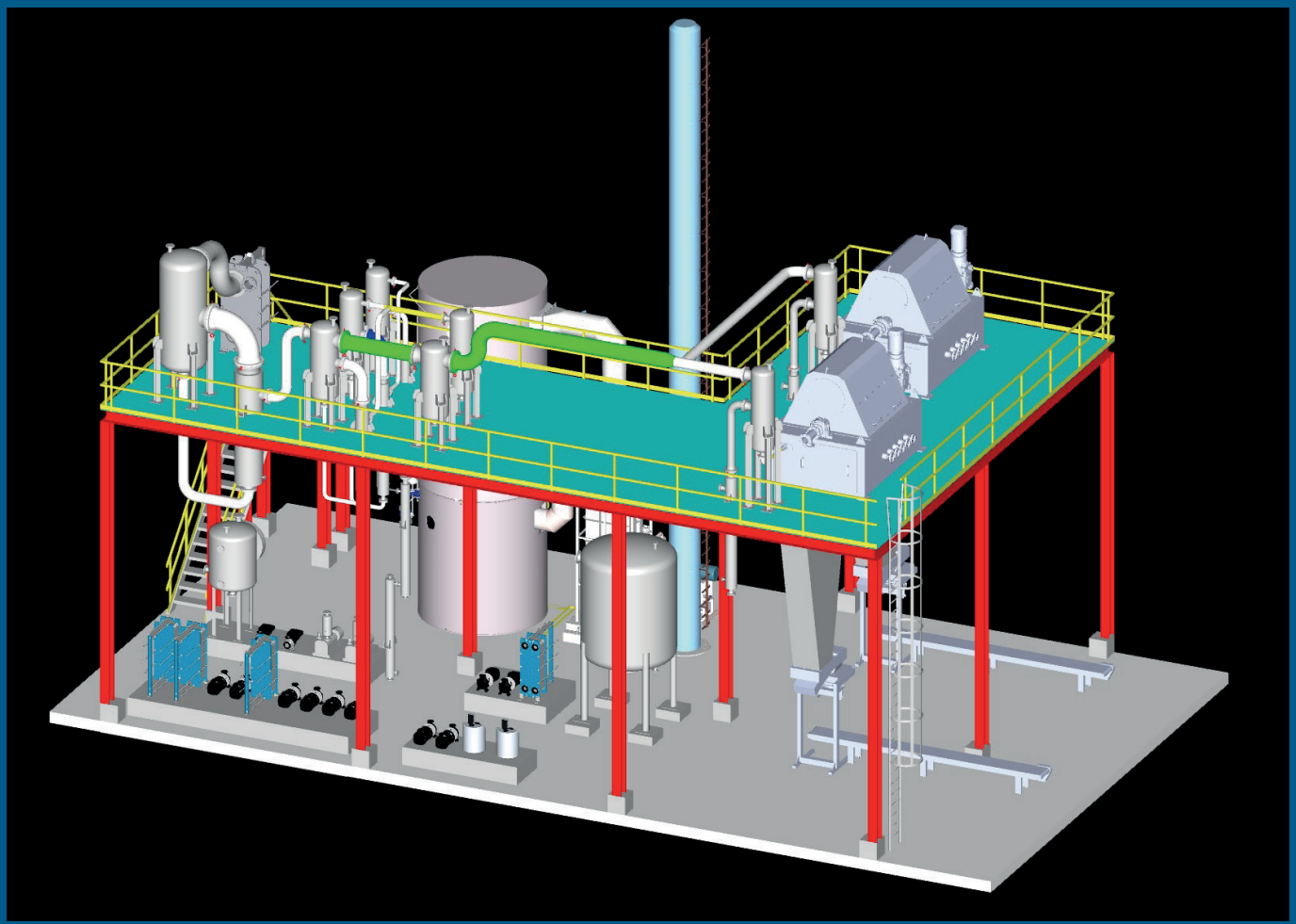
WILK-GRAPHITE
EQUIPMENT FOR THE CPI

EXTRALKALI – NAOH CCONCENTRATION



WILK GRAPHITE

Wilk-Graphite focuses on equipment and processes related to corrosive applications in relevant industries like Chemistry, Metallurgy, Pharma, Mining and Batteries. For more than 30 years we have been gaining experience by using materials like Graphite, Silicone Carbide (SIC) and PTFE and installing many thousand pieces of equipment. We developed process technology which have been acknowledged by the market as innovative and cost saving.

Wilk-Graphite is located in Lörrach (Germany) with offices and workshops in Germany, France, USA, Korea and China.

PROCESS TECHNOLOGY

- ExtrAcid® is the first system that recycles waste sulfuric acid under pressure using an innovative patented loop system producing high concentrated acid and process steam at the same time
- ExtrAkali® reduces Capex and Opex for Caustic Soda concentration. Saving 25 to 35% energy in 4 steps evaporation and using NoMoCorr® SIC block heat exchanger for 98% steps with long live time and sharply reduced maintenance cost. Shared development with Chem Eng.
- HCL Synthesis units and systems from Nantong Sunshine
- HCL purification systems from Nantong Sunshine

ASKR AND RDR

- Stirrer free crystallizer and reactor that-produces up to 3 times larger crystals. Limited residence time distribution provides homogenous products.
- Batch or continuous operation

MATERIALS AGAINST CORROSION

For more than 30 years the Team works successfully with many thousands references

- Carbex® Graphite
- NoMoCorr® Silicone Carbide (SSIC)
- PTFE

For universal chemical resistance in severe surroundings up to 450°C and 40 barg.

EQUIPMENTS

Equipment	Graphite	Silicone Carbide	PTFE
Heat Exchanger	X	X	
Columns	X	X	X
Internals	X	X	X
Compensator		X	X
Pipe systems		X	X
Reactors	X	X	X

SCANVEX SAFETY SHIELDS

- Safety Tape
- Safety Shield
- Safety Ring

CHEM ENG

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EXTRALKALI – INNOVATIVE CONCENTRATION OF NAOH LESS ENERGY CONSUMPTION AND LONGER LIFE TIME

The concentration of NaOH from usually 30 to 98,5% is a well known technology ordinarily based on Nickel materials. Is is divided into a Evaporation part from 30 to 50% and a High Concentration part from 50 to 98,5% which can be combined.

Usually it is a high temperature process in severe corrosive surrounding asking for best choice of material and a demand for low energy consumption.

Replacing known but limited Nickel Alloys by Silicone Carbide as longer lasting material for evaporation processes Extralkali reaches longer life times resulting is less maintenance and production down time. Changing the final vaporizer to NoMorCorr SIC Block heat exchanger allows at the same to regain energy for the previous steps. Based on this 2-4 stage evaporation is senseful. This results in less energy consumption and a Opex, which is significantly less.

EXTRALKALI – COVERING THE COMPLETE SYSTEM

- Evporation of NaOH up to 50%
- Revamping
- High concentration up to 98,5%
- Combined plants from 30 to 98,5%
- Flaking or Prilling

BENEFITS AT A GLANCE

- High expertise in caustic evaporation, concentration and solification
- Taylor made concept
- Partner for complete solution from 32% wt NaOH solution up to 99% solid NaOH
- Virtually no corrosion with SIC equipment
- No Nickel pick up – better products
- Low investment cost even with considering additional thermal oil heater
- Lower energy consumption – lower Opex

REVAMPING

Ordinary systems based on Nickel materials consist of sometimes only 2 or 3 evaporation effects. These can be revamped by adding a SIC based 3rd and / or 4th effect. Each additional effect lowers the energy consumption.

- Possibility to revamp existing double effects or triple effects evaporation to a quadruple effects system (very low space requirement)
- Payback less than two years even considering an additional thermal oil heating system
- Attractive concept especially in country with high energy costs and CO2 emission taxes
- Easy installation of revamping effects in skids

INNOVATIVE SILICONE CARBIDE MATERIAL

The main reason for todays vacuum system ilimitation is the corrosion resistant materials of known corrosion resistant materials. All known materials need to reduce the boiling temperature because corrosion resistance is not available any more above this point. This holds true for glasslined, PTFE, graphite or tantalum as potential materials of choice.

Silicon Carbid solves the problem and allows high temperatures reaching the boiling point of H2SO4 even under pressure. It is fully resistant against all concentrations and temperatures and in addition even to impurities like HF.

Add Bullet points of SIC z

SIC is used as a material of choice for the following components for high temperatures. Most of them are innovatively designed in detail or generally by Wilk-Graphite for the use in given severe applications.

- Evaporators up to 500° and 20 bar
- Separators
- Pipes
- Compensator
- Thermowells
- Columns

Lower requirements are handled in PTFE.

SIC – THE BEST ANTI CORROSION MATERIAL

- Universal Chemical resistance
- Highest thermal conductivity
- No abrasion
- No contamination
- Extremely hard ceramic
- Low wall thickness
- Low fouling rates
- High velocities
- High thermoschock resistance
- Many designs possible
- High temperature resistance
- Low surface roughness

SIC – COLUMNS AND SEPARATORS

Our own design department developed the SIC columns and separators for the usage in the Extracid system. Strong, circular sections are combined to a SIC column securely tightened by a spring systems. Sections can have nozzles for various purposes. Sizes of up to DN 1000 are available.

All systems are vibration free installed by our SIC compensators.

SIC – COMPENSATORS

Vibrations and movements of a thermal expended system need to be taken care off. The development of a SIC compensator puts us in the position to allow safe operation not only for the Extarcid system. Compensators can handle up to 500°C, Pressures from vaccum to 10ar and one directional movements from mm to cm..

NoMoCorr® – INNOVATIVE SILICONE CARBIDE MATERIAL

Extracid is the first system with extensive usage of SSIC at high temperatures and pressures. Without SSIC block heat exchangers conventional systems have to use available materials such as Tantalum, graphite or glasslining. The limitation is the reason why the multistage systems operate under vacuum. Vacuum reduces the temperatures, however the equipment gets large and expensive.

Silicon carbide solves the problem and allows high temperatures reaching the boiling point of H_2SO_4 even under pressure. It is fully resistant against all concentrations and temperatures and in addition even to impurities like HF.

SIC is used as a material of choice for the following components for high temperatures. Most of them are innovatively designed in detail or generally by Wilk-Graphite for the use in severe applications.

- Heat exchanger up to 450 °C and 40 barg
- Separators
- Pipes
- Compensator
- Thermowells
- Columns

SIC – THE UNIVERSAL ANTI CORROSION MATERIAL

- Universal Chemical resistance
- Highest thermal conductivity
- No abrasion
- No contamination
- Extremely hard ceramic
- Low wall thickness
- Low fouling rates
- High velocities
- High thermal shock resistance
- Many designs possible
- High temperature resistance
- Low surface roughness
- No aging / no fatigue

KEY PROPERTIES

- Density > 3 120 kg/m³
- Thermal conductivity: 130 W/(m.K)
- Vickers hardness: 19,2 GPa (500g load) > Tensile Strength: 210 MPa
- Young's modulus: 420 GPa

SIC BLOCK HEAT EXCHANGER

Block Heat exchanger with blocks made of NoMoCorr® Silicone carbide have been developed matching the market demand for a universally resistant, robust heat exchanger. It has no limitations coming with other materials or designs.

The block technology for heat exchanger is well-known since decades by units made of graphite blocks. It is a simple, easy to build and maintain structure which now has been adopted for blocks made of SIC. NoMoCorr SIC blocks are made of one very hard piece with various different drilling sizes following the latest studies on SIC design.

NoMoCorr SIC block heat exchanger combine the benefits of the material for chemical resistance bursting the limitations known before in temperatures and pressures, lifetime and economics.

Our heat exchanger are made in France under stricked quality control and have been used since the beginning in those applications where other materials and constructions fail. At the same time they are competitive in Capex and Opex to most of the systems known saving money and keeping away troubles.

APPLICATIONS

- HF in all temperatures and concentrations
- H_2SO_4 all concentrations up to the boiling point and above
- Stainless steel pickling lines
- Multi purpose plants
- Acid recovery
- Caustic Soda

SIC (SILICONE CARBIDE) BLOCK HEAT EXCHANGER

- temperature and pressures (40 barg 450 °C)
- very high thermal conductivity
- no contamination
- no abrasion
- low fouling
- innovative baffle system
- universal chemical resistance
- Modular design
- SIC heads
- Low number of flat gaskets
- no aging / no fatigue

LIMITATIONS

- Block Ø < 300 mm
- Block height < 320 mm
- Area up to 60 m²
- Design pressure < 40 barg
- Temperature < 450 °C
- Hole diameter 8 / 12 mm

EVAPORATION PLANT

WITH 4 EFFECTS A

- By high temperature only use of SIC equipment to grant an excellent product quality (more or less no Ni pick up) and a long life of all equipment.
- Up to 5 effects available to reduce energy consumptions / CO2 emissions ExtrAlkali is the only brand offering such plant concept.zz

1 Typical concentration from 32% wt NaOH to 50% NaOH.

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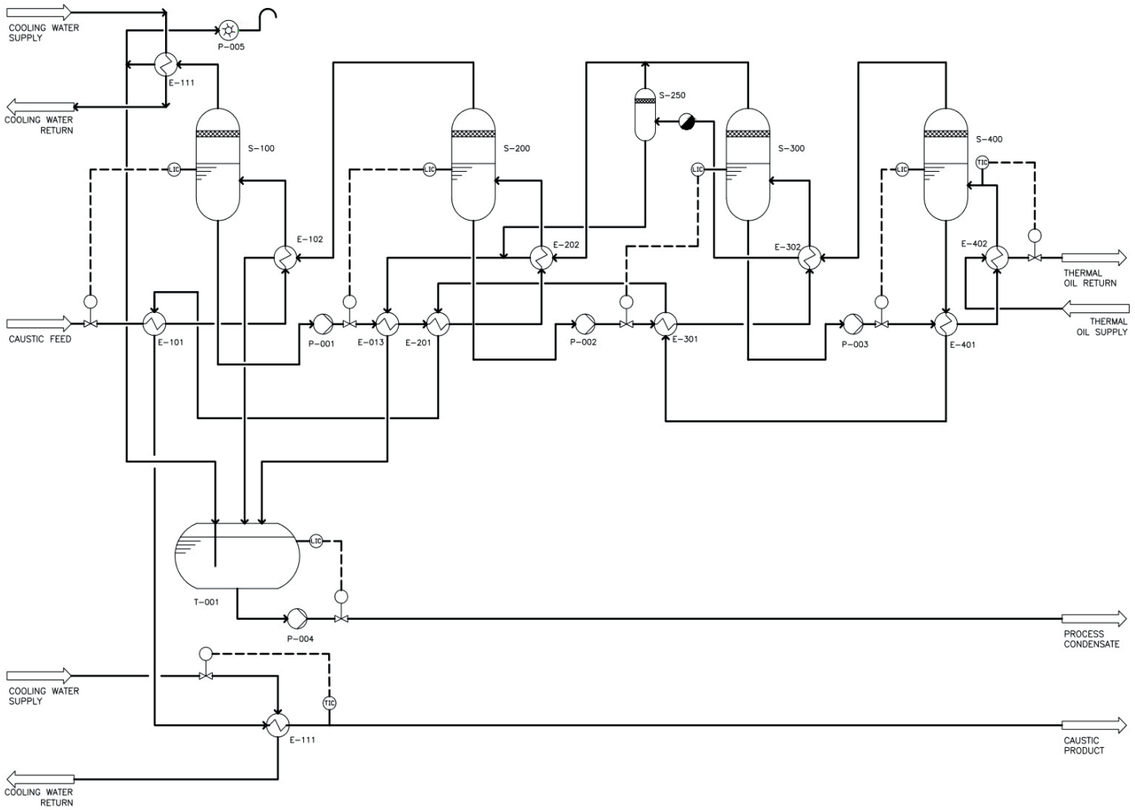

REVAMPING SKID

WITH 4 EFFECTS A

Ordinary plants have 2 or maybe 3 effects. Adding effects leads to less operational cost (Opex) and at the same time the investment (Capex) is increased. Our Revamping package is a stand alone skid unit, which can be easily integrated into a running system.

It follows the idea of maximizing the savings low investment as possible. Part of the investment is the integration of revamping system. By using a skid with only a few required connection and a small footprint the cost for the installation can be minimized. At the same time the area of a revamping skid is small and can be easily placed in most exisisting plants.

MAJOR EQUIPMENT IS

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CAPEX / OPEX RELATION

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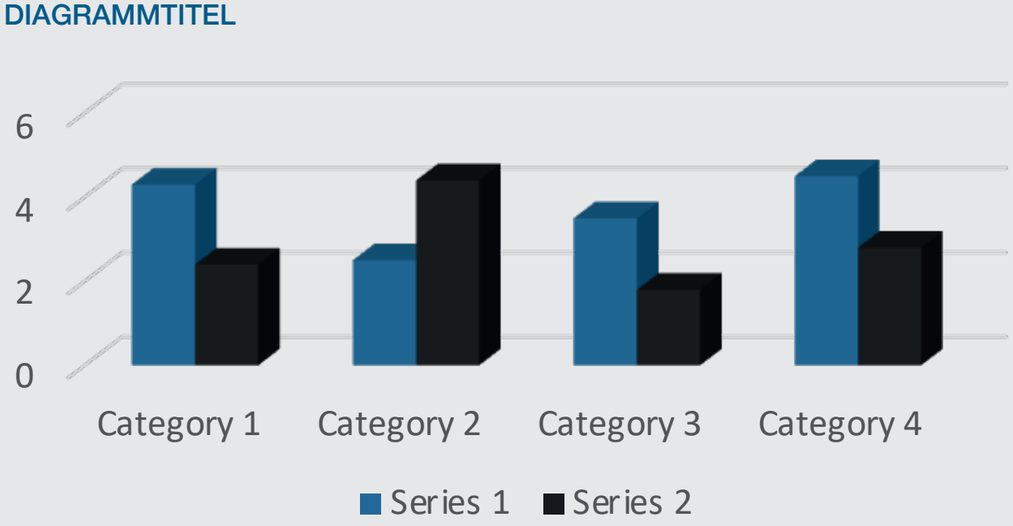
- Investment into 4 instead of 3 effects is paid back within approx 2 years due to lower OPEX
- Based on recent project, our offered price is appr. 1 effect lower than today market prices



HIGH CONCENTRATION PLANT

HIGH CONCENTRATION UNIT

- Typically, from 50% wt NaOH to 98,5 tot solid.
- Hot 50% wt NaOH is flashed in two flash tanks than finally concentrated up to 98,5% tot solid
- No use of molten salt as heating medium. Standard thermal oil is needed.
- All vapor recovered in combined plant

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COMPARISON TO ORDINARY PROCESSES

EXTRALCALI® CASE STUDY – ENERGY CONSUMPTION

Compared to leading international competition the energy consumption is compared for standalone and combined units. Evaporation 35% reduction by additional stage Concentration alone same as competition Combine plant 20% energy reduction by using energy from concentration in the first evaporation stage.

EXTRALCALI® CASE STUDY – OPEX AND CAPEX

Investing in additional stages and combined technology pays brings savings on operational cost, which means the pay back period or ROI is very fast Evaporation 1 stage more pays back in less than a year Combine plant offers savings of 1,8 Mio € per year.

ExtrAlkali	Wilk-Graphite / Chem-Eng			Others		
	Energy	Cost	Nr stage	Energy		Nr stage
	kW	€ / year	-	kW	€ / year	-
Evaporator alone	2900	998.760	4	4400	1.515.360	3
Concentrator alone	12700	2.479.680	2	12700	4.373.880	2
Combined system	13500	4.132.800	5	17000	5.854.800	5

EXTRALCALI® CASE STUDY – LAYOUT

Evaporation Smaller footprint in the market Combine plant. Huge saving in civil in comparison with stand alone plants

ExtrAlkali	Wilk-Graphite / Chem-Eng		Others	
	Footprint	Nr stage	Footprint	Energy
Evaporator alone	6 x 6 x 14	4	18 x 12 x 20	3
Concentrator alone	20 x 12 x 14	2	24 x 12 x 23	2
Combined system	22 x 12 x 14	5	40 x 12 x 23	5

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