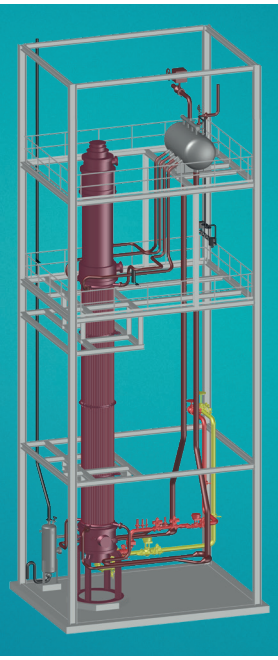
sgl carbon

Process routes for the generation of HCl gas

Process Technology – White paper

Applying the same feed, this HCl gas synthesis unit replaced an existing process that combined an acid synthesis and desorption unit to produce HCl gas.

The new process route now produces 2.5 t/h of steam instead of consuming 6 t/h steam.



↑ Layout sketch for a 3 barg HCl gas synthesis unit with steam production

HCl (hydrogen chloride) gas is a common component of many chemical processes. As manufacturer of corrosion resistant impervious graphite and PTFE-lined pressure vessel equipment, SGL Carbon provides solutions for the generation of HCl gas using several proven process routes.

We are available to consult with you on the distinctive features of each process route and will optimize the specific energy demand and capital cost based on your feed stocks and requirements.

HCl gas is often used as feed stock in various processes in the organosilicon, PVC, photovoltaic and semiconductor industries, just to name a few applications. On the other hand, HCl gas is often a by-product that is recycled for reconcentration or the production of Chlorine.

Based on available feed stock conditions and your individual requirements for HCl gas and hydrochloric acid, especially concerning pressure and composition, the following routes may be considered.

Description of process

Desorption

HCl desorption systems consist of a column that is heated by a reboiler for stripping HCl gas from acid, with azeotropic acid as sump product.
If strong hydrochloric acid is available, HCl desorption can be selected for generating HCl gas at elevated pressure (up to approx. 6 barg). The product gas composition is typically above 99,8 %, while non-volatile substances remain in the azeotropic bottom product. The moisture content can be reduced to approx. 20 ppmw by chilling the HCl gas.
HCl desorption systems are operated with steam and require rather high energy input for separating HCl from water. Additionally, weak acid is generated as a by product, which typically needs to be handled further in a closed HCl loop.

Azeotrope shifter

HCl azeotrope shifters separate hydrochloric acid completely into hydrogen chloride and water, with no weak acid by product. Accordingly, the system consists of both a stripping (desorption) section and a water evaporation section.
A key challenge for splitting hydrochloric acid into its components is to effectively break the azeotropic point. Common approaches for achieving this are either adding an extractive agent or utilizing the pressure dependency of the azeotropic point.
SGL Carbon provides various solutions such as extractive distillation and pressure swing systems. Azeotrope shifters are energy demanding process routes, which require effective concepts for heat integration.

Absorption

HCl can be recovered from HCl-containing off gases by selectively absorbing HCl to form hydrochloric acid that can be further processed with above mentioned process routes.
Absorption can be carried out isothermally, which is typically done in a falling-film absorber, or adiabatically using an absorption column.
Isothermal absorbers are cooled, removing most of the heat absorption, allowing the production of highly concentrated hydrochloric acids.
Adiabatic absorption is often used for selective absorption of HCl while volatile impurities are stripped off with the off gas, resulting in high quality acid.

Synthesis

HCl gas can be generated by the reaction of chlorine with a hydrogen-containing fuel. An HCl gas synthesis unit consisting of a specialized furnace and gas cooler is typically applied to convert chlorine by applying hydrogen as feed stock to generate HCl gas with approx. 3 barg.
Since the reaction must be carried out with an excess of hydrogen, the HCl gas contains 2-5 vol.% hydrogen. Special furnaces are available to recover the exothermic reaction enthalpy.
Alternatively, chlorine can be converted into hydrogen chloride by reaction with LPG or Methane in a porous reactor system. Such systems are typically combined with a desorption unit to produce HCl gas, while the weak azeotropic bottom product from the desorption column is applied in the porous reactor as absorption media.

Tailor made design

As the feed stock boundary conditions and requirements for HCl gas quality vary, tailor-made system designs considering the above-mentioned process routes, or a combination thereof, are common solutions.
By applying state of the art process simulators, SGL Carbon can provide process comparisons including OPEX and CAPEX estimates to enable our customers to select the most economic and reliable process route.

Overview potential process routes for different feed stocks

	Feed stock	Process route
A1	Strong hydrochloric acid (>20 wt% HCl)	Desorption, azeotrope shifter
A2	Weak hydrochloric acid (<20 wt% HCl)	Azeotrope shifter, water evaporation*
A3	Contaminated hydrochloric acid	Evaporation, acid stripping, adsorption*
B	Hydrochloric acid containing off-gas	Absorption*
C	Chlorine	Synthesis with hydrogen or hydrocarbon*

* followed by further process steps

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