Chlor-Alkali Industry

Dependable online, inline, and atline solutions for your process needs.

Metrohm
Process Analytics

Chlorine and Caustic Soda: Chemical Building Blocks

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Uses of chlorine

Chlorine (Cl_2) ranks number 7 on the list of the most commonly produced chemical substances. Since chlorine is such an extremely reactive molecule, it is dangerous to transport and handle after purification. Corrosive acids can form if the purified Cl_2 is exposed to moisture.

It is the basis for the production of numerous intermediate substances, which, in turn, are important feedstock materials in the petroleum, aluminum, paper and pulp, or pharmaceutical industries.

For instance, chlorine is used in the production of an impressive 80% of drugs. Polyvinyl chloride (PVC, one of the most widely produced polymers worldwide), isocyanates, and several chemical solvents can be made as a result of the generation of chlorine. Another common use is the disinfection of water sources (drinking water, swimming pools) to protect human health.

Uses of caustic soda

Caustic soda (sodium hydroxide, NaOH) is another crucial basic chemical which enables production of organic chemical products, bleach, detergents, paper, cellulose products, and several other materials.

The Kraft Process, which is used in paper mills to convert solid wood into pulp, is responsible for a considerable percentage of caustic soda consumption.

This product is also used frequently to adjust pH in several production processes in many industries.

The Chlor-Alkali Process

By far the largest part – about 95% – of the chlorine produced globally is obtained via the chlor-alkali process. In this process, caustic and chlorine are created together in similar proportions via electrolysis of sodium (or potassium) chloride brine.

There are three main methods used to create chlorine and caustic from brine:

- membrane cell process
- mercury cell process
- diaphragm cell process

Safer technologies for the future

The most commonly applied electrolysis technique in Europe is the membrane cell technique (64%). All new plants are based on membrane cell electrolysis of brine, which does not include mercury and asbestos like the other processes.

In Europe, the top chlor-alkali producers are Germany, followed by France, Belgium, and the Netherlands.

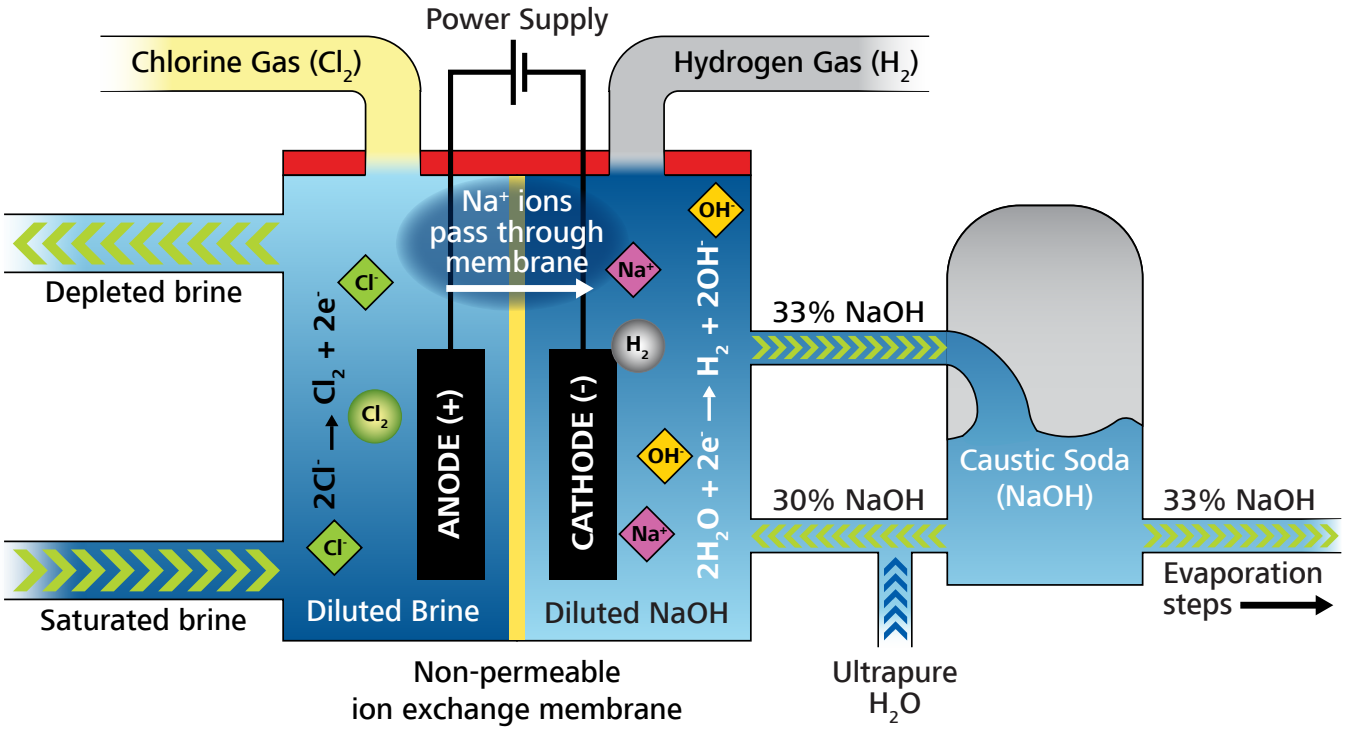

Diagram of membrane cell technique for the production of chlorine. Adapted from www.eurochlor.org.

Reduce Risk with Online Process Analysis

Every minute counts

Performing manual sampling followed by laboratory analysis can take up precious time. Inefficient and cumbersome analytical methods can also miss significant events such as ion exchange breakthrough early on, or allow the process to be out-of-specification until the next measurement is taken, whenever that may be. When it comes to true process optimization tactics, every minute counts.

In the membrane cell process, it is imperative that ultrapure brine is used for electrolysis, otherwise the expensive membranes can become fouled. Even exposure to higher levels of hardness for a short time can lead to premature membrane fouling. This causes a loss in current efficiency which leads either to **higher utility costs** or **lower product yields** until the membrane is eventually replaced during a scheduled shutdown.

Advantages of online process analysis

Metrohm Applikon, with the brand of Metrohm Process Analytics instruments, is able to offer several application solutions for the chlor-alkali industry.

Process analyzers from Metrohm are designed to offer fast, reliable, accurate measurements in a rugged housing, 24/7 to ensure processes are always running within specifications. Online analysis with industrial process analyzers lessens the need for highly-skilled technical employees and saves time by automating measurements directly at the sample point. Reducing manual sampling **lowers costs** and **increases the safety** of plant operations.

With subsidiaries located worldwide, you can rest easy knowing we can support you locally, wherever you are.

Applications

Process Application Notes for the Chlor-Alkali Industry

- Hardness in Brine.
  AN-PAN-1005

Improve upon your brine treatment efficiency
Brine must be pretreated in several steps to reduce impurities such as calcium and magnesium ions (hardness). After primary treatment, the purified brine is passed through an ion exchange unit to further minimize contaminants before the electrolysis process.

Accurate determination of hardness concentrations can estimate the efficiency of settling and resin treatments. Upstream control of brine quality helps overcome costly membrane remediation procedures before fouling occurs.

The 2035 Process Analyzer is the perfect solution to monitor hardness in brine online during all stages of this process.

- Monitor hardness in brine in µg/L to mg/L with high-precision burette dosing & auto-calibration.
- Available in three versions for maximum application coverage: potentiometric titration, thermometric titration, or photometric measurement.
- Suitable for other applications such as caustic and carbonate in brine, hypochlorite in brine, chlorine in brine & waste streams, and much more.

The Metrohm Process Analytics 2035 Process Analyzer (L), for potentiometric titration of high levels of hardness in raw brine.

The 2035 Process Analyzer configured for photometric measurements (R) is ideal for monitoring low concentrations of hardness in polished brine prior to the electrolysis process.

Applications

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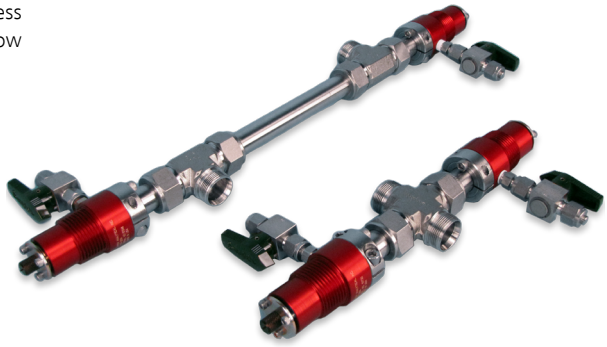
Fast, safe moisture measurements in gases

Moisture determination in the produced gases (Cl_2, H_2) is necessary to overcome corrosion in storage containers and transport pipelines. Vaporization of the gases after storage, without proper removal of moisture beforehand, can also clog the container valves and lead to further handling issues.

Inline near infrared spectroscopy (NIRS), with a reference method (such as Metrohm Karl Fischer titration) is ideal for this application. Near real-time analysis of low moisture content without chemical reagents is possible with the use of flow cells and fiber optic connections.

- Safe, reagent-free analysis directly inline.
- NIRS XDS is capable of monitoring up to 9 different process points with the multiplexing capability.
- Measurement technique sensitive to low levels of moisture.
- Reference method also provided by Metrohm (Karl Fischer titration).
- Process analyzer is available in ATEX version.

The NIRS XDS Process Analyzer from Metrohm Process Analytics, configured for ATEX applications, with rugged flow cells (R) for inline gas measurements.



Process Application Notes for the Chlor-Alkali Industry

- Online Determination of Anions in 50% NaOH and 50% KOH by IC (ASTM E1787-16). **AN-PAN-1046**

Impurities in concentrated caustic with Process IC
ASTM method E1787-16 specifies ion chromatography to measure several anions in concentrated NaOH or KOH solutions. The many **intelligent sample preconditioning techniques** offered by the Metrohm Process IC make the analysis of anion impurities in concentrated caustic solutions simple and easy to perform online.

- IC is a robust analysis method suitable for measuring several components in a single sample run.
- Intelligent sample preparation leads to safer analysis and more reproducible results.
- Measures analytes from ng/L to %.
- Optional: integration of pressureless ultrapure water system for the most reliable automated trace analysis.

The **Process Ion Chromatograph TWO** from Metrohm Process Analytics. Configured to analyze both anions and cations simultaneously for the most comprehensive overview of your process. Up to 20 sample streams can be connected to a single instrument.

Model shown with the optional integrated ultrapure water system (ELGA) and several sample preconditioning modules to keep the analyzer running unattended with full protection from harsh sample streams.

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