

Technical report of gas analytic technology to the topics:

Gas analysis technology, gas processing, extractive gas analysis, green hydrogen, electrolyzer, power to gas and power to liquid, process analysis, process analysis technology (PAT)

Industrial processes are monitored, controlled and regulated by various parameters. One of these fundamental parameters is the recording of gas components that pertain to reactions. Important processes are large chemical syntheses, separation plants, gas production facilities, furnace gas production, fermentation processes, biogas plants and combustion controlling on fossil fired boilers in power plants. The measurement of exhaust emissions for the purpose of keeping the air clean has played an important role since 1980.

In the course of climate change, there is an increasing focus on the production of **renewable hydrogen**, so-called **green hydrogen**. **Power to gas** and **Power to liquid** processes are being used to replace fossil fuels. **Hydrogen electrolysis** is monitored for gas quality, impurities and explosive gas mixtures (oxyhydrogen) using **extractive gas analysis technology**.

The following:

- intermittent wet-chemical laboratory analyses
- in situ measurements that measure directly within the process
- extractive measurements are used to record gas components.

Extractive gas analysis systems are widespread. The measurement gas must be extracted, cleaned, dried and transported (see application examples).

Gas analysis devices for qualitative determination provide various methods of measurement:

- Heat conduction principle
- Infra-red and ultra-violet principle
- Paramagnetic principle
- Physical-chemical principle
- Chromatographic principle

There are several practical examples listed:

Sample application 1:

Operative measurement of the boiler with fossil fuel via extractive measurement of carbon monoxide (CO), oxygen (O₂) and nitrogen monoxide (NO).



Sample application 2:

Heating value of quantity and gas composition measurement (**metering technology**) using gas chromatographs.



Sample application 3:

Safety-related operational measurement of oxygen (O₂) and hydrogen (H₂) on **electrolysers** for the production of hydrogen.

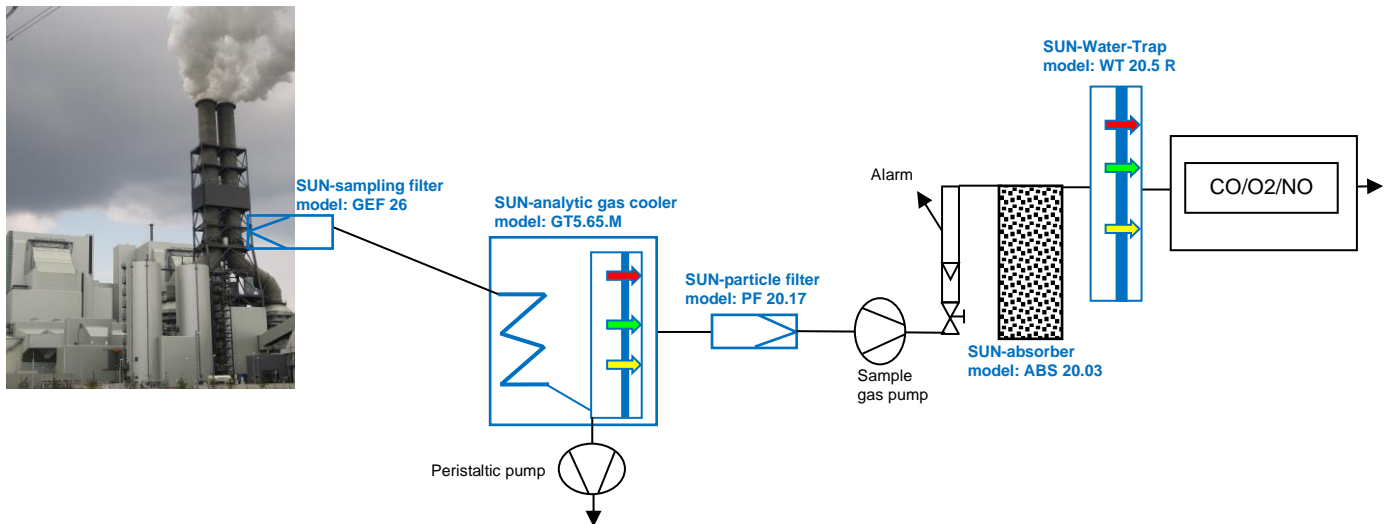
Hydrogen
tested
*Ready for the
future energy*

Sample application 1:

Operative measurement of the boiler with fossil fuel via extractive measurement of carbon monoxide (CO), oxygen (O₂) and nitrogen monoxide (NO).

In combustion plants, the oxygen and carbon monoxide content of the flue gas is a direct measure of the excess air and the most economical combustion. In addition, the nitrogen monoxide content is measured for emission monitoring.

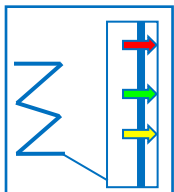
Gas flow diagram:



Explanation of symbols:



SUN-sampling filter model GEF 26



SUN-analytic gas cooler model GT5.65.M





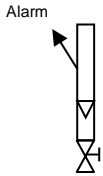
Peristaltic pump



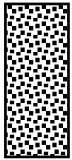
SUN-particle filter model PF 2017



Sample gas pump



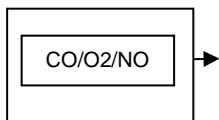
Flow meter with regulator valve and alerting



SUN-absorber model ABS 20.03



SUN-Water-Trap model WT 20.5 R



Gas analyser

Functional description:

The measurement gas is extracted via **sampling filter** model GEF 26. The inner micro glass fibre element with a pore size of 10 µm filters out dust particles. Piping made from stainless steel or PTFE serves to transfer the sample gas. Heated lines are practical for water-soluble gases, such as sulphur-dioxide (SO₂).

The following **analytic gas cooler** model GT5.65.M cools the measurement gas down to a defined dew point. The result is a condensation of the moisture inside the measurement gas, which is usually removed by a peristaltic pump. An additional **particle filter** model PF 20.17 with a pore size of 2 µm provides cascaded particle separation. A sample gas pump transports the gas further to an **absorber** model ABS 20.03 which binds aggressive components such as hydrogen fluoride (HF), hydrochloric acid (HCL) and acid aerosols (sulphur trioxide/SO₃). These cause corrosion in the physical part of the analyser, and provoke faulty measurement or device breakdown. A flow meter with a regulator valve monitors the gas flow. A visual and electrical alert is standard.

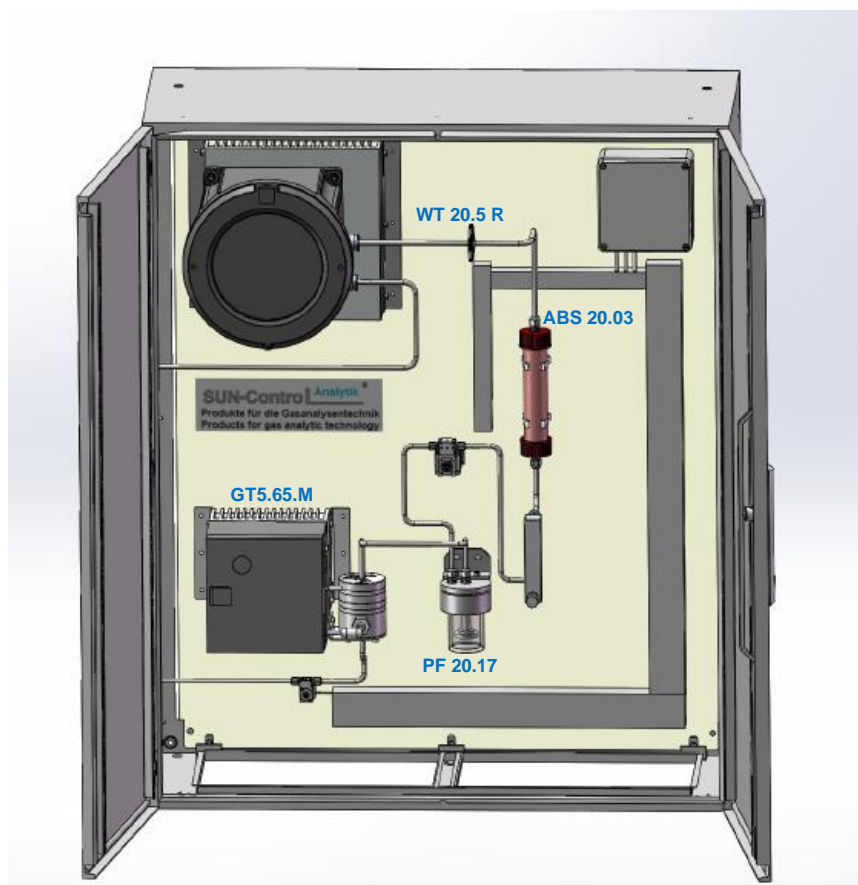
A **Water-Trap** with fine particle filter model WT 20.5 R completes the gas sample handling. If one of the gas components fails, the WT 20.5 R's built-in **SUN-Control-Analytik-Membrane**® protects the high-grade analyser from penetrating condensate and fine particles.

The gas analyser transforms the desired gas concentration into an analogue and/or digital signal, which is further processed as a control, regulation and alerting signal.

Installation example:

The picture shows an analysis cabinet with the components listed in the gas flow plan:

- SUN-analytic gas cooler model GT5.65.M
- Peristaltic pump
- SUN-particle filter model PF 2017
- Sample gas pump
- Flow meter with alerting
- SUN-absorber model ABS 20.03
- SUN-Water-Trap model WT 20.5 R
- Gas analyser



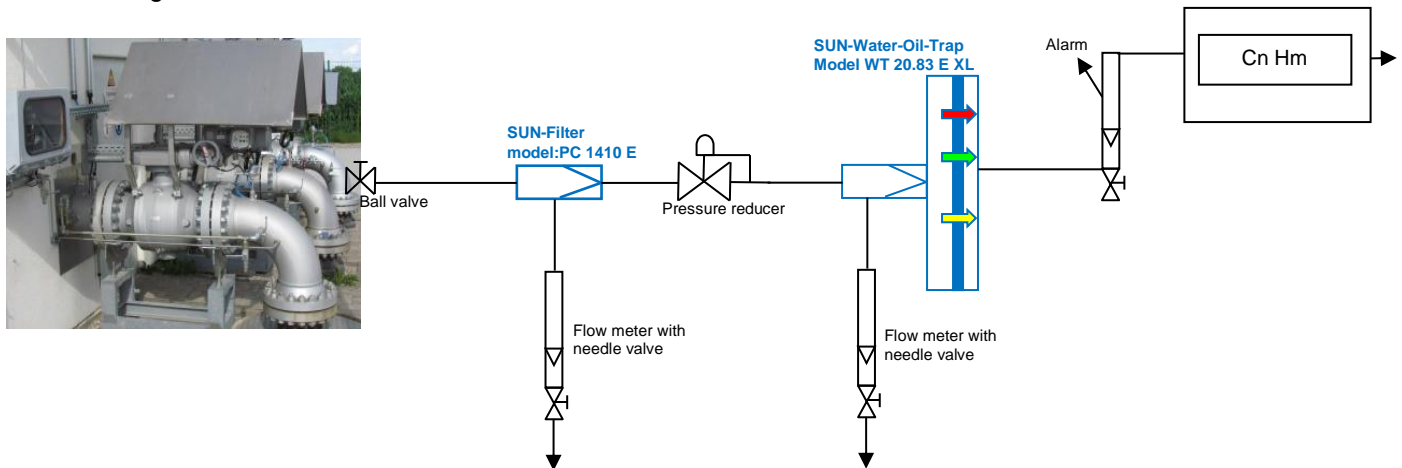
Sample application 2:

Heating value of quantity and gas composition measurement (metering technology) using gas chromatographs.

Germany obtains its natural gas requirements from various countries such as Russia, Norway, England, Holland and partially from own sources. Fortunately, an increase of **renewable energies**, such as biogas and green hydrogen (power-to-gas) has been registered.

The composition of individual sources of the gas mixture is very different. In order to ensure the gas quality for energy billing purposes, the gas concentration must be accurately determined. This is where the gas chromatograph, the flagship of gas analysis technology, is used.

Gas flow diagram:

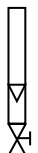


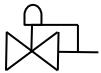
Explanation of symbols:

 Ball valve

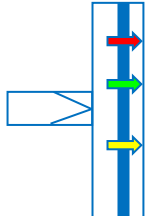
 SUN-filter model PC 1410 E



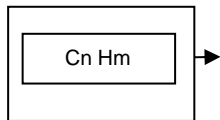
 Flow meter with regulator valve and alerting



Pressure reducer



SUN-Water-Oil-Trap model WT 20.83 E XL



Gas analyser

Functional description:

A ball valve allows the analysis system to be blocked from the process. The following **particle filter** model PC 1410 E with a micro glass fibre element first filters out dust particles. It also extracts condensate that is transported away via a drain. A downstream pressure reducer with safety valve reduces the process pressure to a moderate pressure.

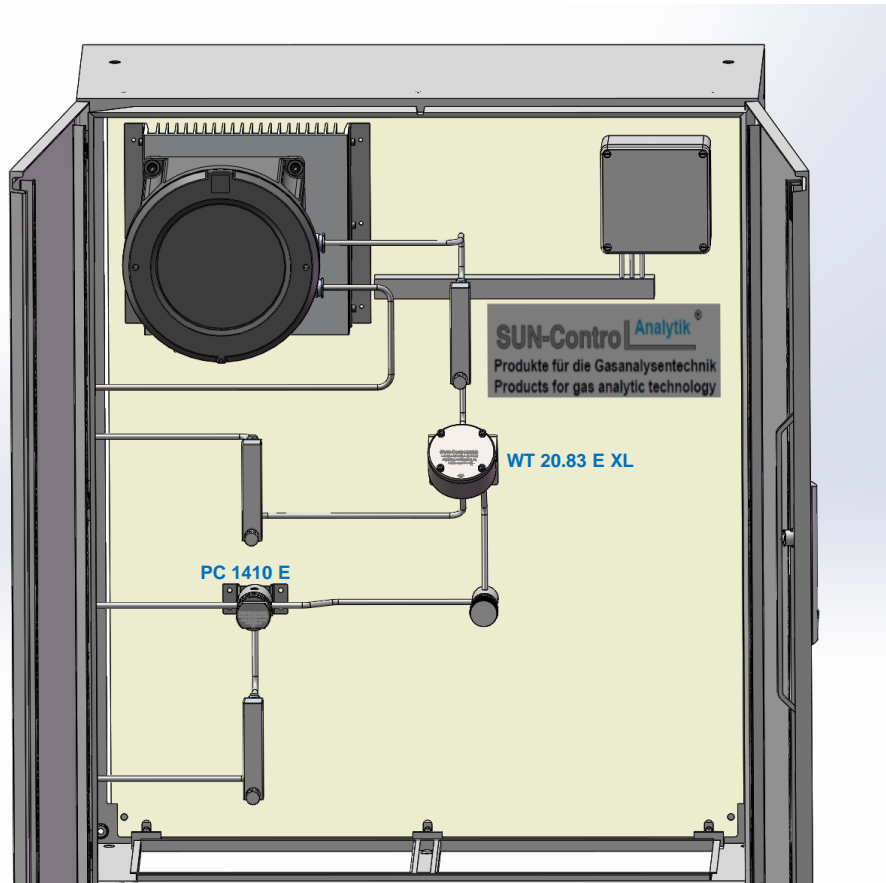
A **Water-Oil-Trap** model WT 20.83 E XL completes the cascaded gas sample handling. The built-in **coalescence filter** removes particles and oil. The SUN-control double membrane system[®] of the WT 20.83 E XL protects the high grade analyser from condensate penetration and fine dusts. The bypass serves as a fast-loop for quick response times as well as condensate discharge.

An full metal area flow meter with a regulator valve monitors the gas flow. A visual and electrical alert is standard. The gas analyser transforms the desired gas concentration into an analogue and/or digital signal, which is further processed as a control, regulation and alerting signal.

Installation example:

The picture shows an analysis cabinet with the components listed in the gas flow plan:

- SUN-filter model PC 1410 E
- Flow meter with regulator valve
- Pressure reducer
- SUN-Water-Oil-Trap model WT 20.83 E XL
- Flow meter with regulator valve
- Gas analyser

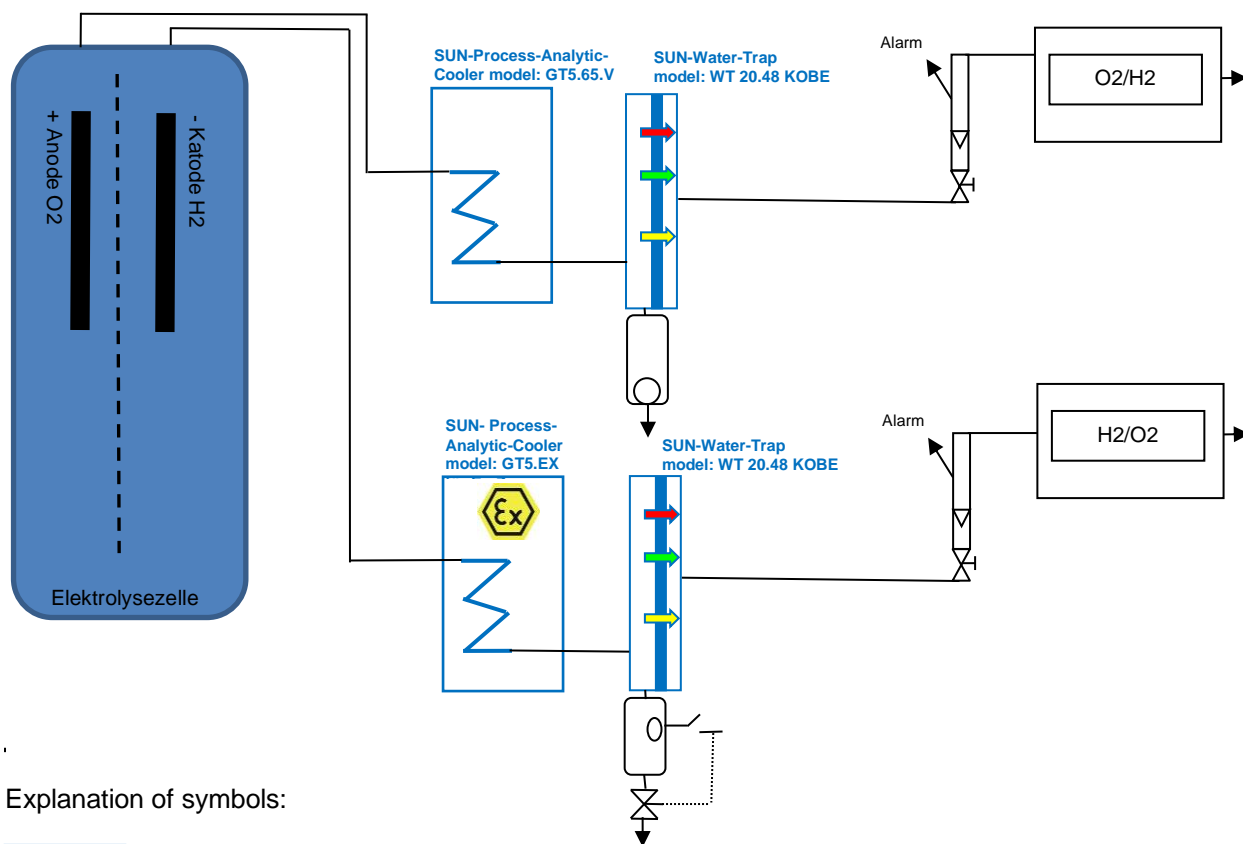


Sample application 3:

Safety-related operational measurement of oxygen (O₂) and hydrogen (H₂) on electrolyzers for the production of hydrogen.

In the course of climate change, there is an increasing focus on the production of **renewable hydrogen**, so-called **green hydrogen**. **Power to gas** and **Power to liquid** processes are being used to replace fossil fuels. The hydrogen electrolysis is monitored for gas quality, impurities and explosive gas mixtures (oxyhydrogen) by means of extractive gas analysis technology from **SUN-Control-Analytik-GmbH**.
 Via electric current, the individual compounds are separated from each other during water electrolysis (2H₂O >> 2H₂ + O₂). If the electric current comes from renewable energy sources (sun, wind), it is considered green hydrogen.

Gas flow diagram:



Explanation of symbols:



SUN-analytic gas cooler model: GT5.65.V

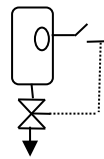


SUN-Water-Trap model: WT 20.48 KOBE

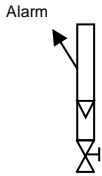




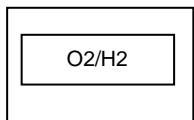
Automatic condensate drain



Condensate vessel with float switch



Flow meter with regulator valve and alerting



Gas analyser

Function description:

The electrode gas is cooled down to a defined dew point via the **Process-Analytic-Cooler** model GT5.65.V from **SUN-Control-Analytik-GmbH®**. An automatic condensate drain removes the resulting liquid.

The **Water-Trap** model WT 20.48 KOBE with the built-in **SUN-Control-Analytik-Membrane®** protects the high-quality analyzer from penetrating condensate and fine dust.

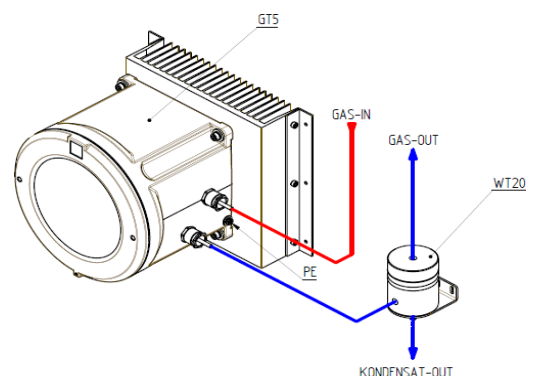
The gas flow monitoring is carried out by a variable area flow meter with a regulating valve. Optical and electrical alarms are standard. The analyzer converts the required gas concentrations into an analog or digital signal, which is processed further as a control, regulation and alarm signal.

The alternative to installation in potentially explosive areas is the Process-Analytic-Cooler model GT5.EX is available. zur Verfügung.

The company **SUN-Control-Analytik-GmbH®** is an official supplier of gas analysis technology for **hydrogen electrolyzers**.



EU - Baumusterprüfbescheinigung



IEC/EN 60079-0, 60079-1, 60079-31

EPS 17 ATEX 1 072

Gas: II 2G Ex db IIC T4 Gb (Tamb +60°C)
 II 2G Ex db IIC T6 Gb (Tamb +40°C)
 Staub: II 2D Ex tb IIIC T130° Db (Tamb +60°C)
 II 2D Ex tb IIIC T80° Db (Tamb +40°C)

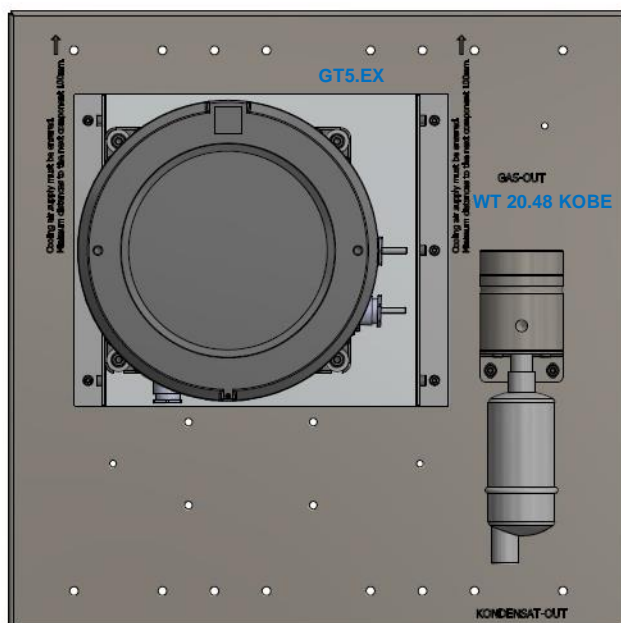
IECEX EPS 17.0036

Gas: Ex db IIC T4 Gb (Tamb +60°C)
 Ex db IIC T6 Gb (Tamb +40°C)
 Staub: Ex tb IIIC T130° Db (Tamb +60°C)
 Ex tb IIIC T80° Db (Tamb +40°C)

Installation example:

The picture shows an analysis Mounting plate with the components listed in the gas flow plan:

- SUN- Process-Analytic-Cooler model: GT5.EX
- SUN-Water-Trapmodel: WT 20.48 KOBE
- Automatic condensate drain



Hydrogen fact sheet:

- Non-toxic, colorless, odorless gas
- Combines with oxygen to give water (H₂O)
- Burns with an invisible hot flame
- Norm density 0.089 kg/m³, west lighter than air
- Ignition range 4 - 77 vol.%, ignition temp.: 560°C
- Most abundant element on earth.
- Highly flammable -Keep away from ignition sources
- Forms dangerous gas mixtures with oxygen (oxyhydrogen)
- High diffusion rate
- conversion 1 ppm = 0.08 mg/m³

- Consider material selection (danger of hydrogen embrittlement of metals such as pipes and instrumentation components)
- Environmentally friendly properties, with air emission-free combustion to water
- Considered an energy carrier of the future that will replace fossil fuels in the medium term

Hydrogen production with color assignment:

- Gray hydrogen: Standard process via steam reforming of fossil fuels.
- Blue hydrogen: Based on gray hydrogen, CO₂ emissions are reduced by earth storage.
- Turquoise hydrogen: H₂ production via thermal methane pyrolysis, CO₂ bonding/processing possible
- Green hydrogen: Electrolysis process produces H₂ and O₂. Feeding of the Elo via renewable energies. e.g. wind or photovoltaic power.

Hydrogen storage options:

- Easy: Pressurized storage in cylinder bundles or caverns.
- Expensive: Refrigeration via cryogenic process at -250°C
- New: H₂ is chemically coupled and stored in carrier material (metals/oils)
- Known: H₂ and CO₂ synthesis to methanol, already realized in petrochemistry
- Interesting: Ammonia production via green H₂ and N₂. Industrial use and infrastructure available

Oxygen fact sheet:

-Colorless, odorless, combustion-promoting gas -Strong oxidant.

-Important component in combustion -Danger of asphyxiation in the event of oxygen deficiency

-Norm density 1.429 kg/m³ -Conversion 1 ppm = 1.33mg/m³

-Strong oxidizing agent and, under unfavorable conditions, can cause carbons such as oils, greases and particles to spontaneous combustion. To avoid such undesirable reactions in plant components, the SUN-Control-Analytik offers a coordinated cleaning procedure for the surfaces in contact with the media.

After the **SUNOX100-P** Process, the surfaces in contact with the media are free of residues.

Technology leader in
Hydrogen-Sample-Handling
Made in Germany

Hydrogen tested
Ready for the future energy
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