

Adding the missing link to high-performing hydrogen value chains worldwide

Based on its proprietary and proven Liquid Organic Hydrogen Carrier (LOHC) technology with Benzyltoluene as carrier medium, Hydrogenious LOHC Technologies allows for superior, flexible hydrogen supply to consumers in industry and mobility across the globe – utilizing conventional liquid-fuel infrastructure. The leading LOHC pioneer offers (de-)hydrogenation plants, EPC and O&M services, ensuring particularly safe, easy and efficient hydrogen storage, transport and distribution.
Economic green hydrogen is a central vector in a sustainable future energy system. But as hydrogen is the lightest molecule, its large-scale storage, its transport and distribution to consumers all over the world remains very challenging.

Our LOHC technology changes the way we handle hydrogen

Our Liquid Organic Hydrogen Carrier (LOHC) is the thermal oil Benzyltoluene. It can chemically bind hydrogen at high storage densities under ambient conditions. It is hardly flammable and non-explosive.
THE LOHC MATERIAL

SAFE
• No molecular hydrogen
• Hardly flammable and non-explosive, even when loaded with hydrogen

EASY
• Ambient storage conditions
• Handling of a liquid oil from -30 °C to 300 °C
• Transportable in existing infrastructure for fossil fuels

EFFICIENT
• High storage density of 54 kgH₂/m³ LOHC
• No self-discharge over time
• High cycle stability of carrier liquid
THE LOHC CONCEPT

Hydrogen storage in LOHC

Transport of loaded LOHC

Transport of unloaded LOHC

Hydrogen release from LOHC

Hydrogen consumption at the refueling station

Hydrogen use in the industry

Green hydrogen production

Renewable energy electrolysis

LOHC transport & storage using the infrastructure for conventional fuels

• Hydrogenation: Chemical bonding of hydrogen molecules to the LOHC via a catalytic reaction in a continuous process
• Exothermic reaction at 25-50 bar, generating about 10 kWh$_{th}$/kg$_{H2}$ heat at $\sim$ 250 °C

• Dehydrogenation: Chemical release of hydrogen molecules from the LOHC via a continuous catalytic process
• Endothermic reaction requires about 11 kWh$_{th}$/kg$_{H2}$ heat at $\sim$ 300 °C
• On-demand hydrogen release with high hydrogen purity
HYDROGEN HANDLING MADE EASY

HYDROGEN GENERATION

- Steam methane reforming
- Coal gasification
- By-product hydrogen
- Hydrogen-rich gases

INDUSTRIAL HYDROGEN

RENEWABLE ENERGIES

- Wind
- Solar
- Hydro
- Biomass

ELECTROLYSIS

HYDROGEN UTILIZATION

- Flat glass production
- Metal refining
- Chemical processes
- Fertilizer production

INDUSTRY SUPPLY

HYDROGEN REFUELING

- Large capacity hydrogen refueling stations
- Bus fleets
- Heavy duty vehicles
- Maritime mobility
- Trains & Trams
THE STORAGE PLANT

Large scale hydrogen storage from industrial and renewable sources

- Optimized for continuous hydrogen storage in LOHC
- Ideal for large-scale hydrogen storage processes
- Easy hydrogen logistics and low operating costs

THE RELEASE PLANT

Mid- to large-scale Hydrogen supply for industrial consumers (refineries, (petro-) chemicals, glass, metals, food etc.) and H₂ refueling stations

- High safety and flexible hydrogen storage capacity
- Ideal for mid- to large-scale hydrogen demand
- Easy on-site installation
LOHC Hydrogenation
Chemical bonding of hydrogen molecules to the liquid carrier oil

THE STORAGE SYSTEMS

Our Storage SYSTEMS are designed to store hydrogen in the LOHC oil. The process is optimized for continuous operation and high efficiencies. During the exothermic storage reaction high-temperature heat is produced, which can be used on-site.

The right product to meet our customer’s demands

Depending on the required storage capacity, we offer tailor-made plants with a hydrogen storage capacity starting from 5 tons per day. For demo projects you can purchase containerized systems as standardized products with 0.9 kg hydrogen uptake per hour – easy and quick to install, fully automated and remotely controlled.
THE STORAGE SYSTEMS

Key Benefits

- Optimized for continuous hydrogen storage in LOHC
- Ideal for large-scale hydrogen infrastructure
- Designed for long-life operations and low maintenance
- High safety and high hydrogen storage capacity
- Low footprint and easy on-site installation

Storage PLANT

Plant-based systems for large-scale hydrogen storage

KEY FEATURES
- Large-scale industrial design
- Designed for direct coupling with SMR or large-scale electrolysis
- Customized starting at a hydrogen storage capacity of 5 tons per day.

Storage BOX 10

Containerized system with 0.9 kg hydrogen uptake per hour, for demo and test purposes.

KEY FEATURES
- Standardized product
- Easy and quick on-site installation
- Fully automated and remotely controlled
- Predefined footprint
**Storage PLANT - Basic Configuration**

<table>
<thead>
<tr>
<th>StoragePLANT 5tpd</th>
<th>StoragePLANT 12tpd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen capacity*</td>
<td>5 t/d // 210 kgH₂/h</td>
</tr>
<tr>
<td>LOHC production*</td>
<td>4500 l/h</td>
</tr>
<tr>
<td>Heat production*</td>
<td>1900 kWth</td>
</tr>
<tr>
<td>Load range</td>
<td>30 – 100 %</td>
</tr>
</tbody>
</table>

*under nominal load

Footprint

- Plant
- Inlet hydrogen stream: 20 – 50 bar, 99.99 % purity
- Inlet LOHC stream: ≥ 0.1 barg, T ≥ 15 °C
- Power connection: 400 V AC, 3 phase, 50 Hz

**Storage BOX 10 - Configuration**

- Hydrogen capacity: 10 Nm³/h // 0.9 kgH₂/h
- Hydrogen supply: 99.999 vol.-% H₂ @ 25 – 50 bar(g)
- Required utilities: power supply, nitrogen, data connection
- Footprint: 20 ft container (ISO 668) / Footprint (excl. storage tanks) — 30 m²
- Standards: German and European Codes and Standards / CE labeled

CUSTOMIZED PLANTS AVAILABLE FOR > 12 t/d

ONE DESIGN, IDEAL FOR DEMONSTRATION PROJECTS AND TEST PURPOSES
LOHC Dehydrogenation
Release of hydrogen molecules from our liquid carrier oil.

THE RELEASE SYSTEMS

Our Release SYSTEMS are designed to release hydrogen from the LOHC oil. The process is optimized for continuous operation and long-term stability. The endothermic hydrogen release process requires heat, which can be supplied by high-temperature waste-heat, natural gas, electricity or hydrogen.

The right product to meet our customer’s demands

Depending on the required needs, we offer plants with a hydrogen release capacity starting from 1.5 tons per day. Ideal for hydrogen refueling stations and industrial supply. We offer our containerized systems with 0.9 kg hydrogen release per hour, for demo and test use purposes.
THE RELEASE SYSTEMS

Key Benefits

- Optimized for continuous high purity hydrogen release from LOHC
- Ideal for medium to large-scale hydrogen demand
- High safety and high hydrogen storage capacity
- Low footprint and easy on-site installation
- Underground storage at hydrogen refueling stations possible

Release PLANT

Plant-based systems for large-scale hydrogen release

KEY FEATURES
- Large-scale skid mounted design
- Designed for industrial processes and large hydrogen refueling stations
- Customized starting at a hydrogen release capacity of 1.5 tons per day.

Release BOX 10

Containerized systems with 0.9 kg hydrogen release per hour, for demo and test purposes.

KEY FEATURES
- Standardized product
- Easy and quick on-site installation
- Fully automated and remotely controlled
- Predefined footprint
## Release PLANT - Basic Configuration

<table>
<thead>
<tr>
<th>Customized plants available for &gt; 1.5 t/d</th>
</tr>
</thead>
</table>

### Release PLANT 1.5tpd

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen outlet*</td>
<td>1.5 t/d // 65 kgH₂/h</td>
</tr>
<tr>
<td>LOHC demand*</td>
<td>1400 L/h</td>
</tr>
<tr>
<td>Heat demand*</td>
<td>780 kWth</td>
</tr>
<tr>
<td>Load range</td>
<td>50 – 100 %</td>
</tr>
</tbody>
</table>

*under nominal load

<table>
<thead>
<tr>
<th>Footprint</th>
<th>Plant</th>
</tr>
</thead>
</table>

| Inlet LOHC stream          | ≥ 0.1 barg, T ≥ 15 °C  |
|                           |                         |
| Power connection           | 400 V AC, 3 phase, 50 Hz|

## Release BOX 10 - Configuration

<table>
<thead>
<tr>
<th>One design, ideal for demonstration projects and test purposes</th>
</tr>
</thead>
</table>

### Release BOX 10 - 1.5tpd

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen outlet</td>
<td>10 Nm³/h // 0.9 kgH₂/h</td>
</tr>
<tr>
<td>Hydrogen quality</td>
<td>Three different modules for hydrogen quality available, up to ISO 14687</td>
</tr>
<tr>
<td>Required utilities</td>
<td>power supply, nitrogen, data connection</td>
</tr>
<tr>
<td>Footprint</td>
<td>30 ft container (ISO 668) / Footprint (excl. storage tanks) ~ 45 m²</td>
</tr>
<tr>
<td>Standards</td>
<td>German and European Codes and Standards / CE labeled</td>
</tr>
</tbody>
</table>
**HYDROGEN OUTLET** purity

**HYDROGEN 4.0**
If the subsequent process or hydrogen consumer can handle a certain amount of impurities we can operate the Release PLANT with a maximized hydrogen outlet stream. The HYDROGEN 4.0 option ensures hydrogen quality of ≥99.99%.

**HYDROGEN 5.0**
In case of higher requirements regarding the hydrogen quality, we offer the HYDROGEN 5.0 upgrade option with a hydrogen quality of ≥99.999%.

**FUEL GRADE**
In case of using the released hydrogen as a fuel, e.g. for fuel cell vehicles, we can deliver a fuel grade hydrogen according to ISO 14687.2-2012 and SAE J2719. This FUEL GRADE upgrade will be integrated into the Release PLANT.

**HYDROGEN OUTLET** pressure

**LIGHT PRESSURE** 10 bar
The Release PLANT operates at low pressures. For pressure requirements of up to 10 bar at the terminal point we offer our LIGHT PRESSURE upgrade. This option will be fully integrated into our Release PLANT.

**MEDIUM PRESSURE** 50 bar
If the requested pressure exceeds a level of 10 bar, you can choose the MEDIUM PRESSURE upgrade which ensures hydrogen pressures of up to 50 bar at the terminal point of our Release PLANT.

**HIGH PRESSURE** 100 bar
In order to use the released hydrogen for refueling of vehicles, high hydrogen pressures at the HRS (e.g. 350 or 700 bar) are required. For these purposes, we can provide a HIGH PRESSURE UPGRADE which ensures a hydrogen pressure of 100 bar at the terminal point of our Release PLANT.
Bound to LOHC, hydrogen is stored at ambient temperature, without the need of pressurized or cryogenic vessels. Due to the liquid state and the diesel-like properties of our LOHC, the material is stored and distributed with existing mineral oil fuel infrastructure. Our LOHC is hardly flammable and non-explosive. By using standard oil infrastructure solutions, LOHC entails a cost-effective way to store and transport particularly large amounts of hydrogen in a very safe and efficient way.
**INFRASTRUCTURE SYSTEM**

**On-Site Storage Tank**

With our expertise in LOHC technology we will provide you with the perfect logistical concept for your hydrogen storage or supply demand with fully flexible hydrogen handling capacities up to multi-ton hydrogen storage in standard oil tanks.

**BASIC REQUIREMENTS**

<table>
<thead>
<tr>
<th>Wall</th>
<th>Double-walled or collecting tray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell material</td>
<td>No special requirements</td>
</tr>
<tr>
<td>Valves, gauges</td>
<td>PTFE, FFKM</td>
</tr>
<tr>
<td>Pressure</td>
<td>Atmospheric or slight overpressure (&lt;0.5 barg)</td>
</tr>
<tr>
<td>Inertisation</td>
<td>Inert gas (e.g. nitrogen)</td>
</tr>
<tr>
<td>Mandatory meters</td>
<td>Continuous level indicator, thermometer</td>
</tr>
<tr>
<td>Configuration</td>
<td>Manlid, bottom outlet, top outlet, pressure relief valve, full drainability</td>
</tr>
<tr>
<td>Options</td>
<td>Baffles, compartments, insulation</td>
</tr>
</tbody>
</table>

**Infrastructure System**

<table>
<thead>
<tr>
<th>IBC Container</th>
<th>1 to 3 m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swap Body Container</td>
<td>10 to 24 m³</td>
</tr>
<tr>
<td>Stationary Tank</td>
<td>10 to 700 m³</td>
</tr>
<tr>
<td>Underground Storage</td>
<td>&gt; 10 m³</td>
</tr>
<tr>
<td>Tank Truck</td>
<td>15 to 30 m³</td>
</tr>
<tr>
<td>Tank Trailer</td>
<td>15 to 30 m³</td>
</tr>
<tr>
<td>Swap Body Container</td>
<td>10 to 24 m³</td>
</tr>
</tbody>
</table>

**Transportation and Refueling**

The existing infrastructure of conventional fuel transportation can be used to handle our LOHC material. If your on-site situation allows stationary storage tanks, you can use conventional tank trucks to deliver LOHC and refuel the on-site tanks. Alternatively we can supply you with swap body containers to transport the LOHC in batches and store it on-site.