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EXPERT SOLUTIONS

CLEAN AIR

SOLUTIONS

ISSUE: 29

THE GAS ANALYSIS MAGAZINE

COMBUSTION EFFICIENCY

Reducing emissions and lowering fuel consumption

GAS CLEAN-UP

Removing harmful substances from process gases

EMISSIONS MONITORING

Ensuring exhaust gases meet environmental regulations



CHANGE IS IN THE AIR

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a spectris company

WE'LL HELP YOU ACHIEVE YOUR CLEAN AIR GOALS

Our Industrial Process & Emissions (IP&E) team is committed to changing the way industries operate by providing gas analysis solutions for clean air.

With an expert team packed with industry experience and applications knowledge, we provide products specifically

designed for the power generation, hydrocarbon processing and emissions monitoring markets.

Servomex analyzers are built to optimize process control, safety and meet environmental standards, keeping your plant and processes future-proof.

They operate across all three stages of our clean air strategy, helping you to achieve combustion control, clean up process gases, and reduce emissions.

Contact us today and find out how we can make your process cleaner, more efficient, and cost-effective.



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GET IN TOUCH TO LEARN MORE: [SERVOMEX.COM/IP-AND-E](https://servomex.com/ip-and-e)

SEE HOW WE HELP

Watch our new clean air video to find out how our gas analysis solutions support your clean air strategy: servomex.com/cleanair



MAKE SERVOMEX YOUR GAS ANALYSIS PARTNER FOR A CLEANER FUTURE

Welcome to the latest issue of Expert Solutions. This edition shows the positive impact of our gas analyzers and systems on the world, by supporting industry in their clean air strategies.

Reducing emissions of harmful pollutants, especially carbon, is a major concern for all industries. In this magazine, we explain how gas analysis helps to make processes cleaner and more efficient, helping plant operators to meet their emission reduction goals.

We've broken down our approach into three phases, showing how dealing with each stage contributes to a better environment for us all.

We also introduce the products that provide the key gas measurements, delivering efficiency, cost savings, safety benefits, and lower emissions.

Servomex's strategy for cleaner air is led by our Industrial Process & Emissions team. These experts not only have a deep knowledge of the products and measurements essential to efficient processes, they also understand the applications involved, and know when to use the right technology at the right process point, so can guide our customers to the best solution.

Start your journey towards cleaner air today. Get in touch with our team to learn more: servomex.com/contact

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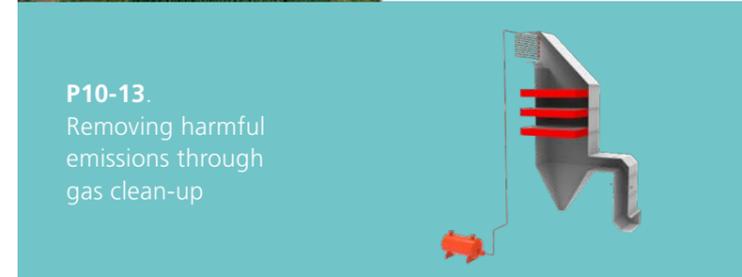
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IN THIS ISSUE

P04-05.
Change is in the air: discover our clean air strategy



P06-09.
Reducing emissions through combustion control



P10-13.
Removing harmful emissions through gas clean-up



P14-17.
Ensure compliance with emissions monitoring

SPOTLIGHT ON OUR SERVICE AGREEMENTS

Delivered through our global Service Network, a Servomex Service Agreement delivers the peace of mind that comes with proactive analyzer maintenance.

Regular servicing of your gas analysis systems adds real value to your operations, delivering improved reliability, increased uptime, and process optimization for your applications.

We have a range of packages available, helping to build an expert partnership that provides you with ongoing support.

Visit: servomex.com/service

CHANGE IS IN THE AIR

We are all increasingly conscious of our contribution towards greenhouse gas emissions.

This awareness has led industrial operators around the globe to look how they can operate in the most environmentally responsible way.

While some of these efforts are driven by government regulations and international action on

climate, such as the 2016 Paris Agreement, there is a growing realization that cleaner operations have significant benefits to process efficiency, profit margins, and public perception.

Put simply, good practice on clean air is good business.

As the global expert in gas analysis, Servomex plays a major role in helping a wide range of

industries achieve their clean air goals.

Our three-phase strategy focuses on the key process areas, working to reduce emissions and mitigate the damage caused by harmful pollutants.

Together, we're already building a cleaner world.

PHASE ONE

COMBUSTION EFFICIENCY

Controlling this important process reaction reduces emissions of key pollutants, including NOx, SOx, carbon monoxide and carbon dioxide, lowers fuel consumption, and improves safety.

PHASE TWO

GAS CLEANING

Safely removing harmful substances from process gases that might otherwise be emitted by the plant. Examples include DeNOx treatments and carbon capture.

PHASE THREE

EMISSIONS MONITORING

Measuring pollutants within the flue gas to determine process efficiency and ensure compliance with the necessary regulations.

Find out how Servomex will make your process cleaner and more efficient: servomex.com/contact

REDUCING EMISSIONS THROUGH EFFECTIVE COMBUSTION CONTROL

The best way to reduce emissions is to avoid producing them in the first place. Optimizing combustion significantly lowers the level of harmful emissions released.

Combustion – usually taking place in a fired heater – is an integral part of many processes, and is often the only way to create the extremely high temperatures required.

The combustion reaction mixes fuel with oxygen (from air), delivering heat energy that can be transferred elsewhere in the process. Typically, this requires a significant amount of fuel, creates potential safety hazards, and generates harmful emissions.

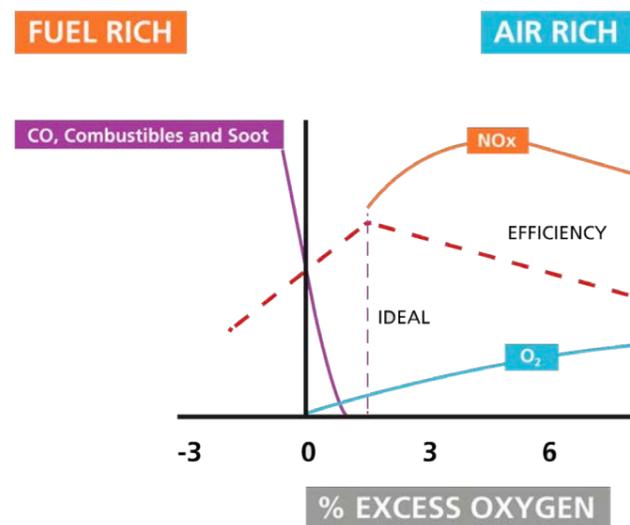
Optimizing the ratio between the air and fuel results in the most efficient reaction. In the time before gas analysis, fired heaters were run in conditions of high excess air. This was inefficient and raised the level of fuel consumption, but avoided the creation of unsafe conditions that could lead to an explosion.

Excess oxygen (O₂) will combine with nitrogen and sulfur present in the fuel to produce unwanted emissions such as oxides of nitrogen (NO_x) and sulfur (SO_x).

Accurate gas analysis of O₂ and combustibles such as carbon monoxide (CO) has provided a way to better balance the air-to-fuel ratio and control the combustion reaction.

Controlling combustion produces many benefits for plants looking to meet environmental standards requirements. Fuel consumption is reduced, and safety improved. It also results in fewer emissions, a reduction in NO_x, SO_x and CO, and a decrease in the greenhouse gas carbon dioxide (CO₂).

EXAMPLE GAS FIRED PROCESS, ACTUAL EXCESS OXYGEN LEVELS WILL VARY WITH HEATER SIZE, FUEL, LOADING AND AMBIENT CONDITIONS.

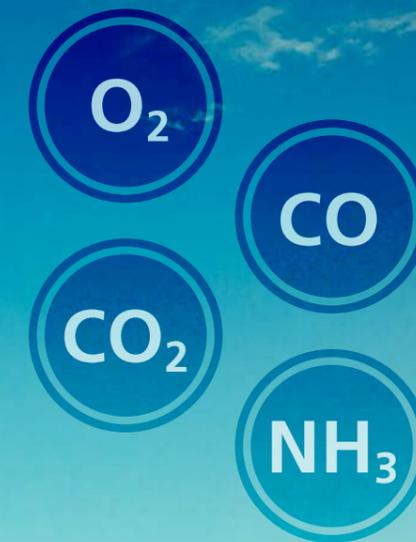


PROCESS EFFICIENCY SUPPORTS CLEANER AIR

Gas analysis also plays a role in many other applications to support greater process efficiency. In general, the more efficient the process reaction is, the fewer harmful emissions are likely to be generated, so this also supports cleaner air.

One key example is the Fluid Catalytic Cracking Unit (FCCU), which is one of the largest air emissions sources in a refinery, and which requires multiple gas measurements across the process.

A process control O₂ measurement is required in the regenerator off-gas, where low O₂ will cause incomplete combustion of the coke and excess O₂ can reduce catalyst life. Measurement of CO and CO₂ in the same off-gas helps calculate catalyst coke formation, while excess O₂ and CO levels require monitoring in the regenerator flue gas, and ammonia (NH₃) slip is measured at the selective catalytic reduction (SCR) reactor outlet to control the DeNO_x process.



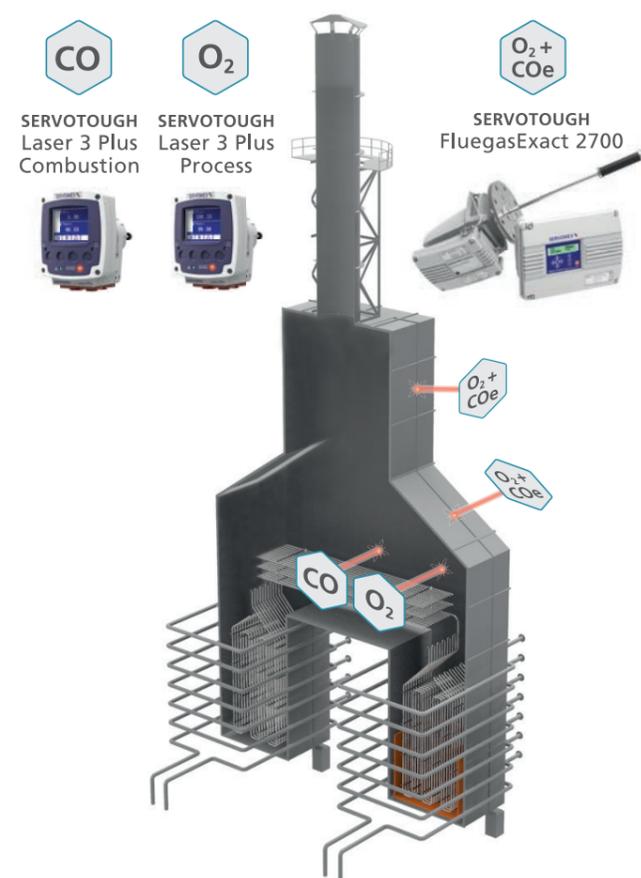
SOLUTIONS FOR COMBUSTION CONTROL

Combustion control relies on accurate measurements of oxygen (O₂) and combustibles (COe) in the reaction mixture.

Zirconia-based sensing technology is long established as a solution for O₂ monitoring in combustion, and delivers reliable, accurate results with a fast response to changing conditions. It has the advantage that a combustibles sensor can be added easily, and at modest cost, to provide an all-in-one combustion control solution.

Tunable Diode Laser (TDL) technology is a more recent solution for this application, and provides an even faster measurement, particularly for carbon monoxide (CO). It also gives an average measurement across the measurement path, rather than the result at a single point. However, since TDL sensing is highly specific to the gas being measured, separate analyzers are required for O₂ and CO.

TYPICAL FURNACE CONFIGURATION



Get the expert view, watch our video on solutions for combustion control: servomex.com/videos

SERVOTOUGH FluegasExact 2700



Designed to measure O₂ and COe in flue gases for improved combustion efficiency and reduced emissions, the SERVOTOUGH FluegasExact 2700 gas analyzer meets the most demanding needs of combustion efficiency applications in the power generation and process industries.

It uses trusted Zirconia technology for O₂ sensing and a sulfur-resistant combustibles sensor, all in one compact combustion gas analyzer.

KEY BENEFITS

- Unique Flowcube technology enables positive flow conditions to be validated, enabling preventative maintenance and low-flow alarms
- Designed for hazardous conditions, with hazard ratings for ATEX Cat. 3, IECEx Zone 2 & North America Class 1, Division 2
- Close-coupled extractive measurement principle ensures a long sensor life by keeping the sensors outside the harsh process conditions, in a heated enclosure

Find out more at: servomex.com/2700

Optimized for fast, accurate and responsive measurements in combustion and process control, The SERVOTOUGH Laser 3 Plus Combustion offers unmatched installation flexibility along with cost and performance benefits, all in a light, compact unit.

Using highly specific TDL sensing to measure either O₂ or CO, it can also be configured for a joint measurement of CO and methane, providing a rapid-response measurement for safety.

KEY BENEFITS:

- Servomex's own line lock cuvette technology ensures the Laser 3 Plus Combustion continues to measure the required gas reliably
- The compact analyzer can be easily installed by a single engineer, with the on-board display negating the need for laptop configuration
- Along with ATEX, IECEx and North American hazardous area approvals, it is also approved for process Zone 2, is SIL 2 assessed, and CE marked

Find out more at: servomex.com/l3plus-combustion

SERVOTOUGH Laser 3 Plus Combustion



GAS CLEANING TO MITIGATE EMISSIONS

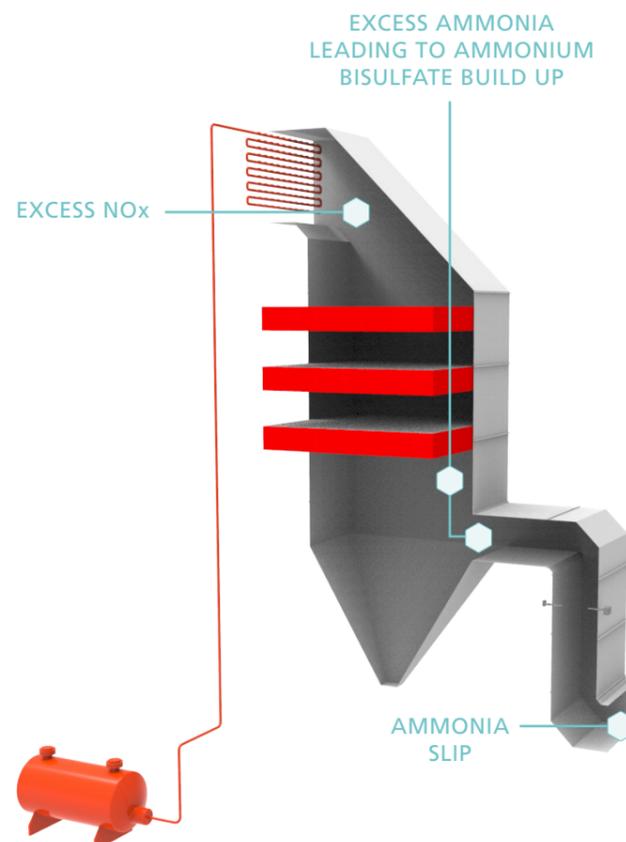
Gas cleaning is the removal of harmful substances from process gases that might otherwise be emitted by the plant. Typical applications include DeNOx (ammonia slip) treatment, flue gas desulfurization, and carbon capture and storage.

AMMONIA SLIP

Ammonia (NH₃) or urea is used to suppress the harmful emissions of NOx from combustion, either in a Selective Catalytic Reduction (SCR) or Selective Non-Catalytic Reduction (SNCR) process.

These methods require accurate NH₃ dosing to reduce NOx levels – insufficient NH₃ will fail to adequately suppress NOx emissions, while too much NH₃ can lead to the eventual formation of ammonium bisulfate (ABS).

ABS is a white powder that can plug the catalyst in SCR processes, causing equipment damage and reducing the value of the fly ash by-product, so it is vital that plants manage DeNOx processes efficiently, controlling the level of ammonia slip to between 2-3 parts per million of NH₃.



FLUE GAS DESULFURIZATION

A flue gas desulfurization (FGD) system removes sulfur compounds (SOx, principally sulfur dioxide) from exhaust gases. It is usually utilized by fossil-fuel power plants and operators in other SOx-emitting processes, such as waste incineration.

Commonly, the flue gas is sprayed with a wet slurry of lime which scrubs up to 95% of the sulfur dioxide (SO₂) content from the gas. Gas analyzers measure the SO₂ content after this treatment to check that any remaining sulfur compounds fall within regulatory limits.

Since gases containing SOx can be corrosive, and treatment temperatures are usually kept high to prevent moisture content from damaging equipment, this gas analysis can be challenging, so non-contact, photometric sensing is the most effective and accurate technology for this application.



CARBON CAPTURE AND STORAGE (CCS)

Capturing and storing carbon dioxide (CO₂) that would otherwise be released into the atmosphere results in a cleaner environment and allows the CO₂ to be used in other processes.

THE THREE METHODS FOR CCS

POST-COMBUSTION CCS

Post-combustion CCS removes CO₂ from the flue gas after fossil fuels have been burned.

OXYFUEL CCS

Oxyfuel CCS reacts the fuel source with almost pure oxygen (O₂) producing CO₂ and steam. Both methods can be retrofitted to existing plants or used in new ones.

PRE-COMBUSTION CCS

Pre-combustion CCS is performed prior to burning the fuel, and converts the fuel into a mixture of hydrogen and CO₂. This is better suited to newly built facilities, as it is difficult to retrofit.

Once the CO₂ is captured, by any method, it is then compressed into a liquid and transported for storage.

SOLUTIONS FOR GAS CLEANING PROCESSES

Since different gas measurements are required for various gas cleaning processes, a range of sensing technologies are required. Servomex offers a range of analytical solutions with features and sensor benefits best suited to each application.

AMMONIA SLIP

SERVOTOUGH Laser 3 Plus Environmental



Ammonia (NH₃) can be monitored by extractive sampling, but the sample must be kept above 554°F (290°C) to prevent the formation of ABS and sulfuric acid. Inlet NO_x concentration, fuel composition and catalyst performance can also affect the measurement, while Infrared-based extractive systems may also be impacted by signal interferences from gases formed by the process, and by high levels of dust.

The SERVOTOUGH Laser 3 Plus Environmental TDL analyzer, installed directly into the process ducts, provides a more effective solution. Its signal is averaged across the duct, for a more accurate NH₃ reading despite uneven flow conditions.

It has the installation flexibility and cost and performance benefits of the rest of the Laser 3 Plus range, including auto-validation software to ensure ongoing accuracy.

See how the Laser 3 Plus solves your challenges servomex.com/l3plus-environmental

FLUE GAS DESULFURIZATION

SERVOPRO 4900 Multigas



The SERVOPRO 4900 Multigas uses Infrared Gas Filter Correlation technology to measure sulfur dioxide (SO₂) in this application, delivering real-time measurements accurate to very low levels, without interference from background gases.

This technology can also support sulfur recovery units (SRUs) which recover sulfur from streams containing hydrogen sulfide (H₂S).

The SERVOPRO 4900 Multigas is a versatile, high-performance analyzer that provides a wide range of measurements of multiple flue gas components. Combining our trusted sensor technologies with an advanced digital platform, it can deliver up to four simultaneous gas stream measurements.

Easily integrated into existing monitoring systems, the 4900 Multigas has low operational requirements, facilitated through long calibration intervals.

Discover the benefits of multi-gas monitoring servomex.com/4900

CARBON CAPTURE

SERVOTOUGH SpectraExact 2500



Capable of single or multi-component gas monitoring in corrosive, toxic or flammable streams, the SERVOTOUGH SpectraExact 2500 uses Infrared and Gas Filter Correlation technologies to measure carbon dioxide (CO₂) at percentage and parts-per-million levels. This means it can measure the flue gas to ensure most CO₂ has been removed, and is also capable of assessing the purity of the removed CO₂ prior to it going to storage.

The SpectraExact 2500 has a flexible, single and multi-component gas analysis capability. It offers reliable, accurate and stable real-time measurements in corrosive, toxic and flammable gas streams.

The sensor is kept separate from the sample cell, ensuring non-contact analysis, ease of maintenance, and safe operation, while a full suite of digital communications allows remote control of its full functionality.

Find out why the SpectraExact 2500 is ideal for CCS processes servomex.com/2500

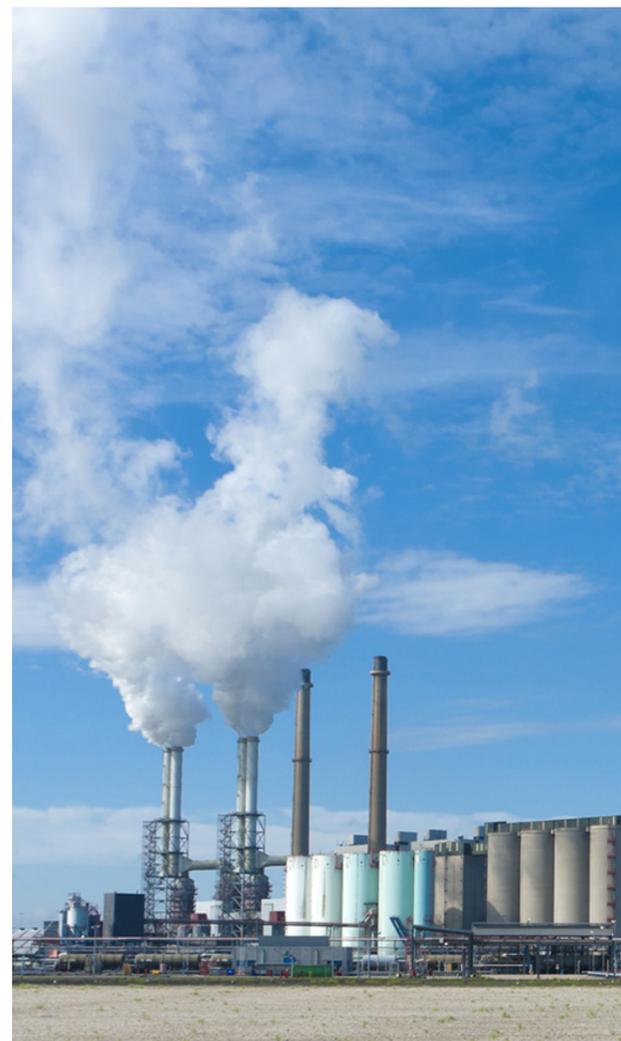
MONITORING EMISSIONS FROM FLUE GASES

Emissions reduction has been high on the agenda for many countries in recent years, with legislation reducing the acceptable amounts of greenhouse gases that can be released into the atmosphere.

Monitoring flue gas emissions helps determine the process efficiency and protect the environment. It also ensures – and demonstrates – that plant operators are complying with the necessary regulations.

Along with the greenhouse gases carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), NO_x and SO_x are also recognized as key pollutants, as is carbon monoxide (CO). They must all be measured in order to achieve a clean air strategy and meet regulatory requirements.

A continuous emissions monitoring system (CEMS) is required to measure all the necessary components of the flue gas and ensure compliance. Industries and processes requiring continuous emissions monitoring include power generation, petrochemical, refining, waste incineration, iron and steel, pulp and paper, and cement manufacture.



USING HYDROGEN AS A CLEANER ENERGY SOURCE

Many plants are also moving to cleaner energy sources, such as hydrogen, while plants that produce hydrogen are ramping up output to meet increased demand.

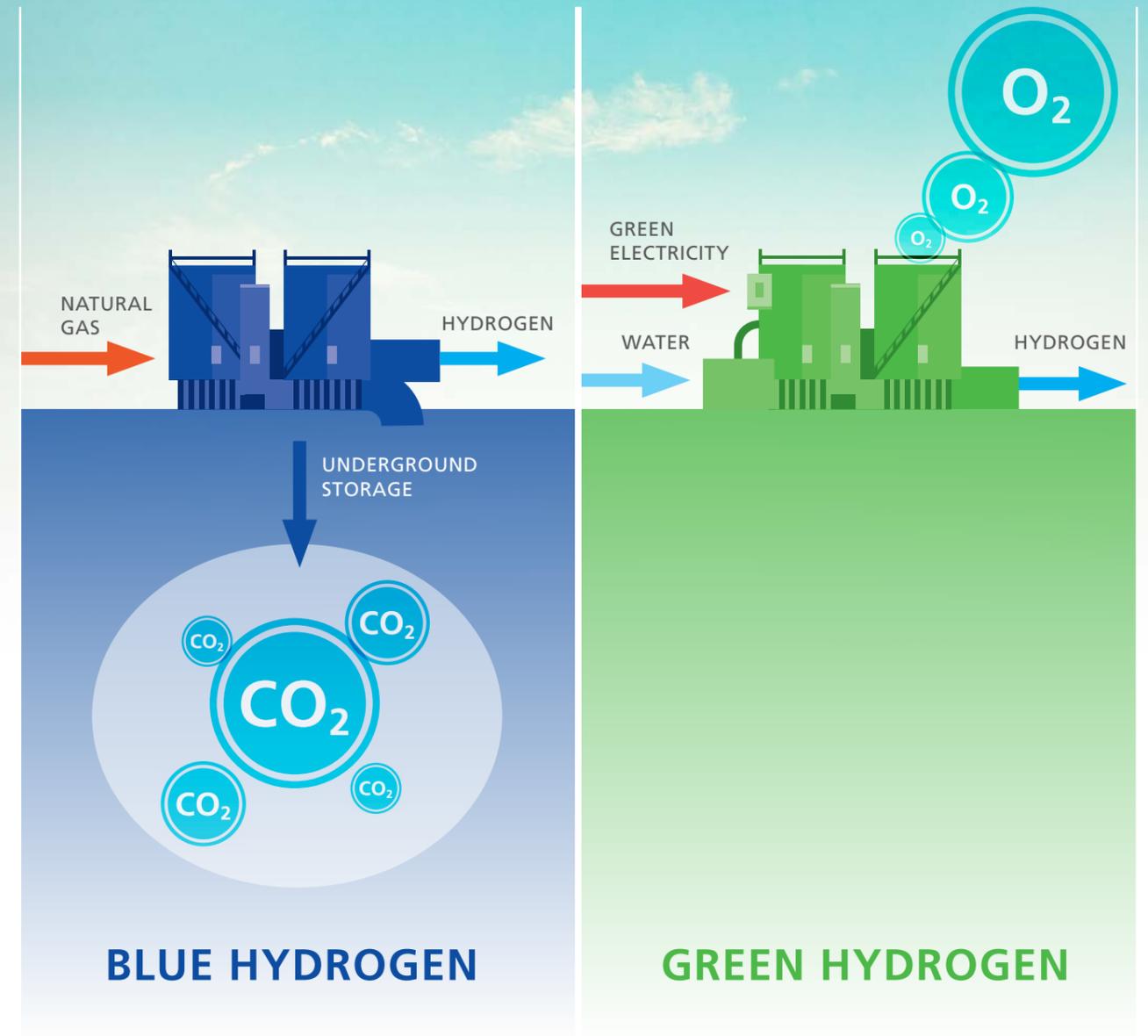
Blue hydrogen is produced using fossil fuel sources, such as natural gas, through steam methane reforming, and can be supported

by carbon capture processes to counter the CO₂ produced during this application.

Green hydrogen is created from non-fossil fuel sources, such as water, using processes like electrolysis, fueled by renewable sources like wind power.

Hydrogen (H₂) gas burns much more cleanly than CH₄, as it does not contain carbon, so cannot form CO₂ as a byproduct of combustion.

The purity of the H₂ affects its quality as a fuel, and this is where gas analysis again plays a major role.



SOLUTIONS FOR CONTINUOUS EMISSIONS MONITORING

Continuous Emissions Monitoring Systems (CEMS) installations must offer the highest sensitivity and accuracy when dealing with multiple measurements for pollutants and greenhouse gases.

CONTINUOUS EMISSIONS MONITORING

SERVOPRO 4900 Multigas



No single technology can provide all the required measurements, so it is important to use a combination of sensing technologies.

Multi-component gas analyzers are ideal for this application, and depending on the process can either deliver all the necessary measurements in one device or form a key part of an integrated CEMS. In many countries, gas analysis systems must also meet MCERTS and QAL1 certifications to comply with regulatory criteria.

A single SERVOPRO 4900 Multigas can measure four gases simultaneously, but not four different gas streams, from a choice of oxygen (O₂), carbon dioxide (CO₂), carbon monoxide (CO), sulfur dioxide (SO₂), nitric oxide (NO), methane (CH₄) and nitrous oxide (N₂O), so multiple analyzers can easily cover the pollutants of interest.

It meets key certification requirements, including MCERTS (EN 15627-3) and QAL1 (EN 14181).

Find out more at: servomex.com/4900

OTHER EMISSIONS MONITORING SOLUTIONS

SERVOPRO NOx



Using time-proven, non-depleting Chemiluminescence detection technology to measure NO or NO/NO₂/NOx concentrations, the versatile SERVOPRO NOx can be calibrated for four measurement ranges from ultra-low to high parts per million (ppm), and is easy to install and operate.

It can be configured to meet a range of regulatory standards, including EPA 1065/1066, LD Euro 6, and HD Euro V1, and is easily integrated into rack-mounted CEMS systems.

Find out more at: servomex.com/nox

SOLUTIONS FOR HYDROGEN GAS PRODUCTION

SERVOPRO MultiExact 4200



Depending on the manufacturing method, the most common contaminants in hydrogen production will be O₂, CO and CO₂, which can all be monitored at percentage levels by our new SERVOPRO MultiExact 4200 multi-component analyzer.

Using a mixture of Paramagnetic, Infrared, and Gas Filter Correlation sensing, the MultiExact 4200 measures up to four gas streams simultaneously, providing high-specification, multi-gas analysis of trace contaminants and flammable gas samples.

The latest generation of our trusted 4200 Series analyzers, the MultiExact 4200 can also be configured to measure percentage CH₄ and ppm-level CO, CO₂, CH₄ and N₂O.

Easy to use, it offers a low lifetime cost of ownership, simple maintenance, and flexible communications options.

Find out more at: servomex.com/4200

HELPING YOU TO BUILD A CLEANER FUTURE

PHASE ONE

COMBUSTION EFFICIENCY

Gas analysis plays an essential role in cleaner plant and refinery operations, whether it is used to ensure more efficient processes, to support the safe removal of pollutants, or to monitor the remaining emissions that are output to the atmosphere.

It also supports the latest trends emerging in the industry, including greater process optimization, the

PHASE TWO

GAS CLEANING

move to cleaner fuels, and achieving higher product yields. With such a wide range of goals to be reached, an equally wide range of sensing technologies is needed, and this is where partnering with an expert gas analysis supplier is key.

Service support is another essential consideration – forging a service contract that maintains gas analysis systems at peak

PHASE THREE

EMISSIONS MONITORING

performance ensures the refinery or plant continues to operate in the cleanest way possible.

Each of the phases outlined in this publication contributes towards a cleaner air strategy. By combining all three, industrial operators can fully address their impact on the wider environment, be an advocate for change and create a world with cleaner air.

PARTNER WITH OUR EXPERT TEAM TO MEET YOUR GOALS

Servomex has the knowledge, experience and expertise to ensure you get the best results from your clean air strategy – and achieve your process goals.

With analyzers powered by a diverse selection of technologies, we work with you to ensure the best-fit and most cost-effective solution for your application.

In addition, our global Service Network offers customizable service packages tailored to the level of support you need, for complete peace of mind that you'll continue to get peak performance from your system.



Find out how we can work towards a cleaner world together. Get in touch now: servomex.com/contact

SERVOMEX PROVIDES A COMPREHENSIVE, SINGLE-SUPPLIER SOLUTION FROM PRECISION GAS ANALYSIS TO ENTIRE SYSTEMS AND EXPERT GLOBAL SUPPORT.



Discover our analyzer range: servomex.com/gas-analyzers

Servomex's analyzer range is the most comprehensive available from a single manufacturer, setting the standard for the industrial gas (IG) market for decades with a unique 'all of market' solution.

Powered by reliable, ground-breaking sensor technologies, our range delivers accurate, stable measurements for every point

in your process, with a full range of percent to ultra-trace measurements.

Servomex analyzers support quality control, maintaining gas purity during the production process and detecting impurities during processes such as medical gas supply or semiconductor production.

We also provide solutions for process control and ensure safety and emissions monitoring for potentially hazardous processes.

Our commitment to ongoing development ensures that even the most trusted measurements are continuously improved, with added features that increase ease of use and reduce the cost of ownership.



Discover our systems solutions: servomex.com/systems

In addition to individual analyzers, Servomex also supplies complete system solutions designed to order for your project. State-of-the-art systems engineering centers in

the US, China, India and Europe provide a global service, offering solutions ranging from simple utilities panels to fully-contained air-conditioned shelters.

Proven experience ensures the optimum level of efficiency, safety and cost-effective operation for your application.



Discover our service solutions: servomex.com/service

Servomex support doesn't end with the supply of your analyzer or system. Our expert team delivers gas analysis expertise directly to your plant. With global coverage provided by service centers and

mobile engineers worldwide, the Servomex Service Network ensures your processes run efficiently, safely and profitably. Support offered includes service plans, spares, on-site support,

commissioning, health checks, training, and equipment rental. We also provide expert support from our extensive network of service centers, or on-site at your facility.

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