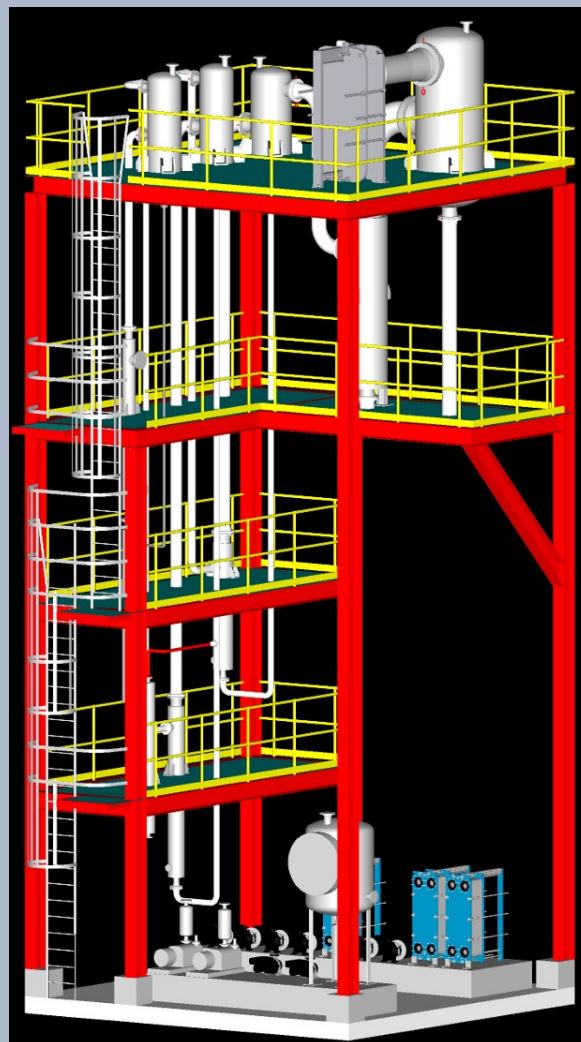




WILK-GRAPHITE
EQUIPMENT FOR THE CPI

ExtrAlkali®

CONCENTRATION/ DEWATERING SYSTEMS FOR THE CHLOR ALCALI INDUSTRY



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. Shared development with Extrasys.
- ExtrAlkali® reduces Capex and Opex for Caustic Soda concentration up to 99%. Saving 25 to 35% energy in up to 6 effect evaporation and using NoMoCorr® SIC block heat exchanger with long lifetime and sharply reduced maintenance cost. Projects are executed with our sister company Extrasys (specilized in systems).
- 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 compaired to standard technology. 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 System | | X | X |
| Reactors | X | X | X |

SCANVEX SAFETY SHIELDS

- Safety Tape
- Safety Shield
- Safety Ring





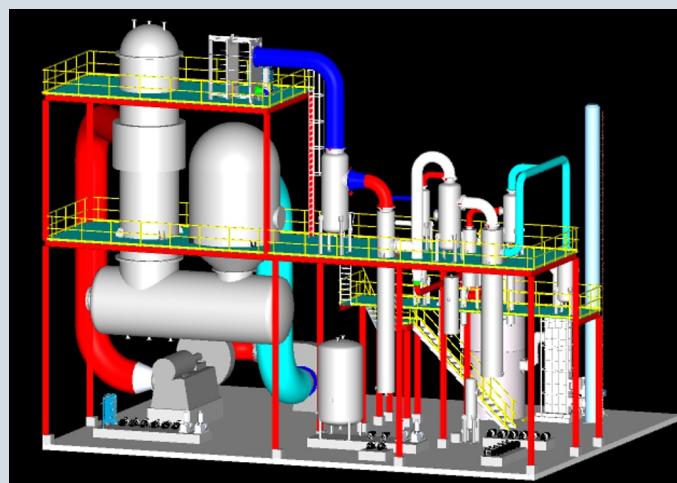
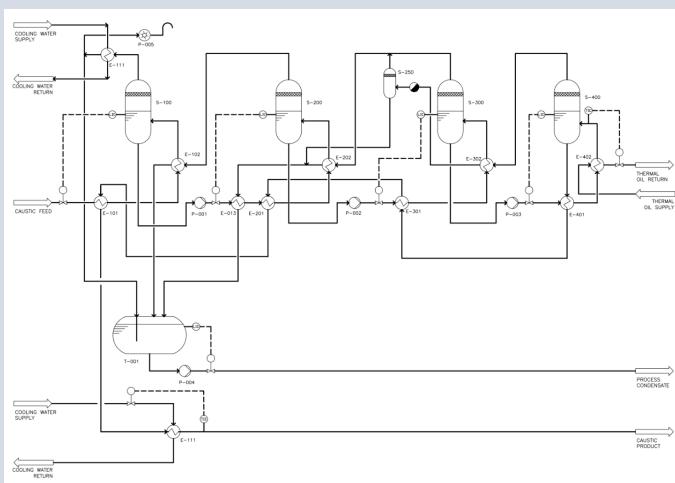
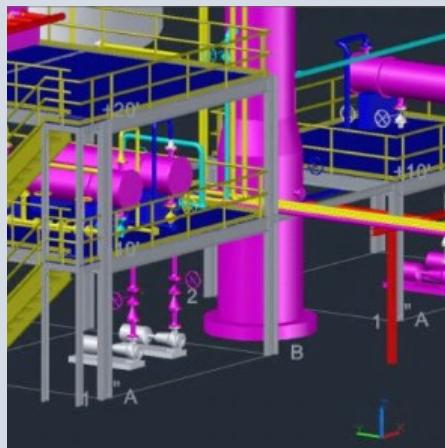
EXTRASYS
CONCENTRATION PROCESS SYSTEMS

ExtrAsys

ExtrAsys was set up to bring the ExtrAcid® and ExtrAlkali® systems onto the market. The company brings together the experience of 30 years in the chemical industry with materials such as graphite, silicone carbide and PTFE.

These years of experience have also highlighted the gaps and limitations of today's technology. With the ExtrAcid® and ExtrAlkail® systems, the limits of today's technology in the recycling of waste acid and soda are being redefined.

ExtrAsys is located in Switzerland with offices in France, Germany, China and India. At our pilot plant in France all possible processes can be tested / demonstrated.





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PROCESS ENGINEERING

- Process Flow Diagram (PFD)
- Piping and instrumentation diagram (PID's)
- Pipe class software
- Intelligent PID's based on AutoCAD Plant 3D
- Specification of all equipment
- Participation to HAZOP study
- Participation to SIL study

CIVIL BASIC ENGINEERING

- 3D model with AutoCAD Plant 3D
- 2D Layout drawings
- List of loading points

STRUCTURAL ENGINEERING

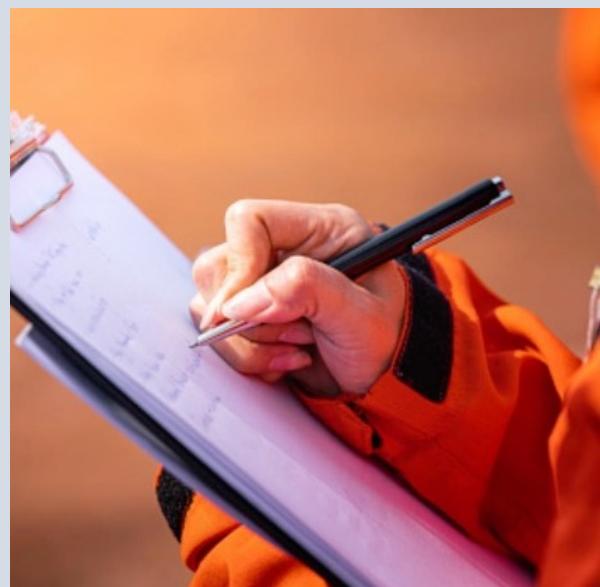
- Steel structure / SKID calculation (Tekla)
- Detail drawings with part lists

CONCENTRATION SYSTEM

- NaOH/ KOH up to 99%
- H₂SO₄ up to 98% (chlorine drying)
- HCl up to 25%
- CaCl₂ up to 72%
- HF up to 40%

NEW DEVELOPMENTS

- HCl Synthesis unit gas or liquid
- DCP / Phosphoric acid using HCl route



ELECTRICAL ENGINEERING

- Motor List
- MCC definition

INSTRUMENTATION ENGINEERING

- Instrument specifications
- Loop description
- IO List
- PLC / DCS definition

ExtrAlkali®- CAUSTIC SODA CONCENTRATION/ DEWATERING PROCESS SYSTEMS

In one Sentence:

ExtrAlkali® is the first system that significantly reduces the Capex – Opex for the concentrating of Caustic Soda using Silicone Carbide to reach a high concentrated caustic soda and process steam at the same time.

INTRODUCTION

Caustic soda from the electrolysis has to be concentrated by removing water and other impurities. By using SIC the End-product is Nikel free even at high concentrations up to 99%. A tailor-made plant:

- No standard concept – designed according to given situation using modules
- According to available utilities on site
- Optimizing OPEX and CAPEX
- 50, 70 or 99% Concentration



SYSTEM WORKS FOR ACID, HF OF HCL AS WELL.

BENEFITS AT A GLANCE

- No Nikel Pick up
- Energy recovery by steam production
- Up to 99%
- Handles impurities
- Small footprint
- Optimized capex and opex

APPLICATIONS

- NaOH/ KOH up to 99%
- H₂SO₄ up to 98% (chlorine drying)
- HCl up to 25%
- CaCl₂ up to 72%
- HF up to 40%

PATENTED DESIGN

The design of the ExtrAlkali® system is patented for up to 6 effects and the usage of SIC material in the required pressure and temperature ranges.

TURN PROCESS WATER INTO PROCESS STEAM

It is well known that the current concentration systems, by evaporation of water, have a high energy consumption. Although the energy consumption has been optimized in recent years valuable energy cannot be recovered due to low temperature levels. The innovative ExtrAlkali® process system is the first that can significantly reduce the energy consumption by producing valuable process steam.

PROCESS DESCRIPTION

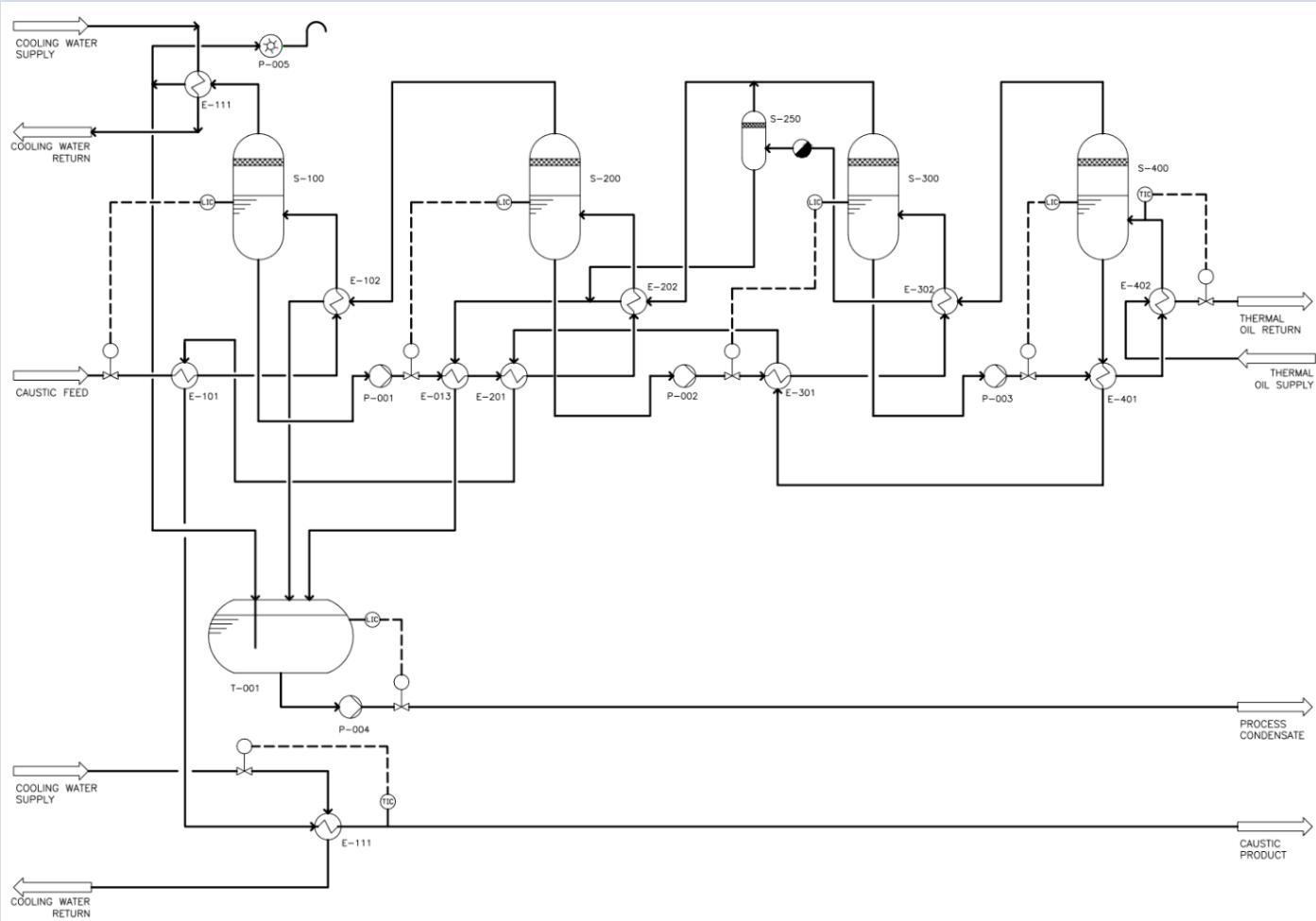
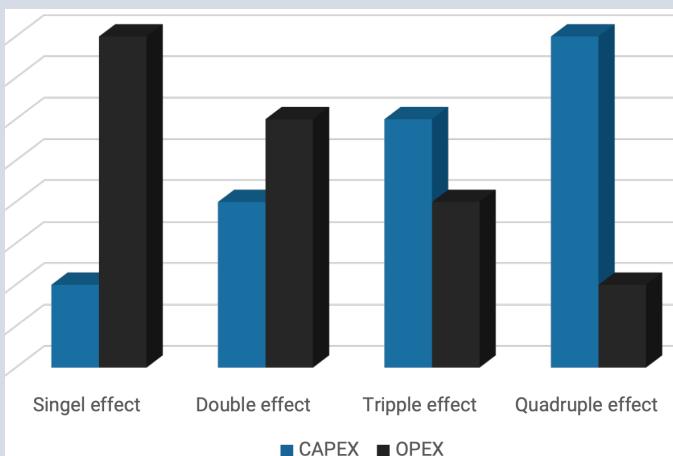
CONCENTRATION PLANT

Extrasys and Wilk-Graphite are the first worldwide to offer a system with up to 6 effects based on a process working at hight temperature.

- Very compact layout
 - Good access to all evaporators/heat exchangers
 - Light steel construction
 - For low capacities possibility to supply the unit as SKID mounted

CAPEX - OPEX

The Investment into the 4 instead of the 3 effects will be paid back within approximately two years due to the lower Opex.



NoMoCorr®- INNOVATIVE SILICONE CARBIDE MATERIAL

SIC – THE UNIVERSAL ANTI CORROSION MATERIAL

Our SIC Products are manufactured from pure directly sintered α SIC, the so called SSiC. They do no longer contain free Silicone, which may reduce the chemical resistance. SIC offers a nearly universal chemical resistance, highest thermal conductivity. Extreme surface hardness allows protection against abrasion and results in high flow rates with increased thermal efficiency. Like hardly any other corrosion resistant material, SSiC is excellently suited for extreme high temperature applications.

- 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 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 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 (SILICON 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

ExtrAlkali® - REVAMPING

REVAMPING MODULE

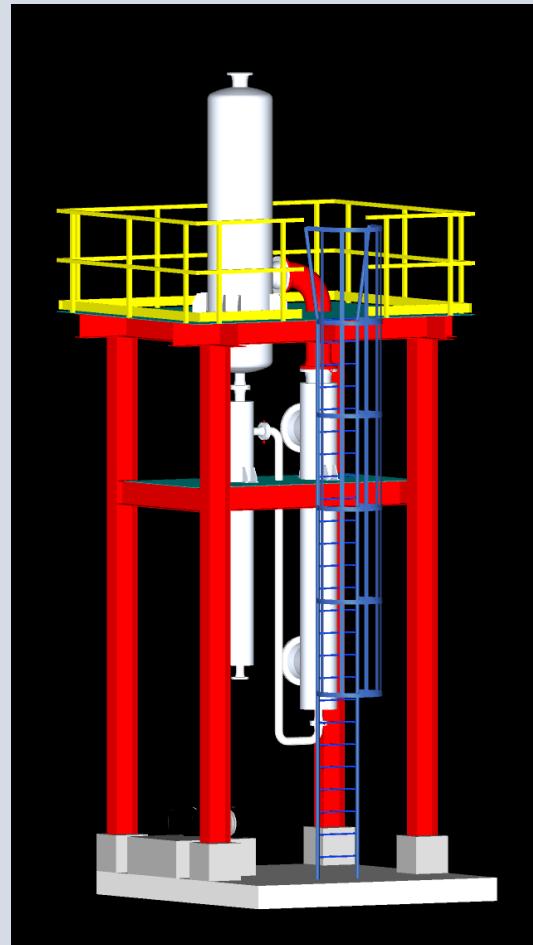
The System of ExtrAlkali® can also be sold as a Revamping Module. It is like typical revamping an upgrade from a double or triple effect system to a quadruple effect system. Here, we also take advantage of the ability of SIC to perform well at high temperatures. Thanks to its unique properties, we can achieve a higher concentration while simultaneously producing process steam. In total we offer up to 6 effects to reduce the energy consumptions and CO2 emissions.

CAPEX – OPEX

With the revamping Module we can nearly guarantee a payback after less than two years. This even with the additional thermal oil heating system.

CONCENTRATION PLANT

The additional effect can be delivered SKID mounted and can be installed next to the existing evaporation unit. If the space is available the additional effect can be installed in your existing building. To reach the high concentration a thermal oil heating unit is required.



| Energy per ton of NaOH 100% | | | |
|-----------------------------|------------------------|------------------------------|-------------------|
| | Steam consumption (kg) | Thermal oil consumption (kW) | CO2 emission (kg) |
| SINGLE EFFECT | 1500 | 1020 | 220 |
| DOUBLE EFFECT | 750 | 510 | 110 |
| TRIPLE EFFECT | 500 | 340 | 73 |
| QUADRUPLE EFFECT | 390 | 265 | 55 |

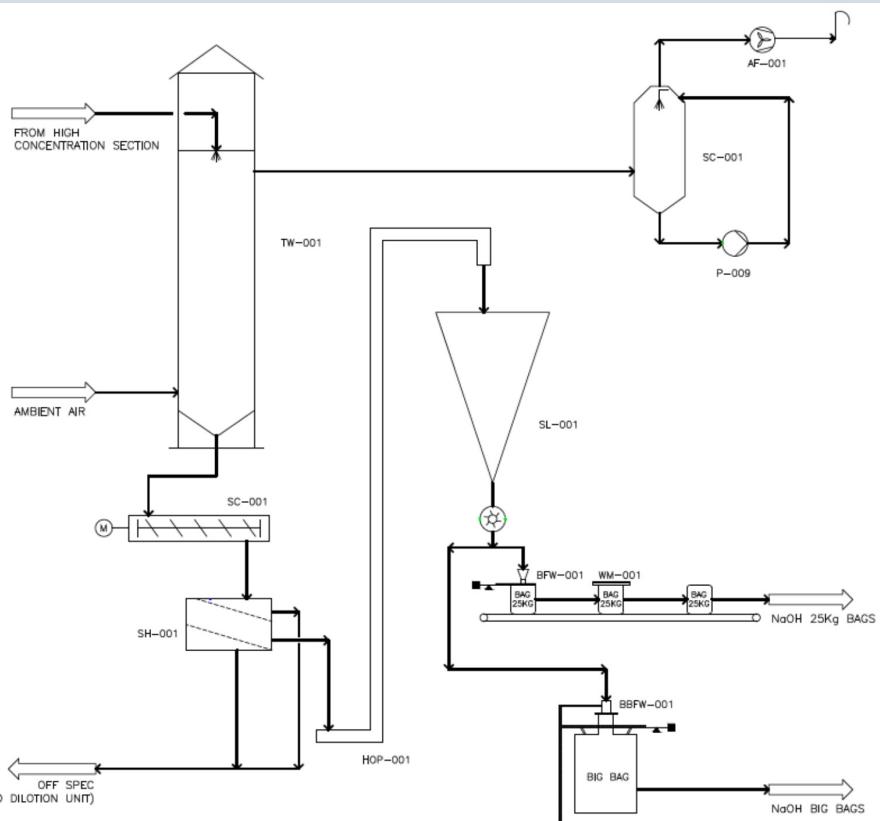
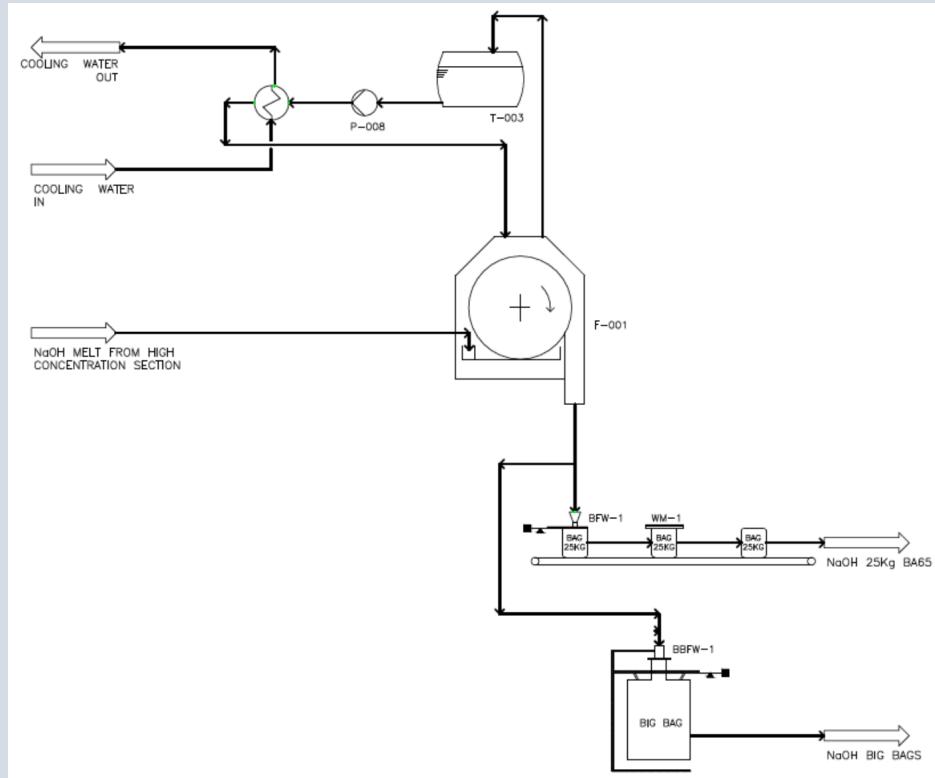
-22% **-48%**

OPTIONS TO SOLIDIFY

OPTION 1: FLAKING UNIT

Supplied by our specialized Partner we can offer a Flaking Unit to solidify the final product. The Flaking unit is a proven design that offers a retractable spraying shaft for easy maintenance, a Cylinder made of Nickel and a melt inlet pipe out of SIC.

- Easy maintenance
- Dust free
- Dust recovery



OPTION 2: PRILLING UNIT

The other Option to solidify the final product is the Prilling unit supplied by our specialized Partner. It offers a very affordable concept with a compact design. It is also possible to provide the Prilling Unit with an automatic bagging system.



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