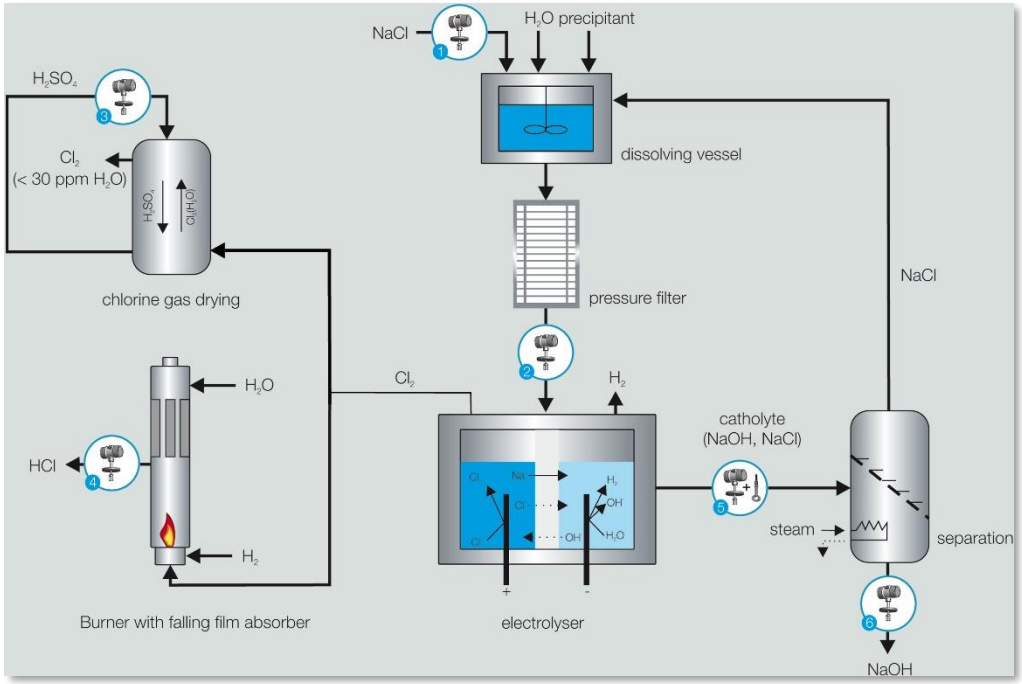
SensoTech
In liquids, we set the measure.

Chlorine-alkali electrolysis

Chlorine-alkali electrolysis

Introduction

- important process in chemical industry
- raw material: sodium chloride/ brine (NaCl)
- products are:
  - chlorine (Cl_2)
  - hydrogen (H_2)
  - caustic soda (NaOH)
  - hydrochloric acid (HCl)
- three manufacturing methods:
  - diaphragm process (see graphic)
  - membrane process
  - mercury process

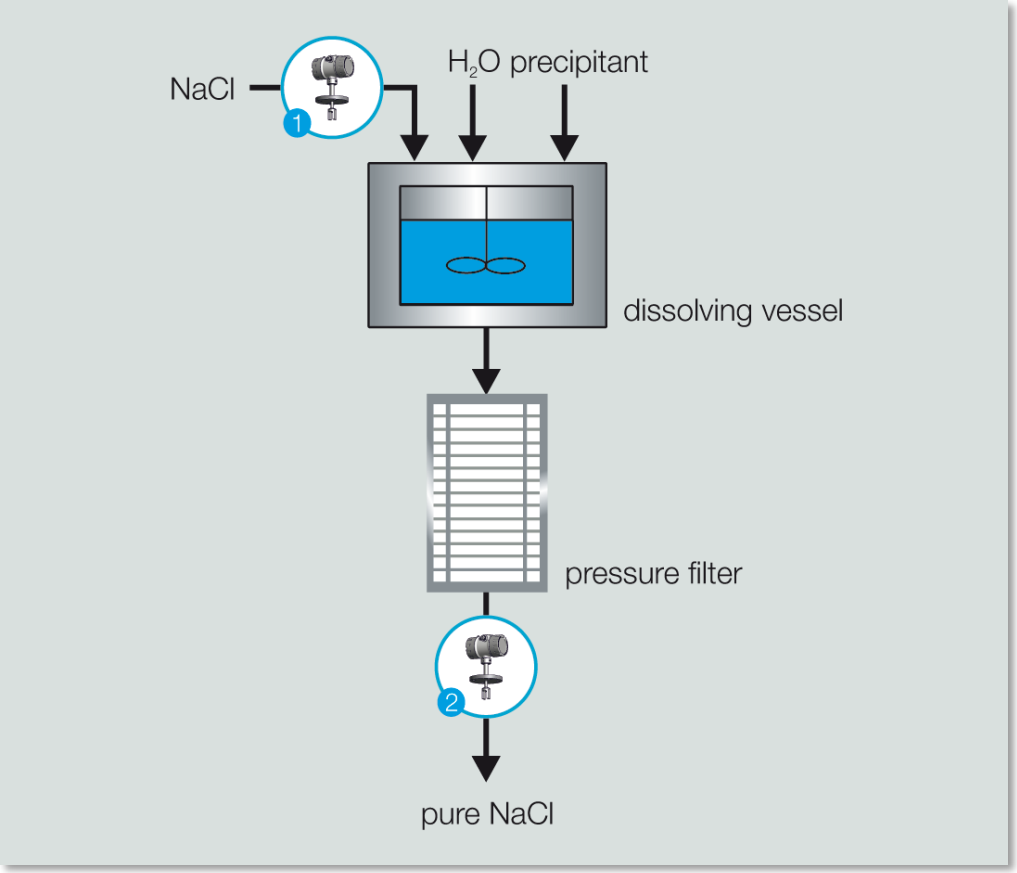


LiquiSonic® is applicable in numerous process steps of chlorine-alkali electrolysis.

Chlorine-alkali electrolysis

Application - dissolving station and brine purification

- first part of the chlorine-alkali electrolysis
- raw brine (NaCl) contains contaminants and calcium or magnesium salts
- impurities clog the fine pores of diaphragm or membrane → purification is needed
- two purification steps:
  - precipitation of the impurities by adding
  - sodium hydroxide in a dissolving vessel
  - contaminants are separated by pressure filter
- measuring tasks:
  - [1] monitoring of the incoming brine (target concentration)
  - [2] monitoring the purification to:
    - maximize NaCl saturation
    - proof the brine purity

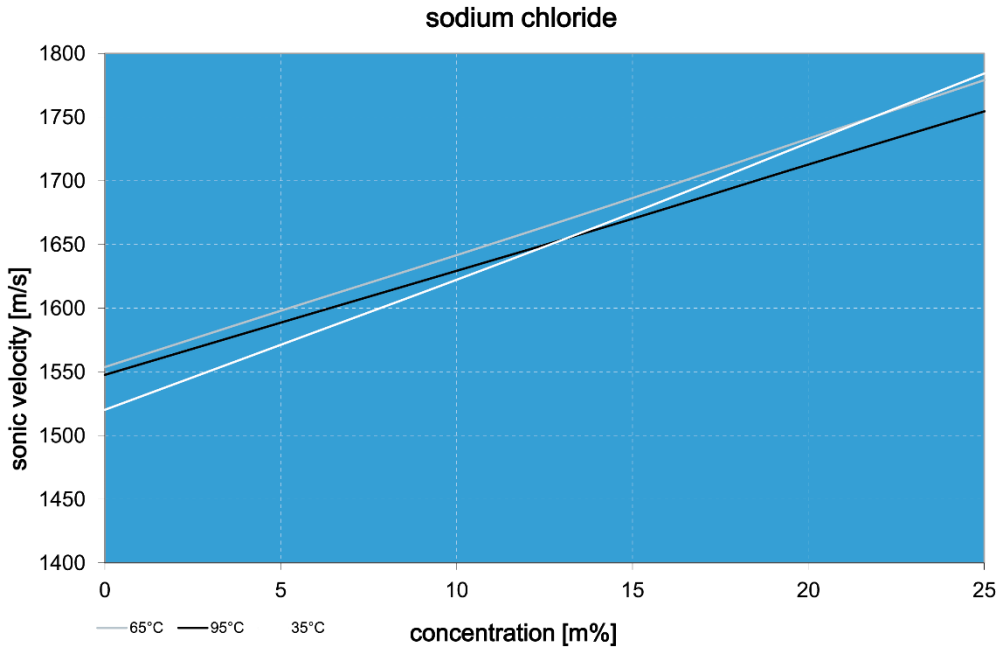


Chlorine-alkali electrolysis

Customer benefits - dissolving station and brine purification

LiquiSonic® provides an exact monitoring of the brine concentration and optimizes processes:

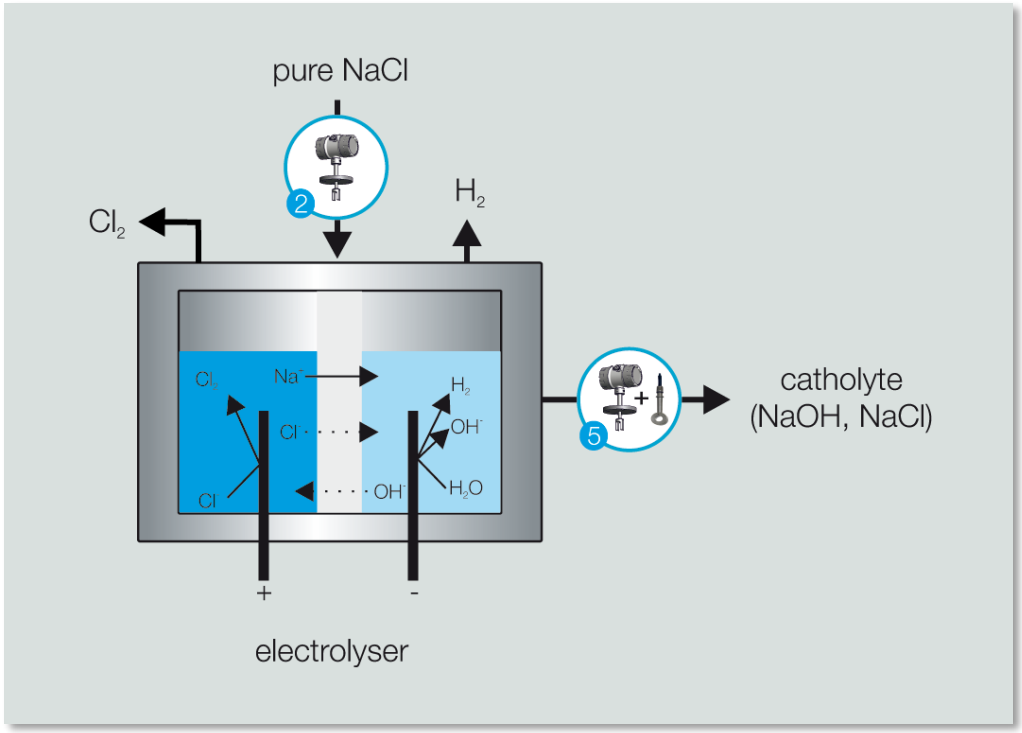
- avoiding of quality failures during the brine purification
- extending of the membrane‘s lifespan
- incoming goods inspection (in cavern mining)
- reduction in electrical energy consumption (electrolysis)
- reduction in water and/or steam consumption (during the salt dissolving)



Chlorine-alkali electrolysis

Application - electrolysis

- two methods are mainly applied:
  - diaphragm process (see graph)
  - membrane process
- nearly the same electrochemical reaction in both methods:
  - NaCl flows in the anode compartment
    → Cl_2 deposits as chlorine gas
  - solution reaches the cathode chamber
    → formation of H_2 and NaOH
- differences between the two methods:
  - material (membrane or diaphragm)
  - catholyte
    - membrane process: NaOH solution
    - diaphragm process: NaOH-NaCl solution
  - purity & concentration of the NaOH solution:
    - membrane process more efficient
    - provides choride-free NaOH solution (without additional cleaning)



Chlorine-alkali electrolysis

Customer benefits - electrolysis

LiquiSonic® provides an exact determination and monitoring of the catholyte (NaOH & NaCl) concentration and optimizes processes:

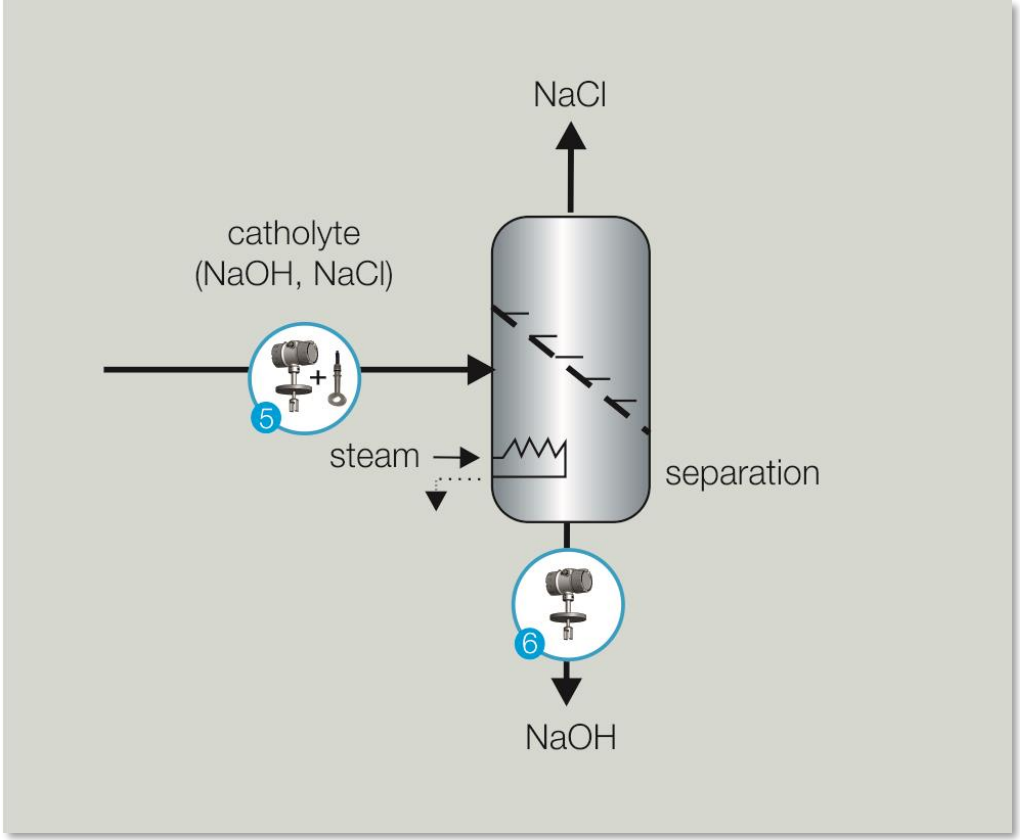
- maximizing of the electrolyzer‘s effectiveness degree, through the continuous
- concentration measurement directly in the process
- extending of the membrane‘s lifespan
- reduction in labor intensive comparison analyses
- energy saving and consumption optimizing (electrolysis)
- increase the yield of the overall process

Chlorine-alkali electrolysis

Application - caustic soda concentration

NaOH gained from electrolyzer cells only yields a concentration range of 12 - 33 wt%

- market ready NaOH typically has 45 - 50 wt%
- accurate concentration monitoring in the cascade evaporators is necessary
- diaphragm process: solution of NaCl and NaOH
  → excess salt precipitates (crystals)
- measuring task [6]: continuous monitoring of NaOH concentration after evaporation

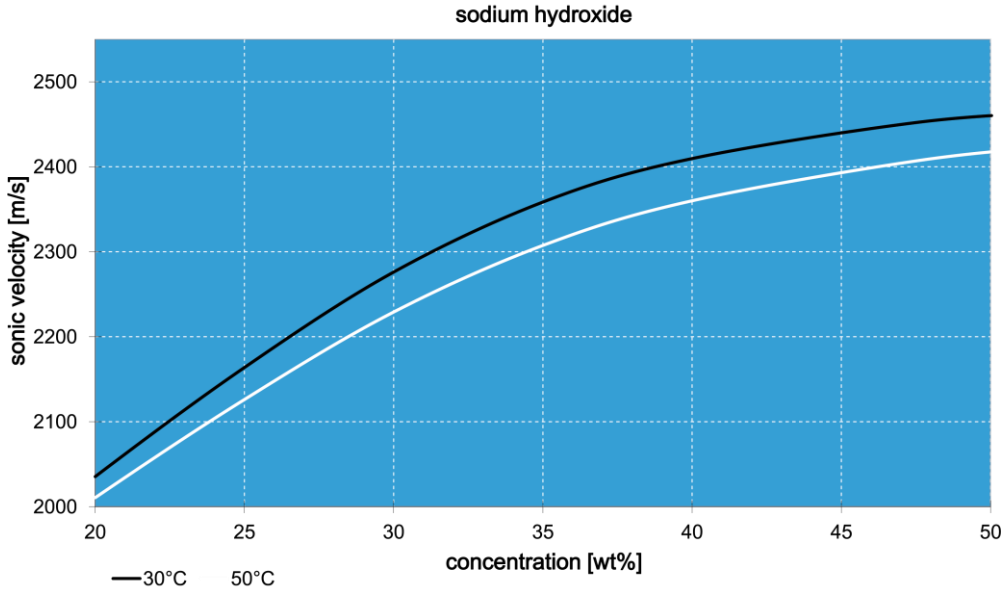


Chlorine-alkali electrolysis

Customer benefits - caustic soda concentration

LiquiSonic® provides an exact monitoring of NaOH concentration and optimizes processes:

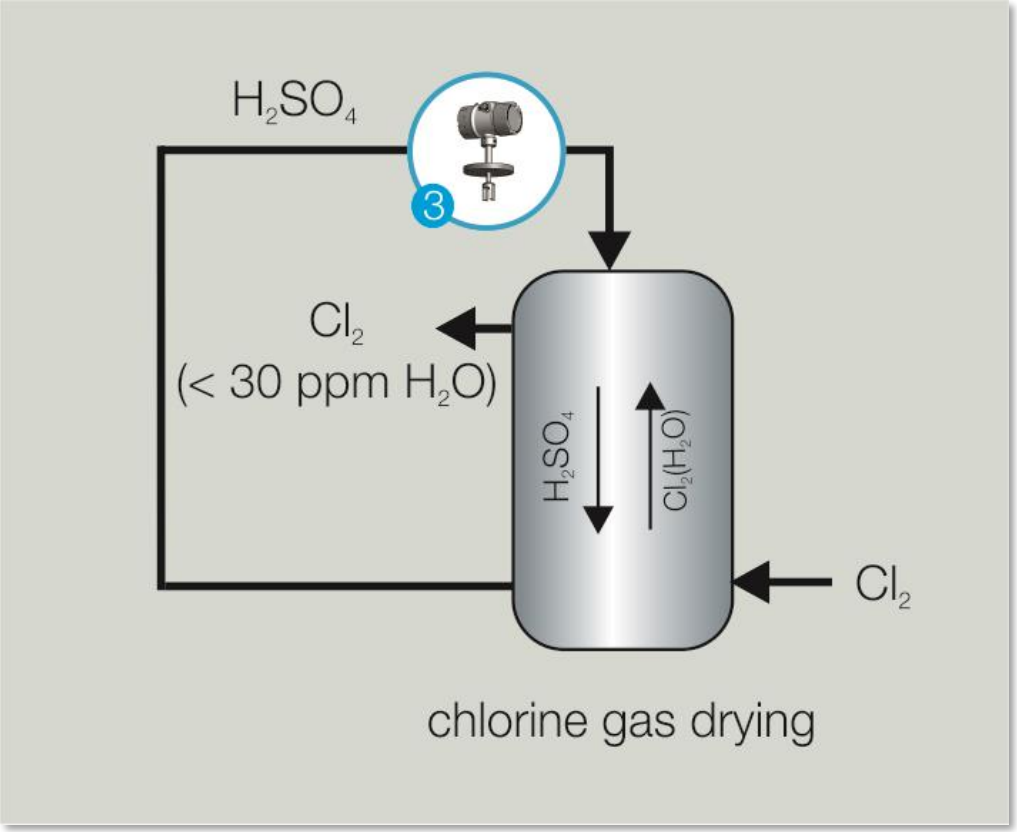
- continuous concentration monitoring of the caustic soda
- reduction of the energy costs during the evaporation
- exact adjustment of the customer-specific product NaOH-concentration



Chlorine-alkali electrolysis

Application - chlorine gas drying

- see application report AP044: chlorine gas drying
- chlorine gas must be freed from its water components to avoid:
  - formation of chlorine hydrate
  - increase of the corrosive behavior
- stage of dehydration: absorption tower
  - remaining humidity of chlorine gas is captured by highly concentrated H_2SO_4
  - as higher the concentration, as more efficient is the drying process
- measuring task:
  - H_2SO_4 concentration monitoring
  - fresh acid redosing control



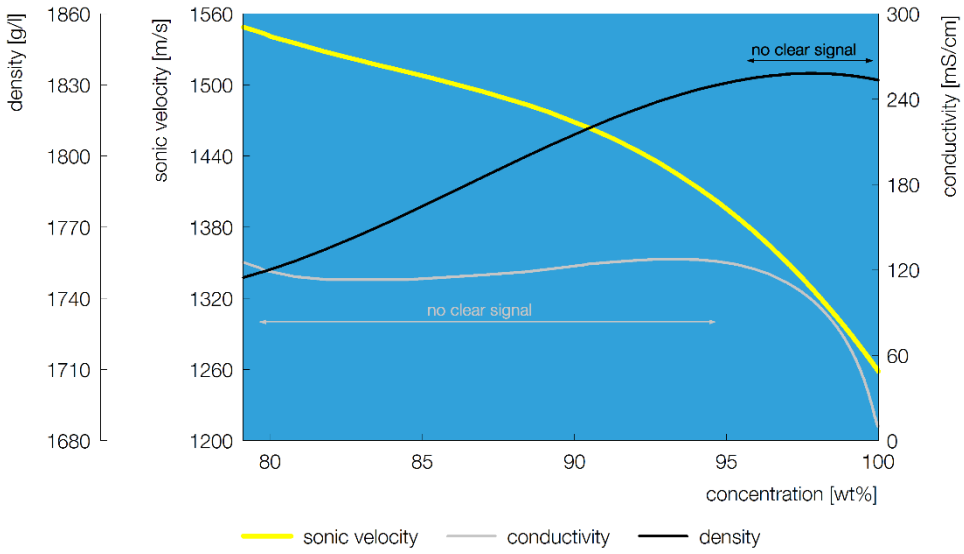
Chlorine-alkali electrolysis

Customer benefits - chlorine gas drying

LiquiSonic® provides an exact determination of H_2SO_4 and optimizes processes:

- continuous monitoring of the H_2SO_4 concentration
- clear reading between 80 - 100 wt% H_2SO_4 unlike density and conductivity
- elimination of labor intensive sampling
- ensuring the desired Cl_2 dryness to avoid corrosion

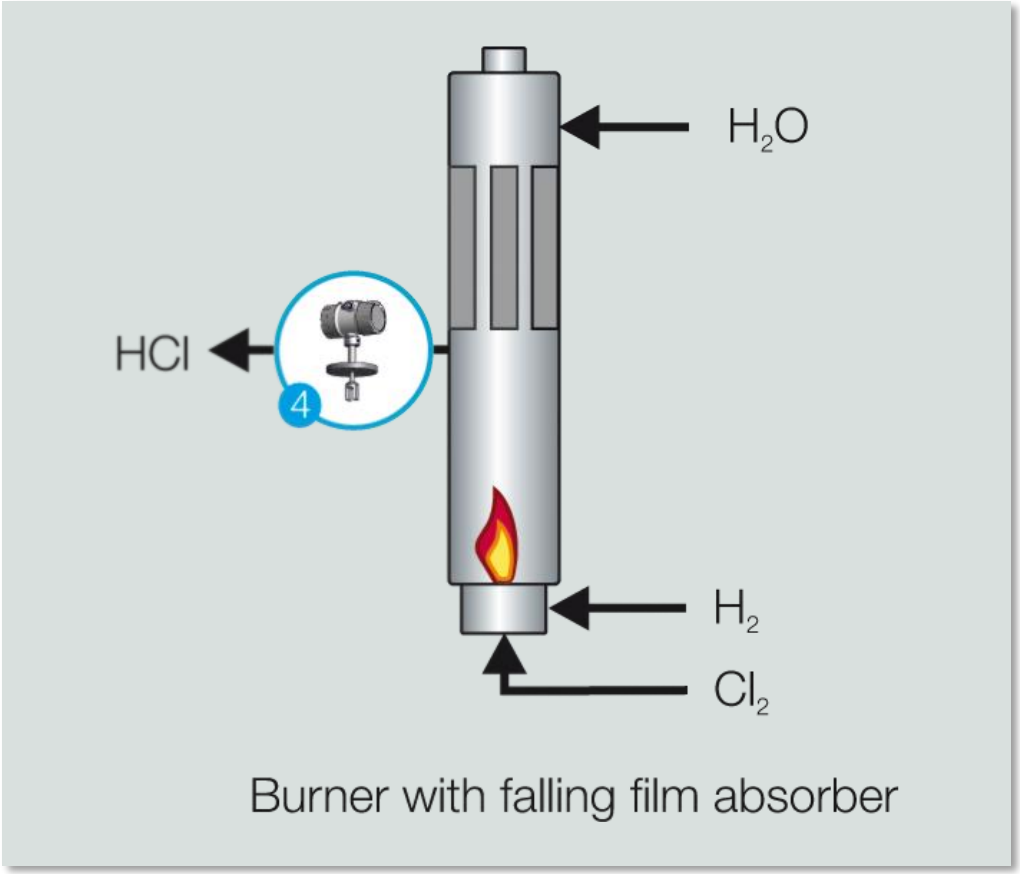
Advantage of sonic velocity analyzers



Chlorine-alkali electrolysis

application - production of hydrochloric acid

- base materials for HCl synthesis:
  - chlorine gas (Cl_2) resulting from the anode of the electrolyzer
  - hydrogen (H_2)
- both gases are feed streams of the burner
- formed HCl-gas streams from the burning chamber into the integrated isothermic
- falling-film-absorber:
  - gas is absorbed by water or diluted acid
    → concentrated hydrochloric acid (37 wt%)
- measuring task:
  - continuous monitoring of HCl concentration
  - quality control (regarding deviations)
  - immediate response to changes in the system



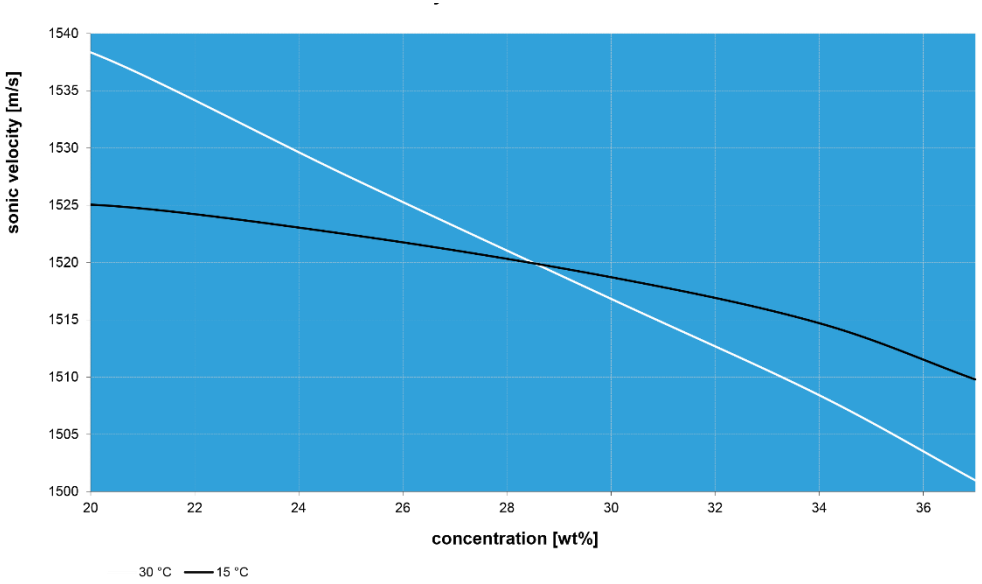
Burner with falling film absorber

Chlorine-alkali electrolysis

Customer benefits - production of hydrochloric acid

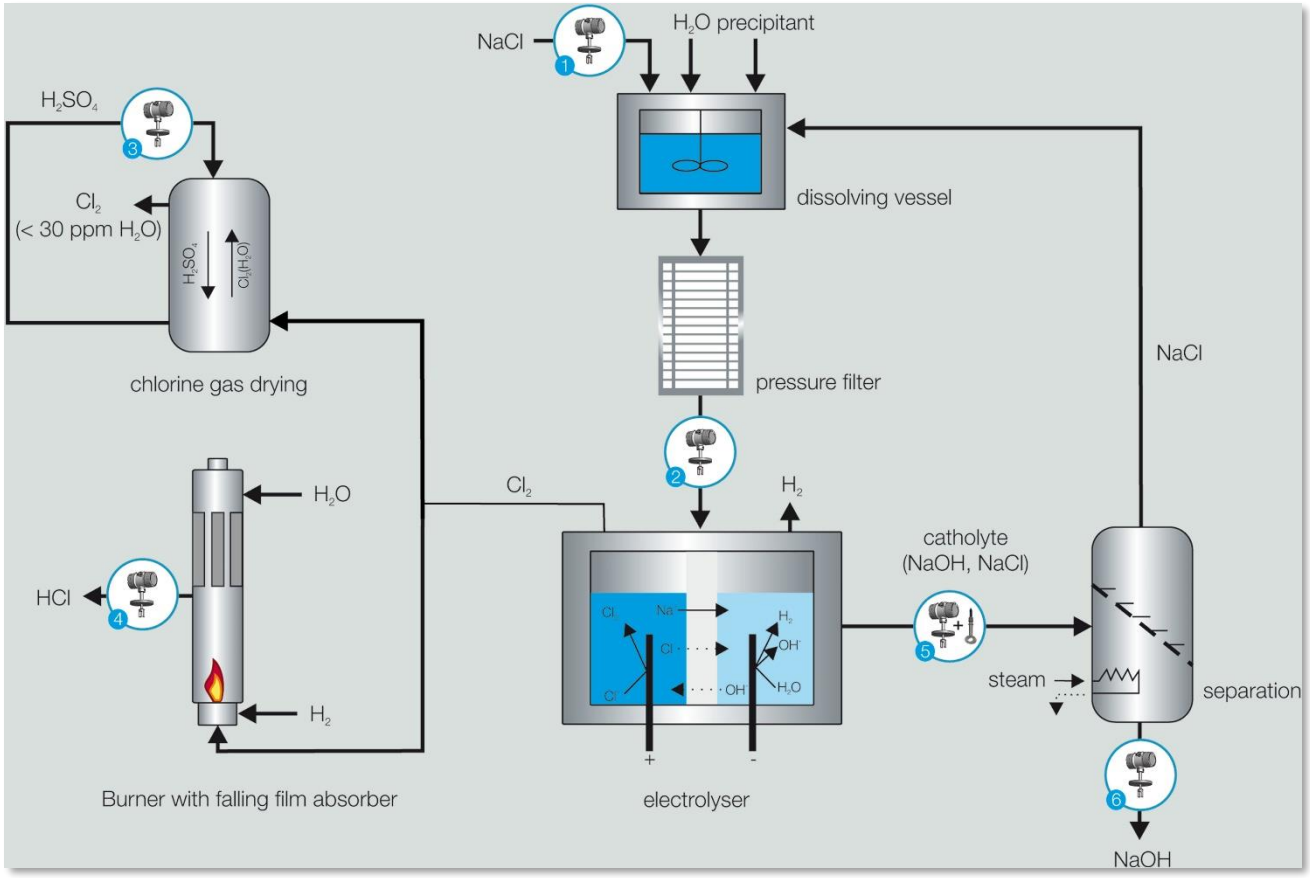
LiquiSonic® provides an exact determination of HCl concentration and optimizes processes:

- continuous concentration monitoring of hydrochloric acid (20-37 wt% HCl)
- ensuring an extremely precise target concentration
- robust analyzer made of special material (Halar-coated flange sensor)



Chlorine-alkali electrolysis

complete process scheme



Chlorine-alkali electrolysis

measuring ranges

Measuring point	Medium	Concentration	Temperature
1 2	NaCl	15-27 wt%	50-95 °C [122-203 °F]
3	H_2SO_4	80-100 wt%	10-55 °C [104-131 °F]
4	HCl	20-37 wt%	ambient temperature
5	NaOH/NaCl (diaphragm)	NaOH: 0-15 wt% NaCl : 0-25 wt%	40-90 °C [176-210 °F]
5	NaOH in front of evaporator (membrane)	25-35 wt%	45-55 °C [113-131 °F]
6	NaOH after evaporator	45-55 wt%	30-50 °C [86- 122 °F]

Chlorine-alkali electrolysis

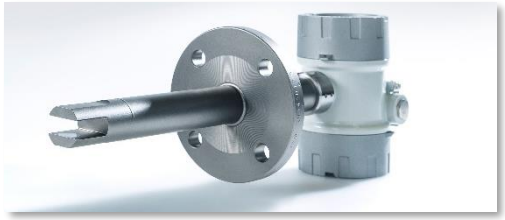
LiquiSonic® 30

- 2-component analyze (NaOH, HCl, H_2SO_4, NaCl)
- LiquiSonic® 30 controller
  - manages up to 4 sensors
- LiquiSonic® ultrasonic sensor:
  - immersion sensor 40-14 V10
  - flange sensor V10 Halar-coated
  - for hazardous areas available (ATEX and IECEx, zone 0 to 2)
  - max. temperature: 120 °C (optional 200 °C)
  - process connection: DIN, ANSI
- recommended materials:
  - H_2SO_4 : HC 2000
  - NaOH : stainless steel
  - HCl : Halar
  - NaCl : HC 2000/titanium

Chlorine-alkali electrolysis

LiquiSonic® 40

- 3-component monitoring (NaOH/NaCl in water)
- LiquiSonic® controller 40
- LiquiSonic® ultrasonic sensor:
  - immersion sensor 40-14 V10
  - for hazardous areas available (ATEX and IECEx, zone 0 to 2)
  - max. temperature: 120 °C (optional 200 °C)
  - recommended material: HC 2000/titanium and PFA coated conductivity sensor
- interface and communication:
  - remote control via web browser
  - Ethernet and RS232-Interface
  - external data storage via USB
  - analog outputs: 4 x 4-20 mA
  - digital outputs: 6x electronic relays
  - optional: Profibus DP or modbus-RS485



Chlorine-alkali electrolysis

References

Vinnolit
Leadership in PVC

AkzoNobel
Tomorrow's Answers Today

ARKEMA
The world is our inspiration

BASF
The Chemical Company

sabic

Formosa Plastics

Mexichem.

OXY

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The right choice

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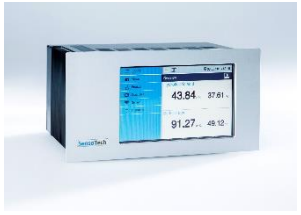
We are committed to quality in every way.

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