



# Horizontal Vacuum Belt Filter

Technical Offer 732482\_01rev5

Project : NiSO<sub>4</sub> production

Client Reference :FENIX

For Boliden

14/05/2025

## TECHNICAL SPECIFICATION FOR "PHILIPPE" VACUUM BELT FILTER

|                 |                                     |
|-----------------|-------------------------------------|
| CLIENT          | Boliden                             |
| JOB REF         | FENIX                               |
| QUOTATION N°    | 732482_6B10-01rev5                  |
| PRODUCT         | NiSO4 production                    |
| SELECTED FILTER | VACUUM BELT FILTER 6 m <sup>2</sup> |
| WIDTH           | 1000 mm                             |
| TYPE            | 6B10 - SERIE 2                      |
| DATE            | 14/05/2025                          |

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100%

#### DRAWINGS FOR "PHILIPPE" VACUUM BELT FILTER

PFD  
General assembly drawing for information only

Note : New data/paragraph added compared to the previous version are highlight in yellow.  
A deviation list is attached to this offer, in a separate file " 732482\_Deviation list commented\_Hasler feedback"

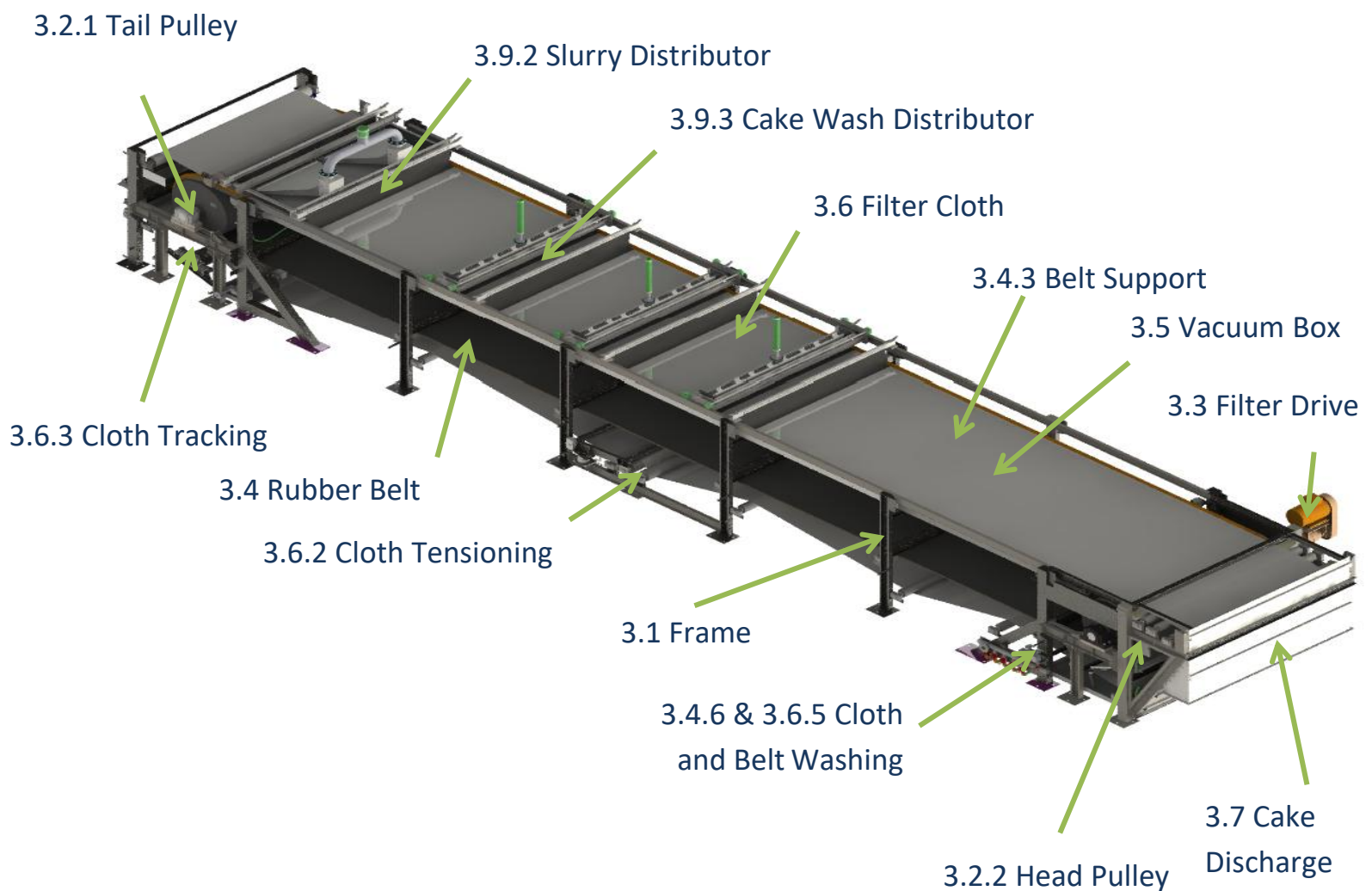
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## TECHNICAL DESCRIPTION OF "PHILIPPE" VACUUM BELT FILTER



## 1. MAIN FEATURES

1.1. ACTIVE FILTERING AREA: 6 m<sup>2</sup>

### 1.2. GENERAL DIMENSIONS

- Width under vacuum: 1000 mm
- Length under vacuum: 6000 mm
- Total width (without drive unit): 1650 mm
- Total length: 9130 mm
- Total height (without slurry distributor): 1560 mm

### 1.3. WEIGHT

- Weight of the filter: See General Assembly

## 2. UTILITIES

### 2.1. ELECTRICITY

Belt drive electrical motor

- Voltage: 3 x 400V (HASLER' standard)
- Frequency: 50 Hz (HASLER' standard)
- Control/instrumentation voltage to be confirmed Refer to the part "ELECTRICAL CONTROL CABINET"

### 2.2. WATER

- Filter cloth washing. Three spray bars in operation.
- Minimum pressure at manifold: 3 bars

#### **Previous design- Without High pressure ramp/Recycling**

- Flow in operation:
    - Cake side flow: 2,5 m<sup>3</sup>/h
    - Opposite side flow: 0,94 m<sup>3</sup>/h
    - Rubber belt washing: 1,58 m<sup>3</sup>/h
- Total water quantity without recycling 5,2 m<sup>3</sup>/h**

#### **New design with water consumption reduction and recycling**

The new design is with high pressure ramp (HP) and strainers filter to recycle the cloth & belt washing water. HP ramp details are in appendix, the strainers details will be given later.

The ramp HP using allows to reduce the basic cloth washing water (cake side flow).

The cloth & belt washing water collected is filter through strainer filter, then redistributed by a pump : one side for cake washing, other side for reusing for cloth & belt washing. The collecting tank is designed with a conical bottom, to facilitate the evacuation of particles from the bottom of the tank . We can see together how you could reuse this residual in your process.

Below are detailed the new flowrate for cloth & belt washing.

The PFD joined to this offer explains the water flow diagram with associated flowrate.

- Flow in operation:
    - Cake side flow: 1,3 m<sup>3</sup>/h assured by HP ramp
    - Opposite side flow: 0,6 m<sup>3</sup>/h
    - Rubber belt washing: 1,15 m<sup>3</sup>/h
- Total water quantity**

So, we reach to 3,05 m3/h vs 5,02 m3/h initially, leading to reduction of water consumption of around 2 m3/h.

By recycling, we estimated a saved water of 2,44 m3/h.

|                                                      |                  |
|------------------------------------------------------|------------------|
| <b>Cloth &amp; belt wash flowrate at first cycle</b> | <b>3,05 m3/h</b> |
| Estimation of loss water :                           | 0,61 m3/h        |
| <b>Recycled water</b>                                | <b>2,44 m3/h</b> |
| Water to make-up after 1 rst cycle                   | 0,61 m3/h        |

|                                              |                   |               |
|----------------------------------------------|-------------------|---------------|
| • Vacuum box wear belts lubrication (1 bar): | 30 L/h to 120 L/h | } No recycled |
| • Belt support wear belts washing (1bar):    | 55,2 L/h          |               |

**NOTE:** For belts lubrication, free solids clean water is required.

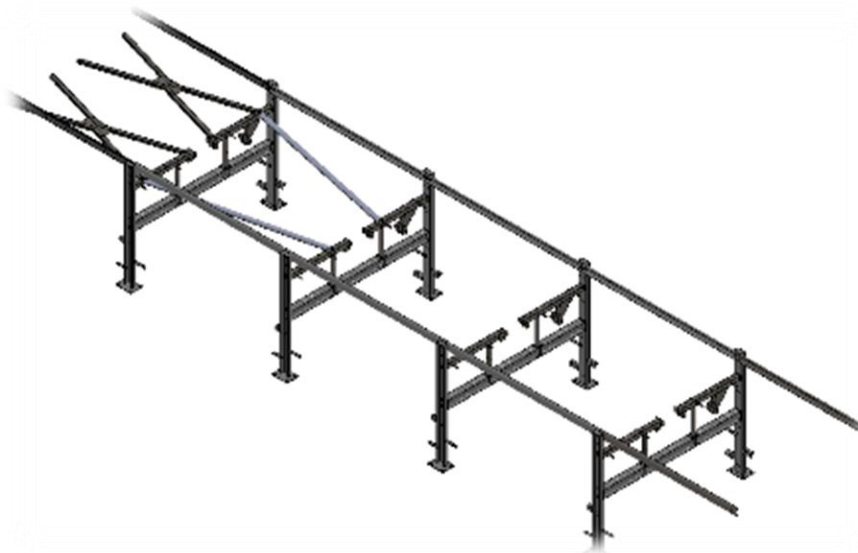
### 2.3. COMPRESSED AIR

Vacuum box tilting, cloth guiding and tensioning

- Flow: 4 Nm3/h - Pressure 5 bars
- Quality: filtered - oil free

## 3. **FILTER SPECIFICATIONS**

### 3.1. FRAME



The filter included consists of a high quality steel frame constructed of standard structural sectional members and sheet steel sections bolted and welded to form a composite structural framework.

- Material of the frame: 316L
- Material of the sheet: 316L
- Material of the bolt and nuts: 316L

The frames includes:

- Two modules at each end of the filter support the head and tail pulleys, the drive unite, the cake disposal elements, the cloth and belt washing system, the cloth tracking equipment.
- Intermediate frames evenly spaced support the belt support table, the vacuum box and its tilting system, the filter cloth and belt return rollers, guide and rails for the movable devices (feed distributor, dams, wash throughs).

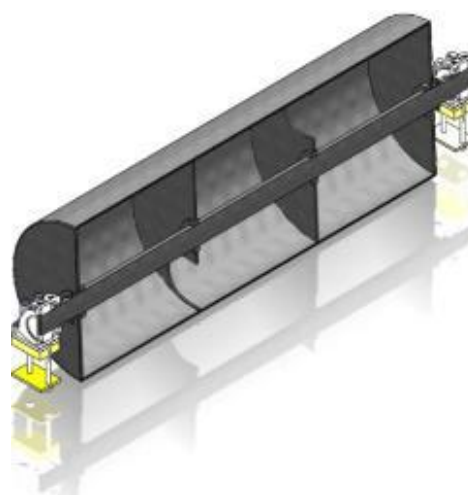
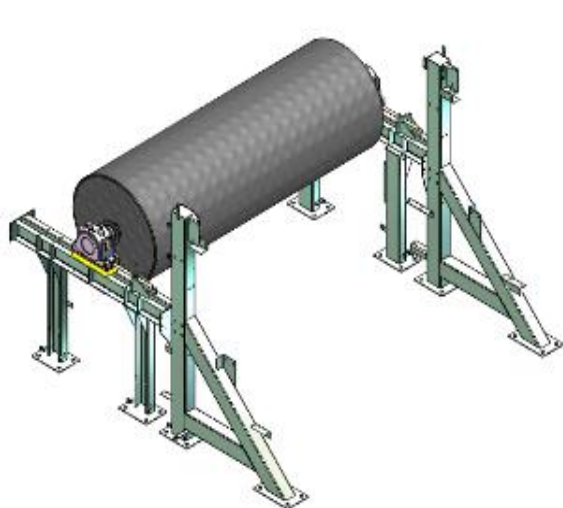
### Special features

- The frame is made of standard profiled structural steel and is fully bolted. This allows the easy replacement of structural members if needed.
- Frame can be mounted and dismantled without any risk of change in final result.
- 

This technology allows the supply of an endless belt for the first mount as well as replacement.

## 3.2. TAILS AND HEAD PULLEYS

### 3.2.1. Tail pulley



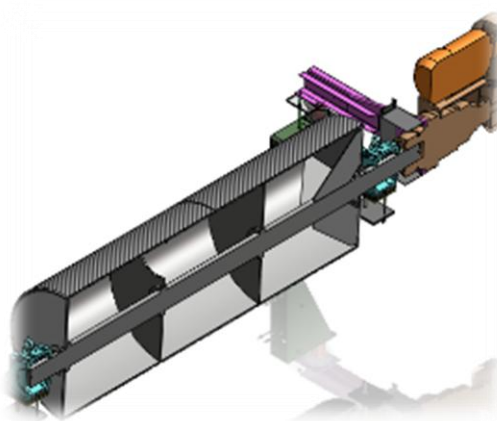
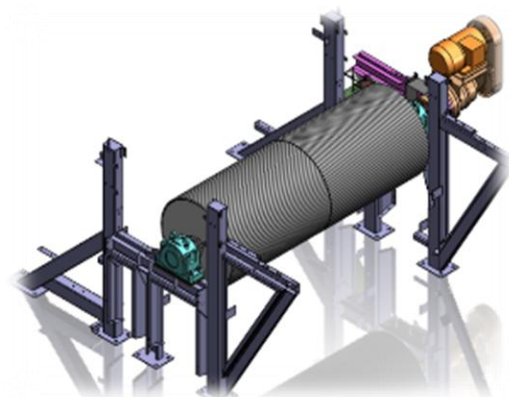
Supported by two tensioning and water - tight swivel- bearing blocks

- Diameter of pulley: 630 mm
- Material of pulley body: 316 L
- Material of shaft: 316 L
- Drip proof disc to protect the bearing blocks
- Lining: Rubber EPDM - 65 shore
- Thickness
  - Shells: 10 mm
  - Flanges: 5 mm

-Tail pulley total weight :

360 kg

### 3.2.2. Head pulley



Supported by two water-tight swivel - bearing blocks

- Diameter of pulley: 630 mm
- Material of pulley body: 316 L
- Material of shaft: 316 L

- Drip proof disc to protect the bearing blocks
- Lining:

Rubber EPDM - 65 shore with a chevron design for belt driving

- Thickness

- Shells:
- Flanges:

10 mm  
5 mm

-Head pulley total weight :

480 kg

### Special features

- **One single through steel shaft :**
  - Provides stiffness of the assembly
  - Eliminates torsion on the external surface
- **External surface, side flanges & shaft covered with hot vulcanized rubber:**
  - Perfect adherence of the rubber and durable protection against corrosion
  - Allows final machining to have pulleys in a perfect horizontal position
- **Drip-proof discs mounted on shafts**
  - Protection of bearings from corrosion

### 3.3. FILTER DRIVE

The filter drive includes the following components:

#### 3.3.1. Variable Frequency Drive (VFD)

Type: Frequency variator IP 2x, refer to the part "ELECTRICAL CONTROL CABINET"

- Brand

ABB ACS880

- IEC standard
- NEMA standard

- Rated power:

1,5 kW

- Index:

IP 2x

- Application:

Constant torque

- Power supply:

3 x 400V (HASLER' standard)

- Output voltage:

Internal supply of logic inputs

Remote control inputs (\*):

- 1 Logic input:

Stop

- 1 Logic input:

Start

- 1 Logic input:

Input status)

- 1 Logic input: Input status)
- 1 Logic input: Fault reset
- 1 Logic input: Local/remote selection
- 1 analog input: 4-20mA speed setpoint (selectable on Local/remote input status)

(Local / remote status change 0 to 1 or 1 to 0 will never change the actual speed)

Remote control outputs (\*\*):

- 1 analog output: 4-20 mA actual speed (10 to 60 Hz)

Accessories:

- 1 EMC compatibility filter
- 1 OIM (operator interface module)

Frequency setting limits:

10 to 60 Hz

### 3.3.2. Electric motor

- Absorbed power: 1,1 kW Filter moves slower than in rev 0 due to the longer cycle time.
- Installed power: 1,5 kW
- Type: Cast-iron body – TEFC – IM1001 (B3) – 4 poles - IP 55 – CI F/B
- Voltage: 3 x 400V (HASLER' standard)
- Insulation: F/B (HASLER' standard)
- Brand:
  - IEC standard: ABB/WEG/SIEMENS
  - NEMA standard:
- Painting: Refer to Part "4. Painting Specifications"
- Belt speed: From 0,8 m/min to 4,5 m/min Longer cycle time --> lower belt speed compared to rev0

### 3.3.3. Planetary gear box

It is fixed on the shaft of the filter head pulley. The gear box is locked in rotation by means of torque handle. The torque is controlled by the dynamometric handle acting on a limit switch in order to protect the gear box and the filter against overload.

Gear unit is design for 50 000 hours / 1,1 kW

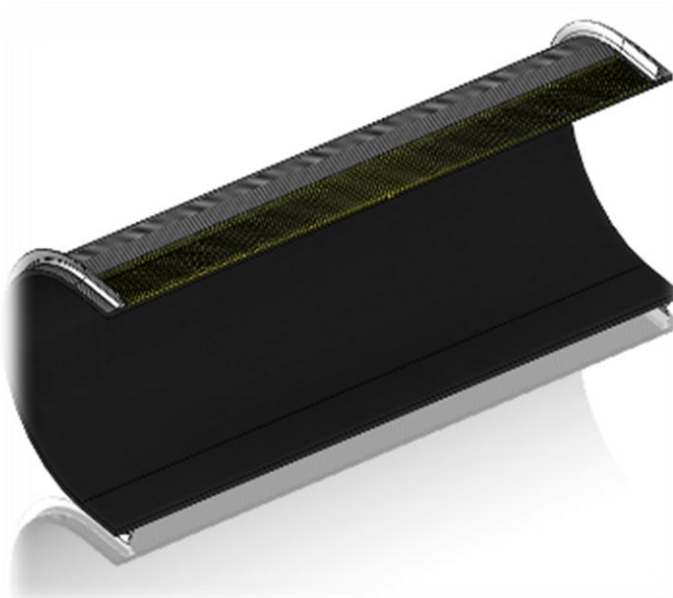
- Constant output torque: 4061 Nm
- Safety factor: 1,3 x Power installed
- Brand: BREVINI, (or equivalent.)
- Painting: Protection class C5

#### NOTE

If other choices are requested, an option will be offer and price adjusted.

3.4.

#### RUBBER BELT



On its upper surface, the belt presents transversal grooves which allow the liquid to flow towards oblong holes drilled in their axis (one oblong hole per groove).

|                              |                 |
|------------------------------|-----------------|
| - Number of belt per filter: | 1               |
| - Material:                  | EPDM            |
| - Width (Useful):            | 1000 mm         |
| - Top cover thickness:       | 13 mm           |
| - Bottom cover thickness:    | 5 mm            |
| - Overall thickness:         | 24 mm           |
| - Material of the carcass:   | Polyester       |
| - Drilling zone:             | without carcass |
| - Number of plies:           | 4               |
| - Weight of the rubber belt: | 494 kg          |

#### **Special features**

- The belt is delivered endless; it is fully machined in HASLER Group factory, controlled and ready to run.
  - The belt is installed on our dedicated machine and run to remove mechanical stress.
  - Carcass is located via our dedicated machine, so that holes are drilled in the centre of the belt, not overlapping with the carcass. Holes are perfectly aligned.
- Drilling and grooving are made according to customer's process requirements.
  - Width and depth of slopes as well as step of grooves and belt thickness are optimized according to customer's requirements. Dimensions of holes also follow that rule.
  - Oblong holes are preferred to round holes in order to avoid fragility in the centre of the belt.

#### 3.4.1. Grooving

Manufactured in our plants with a slope towards the oblong holes.

- Pitch: 18 mm
- Width: 9 mm
- Depth: 5 - 10 mm
- Drilling oblong holes: 8 x 22 mm

#### 3.4.2. Belt curbs

- The curbs are made of Natural Rubber and cold bonded on the belt sides to form a containing wall.
- Type: Undulating section with and high flexibility obtained from casting. The design was patented by HASLER Group/Filtres Philippe. It's "accordion" shape provides a good support of the filter cloth, a good tightness at the bottom as well as high flexibility when passing over the pulleys.
- Height of rubber curb bonded to the belt: 70 mm

#### 3.4.3. Belt support on upper side (active part)

The rubber belt support device ensures any contact between the rubber belt and the frame support and protects the rubber belt against wear. The support table is constituted by set of steel sections. The top of these steel sections is covered by HMWPE sliding strips and a set of endless wear belts driven by the rubber belt, slide on. An automatic take-up device allows to compensate the stretch and maintain each belt under tension.

- Steel frame sections: 316L
- Sliding strips: HMWPE
- Endless wear belts: Polyester reinforced rubber with PE sliding side
- Dimensions of belts (W x T): 30 mm x 5 mm
- Support distribution : 2 x 2 sections (on each side of the vacuum box)

#### Special features

- **Belt supporting system provides optimum flatness, hence maximizing cake washing efficiency and recovery of filtrates.**
- **Best solution to reduce belt wear and low cost of spare parts (wear belts and sliding rules).**
- **Doesn't require blowers and air boxes (air support table) nor important amount of water (water support table).**

#### 3.4.4. Belt support on return side

By rollers supported by water-tight ball bearing blocks.

- Material of roller: 316L
- Diameter of roller: 219 mm

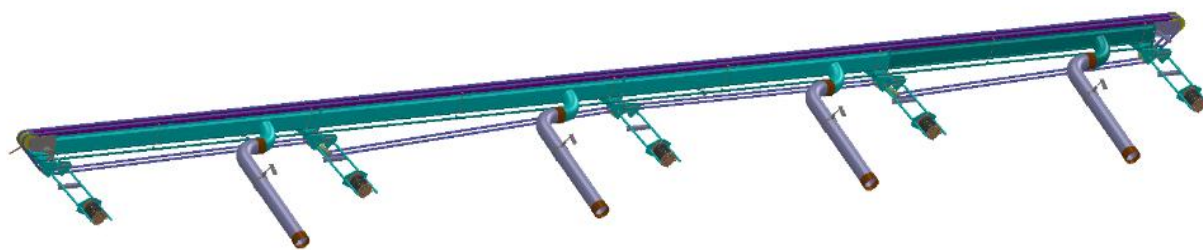
#### 3.4.5. Belt tracking

- Roller made of HMWPE fitted on shaft.
- Diameter of roller: 100 mm
- Shaft: 316L

#### 3.4.6. Rubber belt washing

- 2 wash headers fitted with spray nozzles
- Construction:
  - Wash pipes: POLYPROPYLENE
  - Spray nozzles: PVDF
- Wash collection trough
  - Material: FRP + Vinyl resin coating outer
  - Outlet pipe connection: DN50, flexible hose to cloth trough

#### 3.5. VACUUM BOX



- Number: 1
- Type: Omega section with special articulated support mechanism
- Body is constituted of several pieces, flange-jointed.
- Construction:
  - Body of the box: FRP + PVDF liner inside + Vinyl resin coating outer
  - Supporting parts: 316L
  - Sliding strips, made of UHMWPE, and supporting :
- Endless wear belts, made of rubber, with polyester down sliding side
  - Number: 2
  - Wear belts supporting rollers: UHMWPE

- Size of wear belts
  - Width: 38 mm
  - Thickness: 10 mm
- Filtrate / gas nozzles
  - Number: 4
  - Connection: DN100
- Connection from vacuum box nozzles to the external frame side made by means of :
  - Elbows to allow the rotating during vacuum box tilting operation.
  - Material of pipe connection: FRP + PVDF liner inside  
+ Vinyl resin coating outer
  - Connection with the others: EPDM sleeve
- Maintenance:
 

The tilting system for the vacuum box allows the access for inspection, cleaning and parts replacement. Powered raising and lowering mechanism consist of an articulated frame pneumatically driven. It is operated by a pneumatic bellow after unclamping.

During operation the vacuum box is clamped in the normal working position.
- If required by process, vacuum box is equipped with movable internal baffles for separating the filtrate ports. The number of baffles is equal to the number of sections minus one.

### 3.6. FILTER CLOTH

- Type: Monofilament
  - Material: Polyester or polypropylene
- Endless joining of the cloth is made by means of ultrasonic welding process. The welded cloth is installed with the help of a fitting up constituted by a winding with a tension-ratchet, fitted on of the filter feed end frame.

#### 3.6.1. Cloth rollers, supported by water-tight ball bearing blocks, consisting of:

- One cloth positioning roller with caps at the ends to bend the cloth on each side.
- Diameter of roller: 60,3 mm
  - Material of roller : 316 L
- One set of exit rollers.
- Diameter of roller: 60,3 mm
  - Material of roller : 316L
- One set of cloth rollers on return circuit.
- Diameter of roller: 60,3 mm
  - Material of roller : 316L

### 3.6.2. Cloth tensioning



Obtained by a framework supporting a cloth roller pneumatically driven.

Regulation and operating of this system by means of adjustment of the air pressure in the pneumatic bellow.

- Number: 1
- Framework: 316L

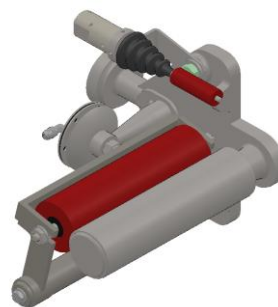
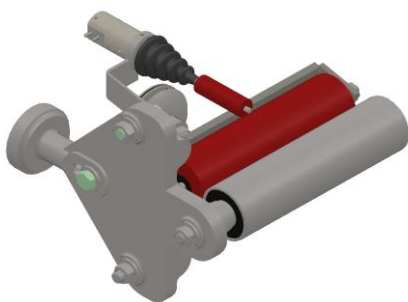
#### Special features

- **Fully automatized system, high accuracy and reliable adjustment.**
- **No counterweights required.**

### 3.6.3. Take-up device

Obtained by means of a roller fitted on set of rails at the feed end of the filter and moving vertically. Take up length is approximately 800 mm.

### 3.6.4. Cloth tracking



The system is made of 2 main pinches which put a pressure or not on the cloth and control its tracking.

The control of the pressure is made thanks to 2 sensors on both sides of the cloth.

- Number of pinches: 2
- Type of pinche: Made by 2 rollers (1 static and 1 movable)
- Material of rollers: 1 x Stainless steel ( 316 L) and  
1 x Polyurethane

### Special features

- Long operational life, no bearing wear as bearing blocks are not used as pivot.
- Pneumatically driven, very soft action on the cloth.

#### 3.6.5. Filter cloth washing

- 3 wash headers fitted with spray nozzles
- Construction:
  - Wash pipes:
  - Spray nozzles:
- Wash collection trough
  - Material:
  - Outlet pipe connection:

Polypropylene  
PVDF

FRP + Vinyl resin coating outer  
Flat welding flange, norm according to  
Boliden's requirement.

#### 3.7. CAKE DISCHARGE

- 
- Diameter of roller:
- Construction:
  - Cake discharge hopper
  - Scraper

Discharge roller  
168,3 mm

316L  
Polyurethane

#### 3.8. FLUIDS DISTRIBUTION

##### 3.8.1. Compressed air circuit

1 cabinet for control of the cloth tracking, cloth tensioning and vacuum box tilting.

- - Compressed air connection on cabinet:
  - Air pressure regulator:
  - Valves:
- Distribution pipes inside the filter
  - Material of pipes:
  - Material of fittings:

Marina IP 55

1/4 " threaded hole or 1/2 " NPT  
Brand NORGREN  
Polypropylene

Polyethylene  
Polypropylene

### 3.8.2. Belt and cloth washing

- A manifold piping with outlets and valves

- Manifold connection:

- Manifold:
- Valves:

- Hoses:

Flat welding flange, norm according to customer requirement.

Polypropylene

Membrane type, body made of cast iron, EPDM membrane.

High quality rubber hoses

- Outlets distribution:

- Cloth and belt washing:
- Wear belts lubrication:

5

2

### 3.8.3. Vacuum piping

#### 3.8.3.1. Filtrate internal pipes for connection from vacuum box to the filter side

- Diameter:
- Quantity:
- Material:
- Connection:

DN100

4

FRP + Vinyl resin coating outer

Pipes with EPDM sleeve, smooth pipe

#### 3.8.3.2. Vacuum manifold between above pipes and filtrate receivers

It is divided in tight zones by an obturator between two flanges.

- Flanges design :
- Number of section:
- Diameter:
- Inlet connection:
- Outlet connection:
- Material:

EN1092-1

1

DN150

4 x DN100

1 x DN125

FRP + PVDF liner inside

+ Vinyl resin coating outer

Pipes with EPDM sleeve for connection.

### 3.9. PROCESS EQUIPMENT

#### 3.9.1. Slurry entrance dam and apron

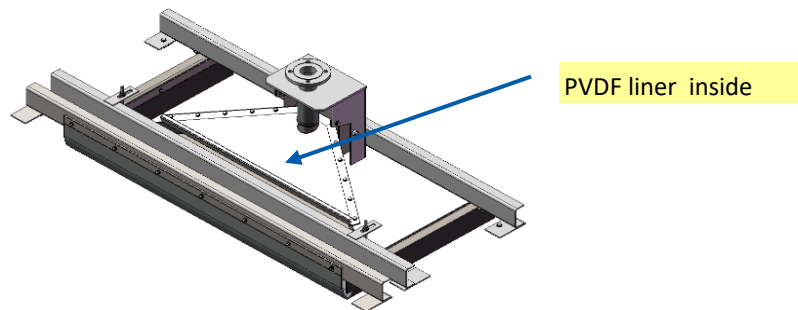
- Apron:
- Support:
- Number:

EPDM rubber

904 L

1

### 3.9.2. Slurry distributor

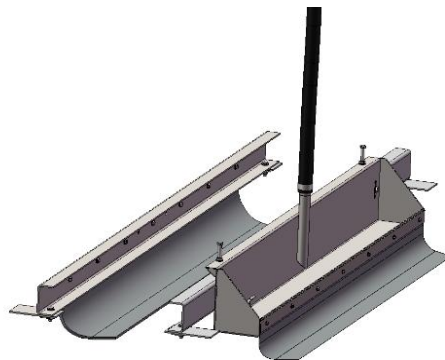


Fish tail feeder especially designed to spread  $\text{NiSO}_4$  production slurry product on the filter width.

- Material:
- Number/Connection:
- Lateral protections of the feeding area by rubber aprons.

FRP + PVDF liner inside + Vinyl resin coating outer  
1 x 40 mm

### 3.9.3. Cake wash distributor



The distributor is adjustable and locked in position on the frame by brackets. It can be moved on the frame when unscrewing the locking system.

- Material:
- Connection:
- Number:

FRP + Vinyl resin coating outer  
1 x 20 mm  
1

### 3.9.4. Pendular dam (separation dam)

- Type:
- Apron:
- Support:
- Number:

Pendular  
Rubber  
904 L  
2

3.10. STANDARDS FOR CONNECTION

- With Boliden:

According to Boliden's requirement.  
EPDM sleeve on smooth

- Internal:

3.11. SITE CONDITIONS

As per request or to be defined later.

- Geographic zone:

Rönnskär, Sweden

- Altitude:

- Temperature:

-35 °C/+35 °C

- Humidity:

### 3.12. ELECTRICAL CONTROLS AND SECURITIES

#### 3.12.1. List of sensors included into the filter

|                                               |                          |          |
|-----------------------------------------------|--------------------------|----------|
| - Emergency stop rope (left/right)            | NB : 2 – HS01/HS02       | Code 1-5 |
| - Cloth misalignment (left/right)             | NB : 2 – ZS03/ZS04       | Code 1   |
| - Cloth tension (min./max.)                   | NB : 2 – ZSL01/ZSH02     | Code 2   |
| - Belt drive unit overtorque                  | NB : 1 – WSH01           | Code 1   |
| - Belt misalignment (left/right)              | NB : 2 – ZS05/ZS06       | Code 1   |
| - Ultrasonic cake measure thickness           | NB : 2 – LT01/02         | Code 7   |
| - Slurry level control                        | NB : 1 – LSH01           | Code 7   |
| - Cloth run-off                               | NB : 1 – SSL01           | Code 2   |
| - Vacuum box wear belt breaking               | NB : 2 – ZS07/ZS08       | Code 6   |
| - Pressure gauge                              |                          |          |
| • Compressed air circuit                      | NB : 1 – PSL02           | Code 3   |
| • Water circuit                               | NB : 1 – PSL01           | Code 3   |
| - Flow indicator                              |                          |          |
| • Vacuum box and table wear belts lubrication | NB : 4 – FISL01/02/03/04 | Code 4   |
| • Type:                                       | Gyrometer with floater   |          |

#### Signal codification

Code 1 – 1 SPST (NC if not acted)

Code 2 – inductive sensor 2 wires (NC if not acted)

Code 3 – 1 SPST (NO if pressure < set point)

Code 4 – reed switch (NO if flow < set point)

Code 5 – include one second SPST to be separately and directly wired in the belt drive motor main contactor coil control circuit.

Code 6 – capacitive sensor 2 wire (NO if not acted)

Code 7 – 4/20 mA dc

The here above controls will be wired on one junction box fitted on the belt filter frame. This box will include one terminal block, one grounding copper bar and cable gland fittings.

Cables and terminals labelling will be in accordance with the electrical scheme identifications numbers.

#### LIMIT OF SUPPLY

Security and functioning of the equipment controlled by the customer's PLC/DCS according to the logic diagrams supplied by HASLER Group. Software programming works by the customer.

All the control and instrumentation cables, conduits and gland fittings not installed in the HASLER Group's workshop will be supplied and installed on site by the customer.

### 3.12.2. Standard list of suppliers

| MATERIAL                           | TYPE                           | BRAND                               | REMARKS                                     |
|------------------------------------|--------------------------------|-------------------------------------|---------------------------------------------|
| Emergency stop trip wire switch    | XY2-CE1A270TK<br>XY2-CE2A270TK | Schneider Electric<br>Télémécanique |                                             |
| Electromechanical limit switch     | ZCK-J1TK<br>ZCK-E61TK          | Schneider Electric<br>Télémécanique |                                             |
| Inductive sensor                   | IB0016                         | IFM Electronic                      | 20 ... 250 Vca/cc                           |
| Pressure switch                    | B4                             | Ashcroft<br>Dresser                 | Wetted parts st. steel 316                  |
| Variable area flowmeter            | 865                            | Gemü                                | With reed switch sensor<br>Type 1251/1256   |
| Junction box enclosure (JB)        | Série KS                       | Rittal                              | GRP IP66 (IEC 529)<br>Nema 4x               |
| Terminal blocks (JB)               |                                | ENTRELEC or<br>WEIDMÜLLER           |                                             |
| Cable gland fittings               | 316 L                          | Capri or<br>Lutze                   | JB and sensors                              |
| Control and instrumentation cables | 1,5 mm2 (AWG16)                | HELUKABEL                           | 300/500V DIN/VDE -<br>SEV 600V-90° UL / CSA |

## 4. PAINTING SPECIFICATIONS

Protection class C5 as required by the customer.

### NOTE:

- All paint layers must be free from zinc

-In case of modification of the process or the colour, HASLER Group will have to be notified no later than 1 month after the order (can be subject for extra prices).

## 5. BATTERY LIMITS AND EXCLUSION

### 5.1. BATTERY LIMITS

The equipment includes everything necessary inside the battery limits for a normal operation of the filter.  
The battery limits shown on the general assembly drawing are:

- Flange of the slurry distributor
- Flanges of the wash distributors
- Rubber sleeves of the filtrate pipes
- Flange of the cake discharge hopper
- Flange of the filtrate manifold
- Flange of the water manifold
- Flange of the vacuum pump
- Flange of the filtrate pumps
- flange of the Filtrate receivers
- flange of the tanks
- Air inlet at the entrance of the pneumatic cabinet
- Terminals of the accessories electrical box
- Anchor bolts

Note : Design of all flanges : EN1092-1

### 5.2. EXCLUSION

- Civil work
- Support steelwork
- Operating platform
- Electrical, wiring and instruments
- MCC or electrical cabinet
- Inspection by independant authorities
- Unload, warehousing and handling on site
- Painting on site

5.3. MODIFICATIONS

The technical specifications described in this agreement cannot be modified without HASLER Group consent.

6. **EC DECLARATION OF INTEGRATION & SAFETY PERSONNEL PROTECTION**

HASLER Group will deliver an EC declaration of integration and not a certificate.

That means that the equipment described above is destined to be integrated or assembled in a general arrangement or to be added to other equipment in integral running with each other.

In consequence, the start-up of this equipment is forbidden as long as the general arrangement in which, it will be integrated or all of integral equipment in which, it must be assembled, are not in compliance with the provisions of directive 98/37/CEE or in compliance with the National provisions for transposition of this directive in the country of start-up.

According to EC standard, safety personnel protections have to be installed all around the filter. HASLER GROUP will provide safety guards all around the filter.

## COMPLEMENTARY EQUIPMENTS & SERVICES FOR "PHILIPPE" VACUUM BELT FILTER

|                 |                                     |
|-----------------|-------------------------------------|
| CLIENT          | Boliden                             |
| JOB REF         | FENIX                               |
| QUOTATION N°    | 732482_6B10-01rev5                  |
| PRODUCT         | NiSO4 production                    |
| SELECTED FILTER | VACUUM BELT FILTER 6 m <sup>2</sup> |
| WIDTH           | 1000 mm                             |
| TYPE            | 6B10 - SERIE 2                      |
| DATE            | 14/05/2025                          |

### TABLE OF CONTENT

#### COMPLEMENTARY EQUIPMENTS AND SERVICES

Appendix "Cloth Ultrasonic welding machine"  
Appendix "Fume Hood & Drip Pan"  
Appendix "Filtrate receiver"  
Appendix "Vacuum Pump"  
Appendix "Filtrate Pump"  
Appendix "High pressure ramp"  
Appendix "Cloth & Belt Wash Tank & Pump"  
Appendix "Local Control Panel"  
Appendix "Erection on site"  
Appendix "Spare Parts - Maintenance Schedule"  
Appendix "Commissioning on site"  
Appendix "Water Quality"  
Appendix "Performance guarantee"

## **Appendix "ULTRASONIC CLOTH WELDING MACHINE" / OPTION**

### **SPECIAL TOOL**

- ONE CLOTH ULTRASONIC WELDING MACHINE

The generator converts the power of the 220V/50Hz or 60Hz network (system) into a 35000 Hz electrical energy. The piezoelectric converter produces mechanical oscillations of the same frequency. The welding gun together with the converter, directs its high frequency oscillations in the plastic material and produces at the requested place an overheating due to friction. The plastic material melts in fractions of a second and forms a lasting molecular assembling.

The ultrasonic energy is started by the impeller incorporated in the hand apparatus. The welding time is controlled, either manually by maintaining the impeller in an unlocked position, or automatically by a timer incorporated in the apparatus. The choice is done by a switch on the frontal side of the generator.

- ONE U 200x50x5 - LENGTH 3550: support to proceed to ultrasonic cloth welding
- ONE CUTTER IRON DUVAUCHEL: to cut the cloth
- ONE WINCH ROLLER: to strength the cloth
- Tools for erection to be provided by the customer.

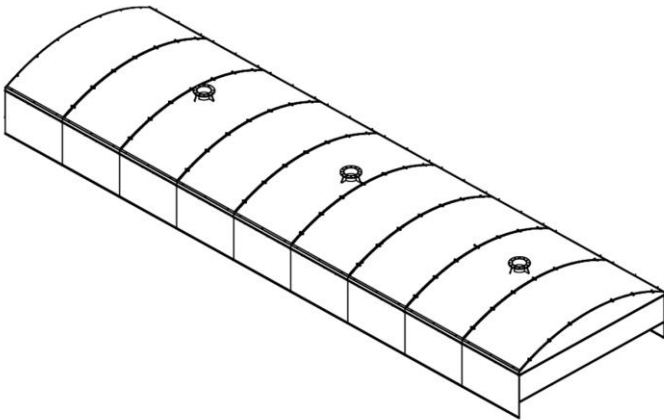
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**Appendix "FUME HOOD"**

It covers the whole or part of the filter active area. The housing structure is made of steel section number and supported by the filter frame. The top is made of polypropylene plate.

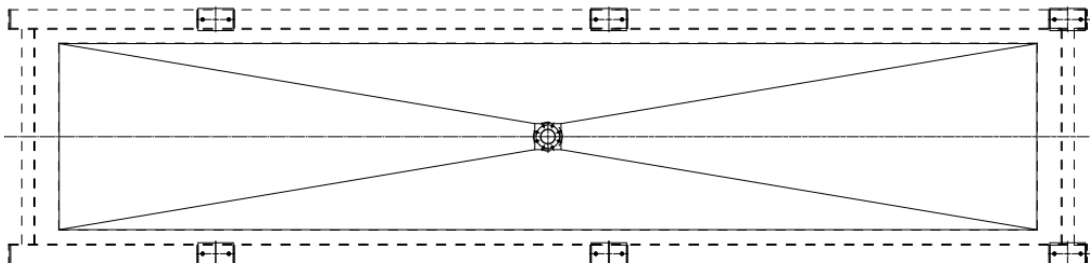
On each side, there is a full openings for easy access to wash through and dams. This openings are blinded by translucent PVC sheets.

- |   |                                  |                                    |
|---|----------------------------------|------------------------------------|
| - | Frame material:                  | 316 L with transparent PVC curtain |
| - | Total length:                    | 9130 mm                            |
| - | Exhaust flowrate to be foreseen: | 2300 m3/h                          |
| - | Outlets                          | 2 x 250 mm                         |
| - | Exhaust fan and piping:          | Excluded                           |



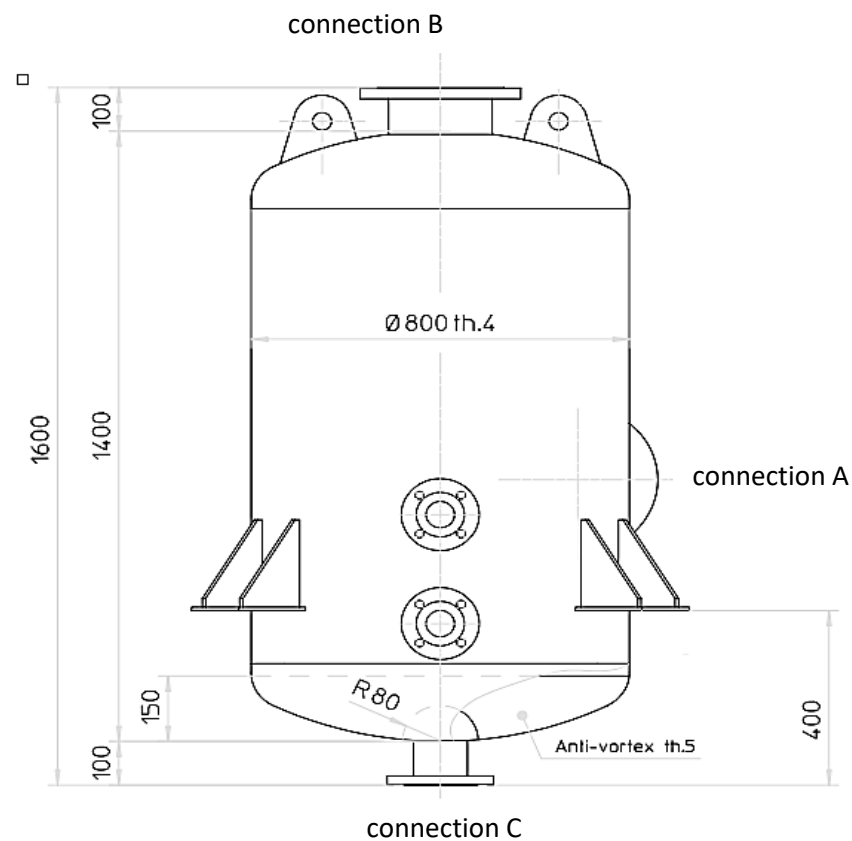
**Appendix "DRIP PAN"**

- |   |            |       |    |       |
|---|------------|-------|----|-------|
| - | Material   | 316 L |    |       |
| - | Dimensions | 7500  | mm | (TBC) |
| - | Lenght     | 1950  | mm | (TBC) |
| - | Width      |       |    |       |



## Appendix "FILTRATE RECEIVER"

- Material: FRP + PVDF liner in + vinyl resin coating outer
- Diameter: 800 mm
- Supporting legs Included
- Connection "A": 150 mm
- Connection "B": 125 mm
- Connection "C": 65 mm
- Other connections
- Level probe: DN50 (2") - Nbre: 2
- Pressure indicator transmitter: DN50 (2") - Nbre: 1



## Appendix "VACUUM PUMP"

- Type: Liquid ring
- Quantity: 1 per filter
- Material: SS 2205 ( UR 45 N) & 316 L
- Delta Pressure: -613 mbar rel
- Nominal pressure: 400 mbar abs

### Sizing basis

- Gaz temperature: 40 °C nominal; 70 °C (Design)
- Liquid ring temperature: 20 °C
- Elevation:

### Characteristics

- Capacity: 1200 m3/h
- Rotary speed:
- Absorbed power:
- Installed power: 30 kW
- Voltage: 400 V
- Frequency: 50 Hz
- Liquid ring requirements: No recirculation
- Noise level: 85 dB(A) at one meter

### NOTE:

Noise measured in open field around pump and with exhaust air flange connected to an exhaust pipe (out of supply) without any reverberation/addition of the pipe or air sound exhaust. Injection water must be not corrosive, free solids, not hard water at a normal temperature. If not, the water must be treated.

### Accessories

100%

- Inlet seal water piping with instrumentation & valves as per P&ID
- Discharge separator in carbon steel
- Transmission per V-Belt
- Vacuum breaker
- Base plate
- Electrical motor 30 kW
- Exhaust silencer excluded
- Painting: Protection class C5

#### Appendix "FILTRATE PUMP"

- Type: Centrifugal
- Capacity 6,3 m3/h
- H.M.T.: 40 m To be confirmed during detail design
- N.P.S.H. (required): To be confirmed
- Material: PE-UHMW
- Shaft sealing: Standardized Simple Mechanical Seal
- Absorbed power: 5,3 kW
- Installed power: 7,5 kW will be refined during detail design with right HMT
  
- Weight (with motor): to be given by supplier

#### Accessories :

- Base for pump and motor.
- standard electrical motor
- Coupling and guard
- Painting: Protection class C5

100%

## Appendix "HIGH PRESSURE RAMP"

One high pressure ramp constituted with an articulated frame driven by a moto-reducer, supporting the washing ramp provided with spray nozzles made of hardened stainless steel.

The ramp has a reciprocating motion.

- Installed power: 0,18 kW (TBC) for reciprocating ramp motor
- Flow rate: 22 L/min (TBC) i.e 1,32 m3/h
- Working pressure: 100 bar

Connection accessories: HP flexibles and hose-couplings

**Nota:** Injection water must be free solids (< 90 µm) to avoid clogging.

- One high pressure pump with electrical motor:

- o Nominal Power: 7,5 kW (TBC)
- o Tension: According CARESTER's requirements
- o Frequency: 50 Hz
- o Requested flow rate: 22 L/min at between 50 to 100 bar
- o Water pressure at inlet: 1 to 3 bar

MOC:

- Frame: 316 L
- Pump head: 316L
- Pistons: Ceramic
- Seals: NBR
- Painting : Protection class C5

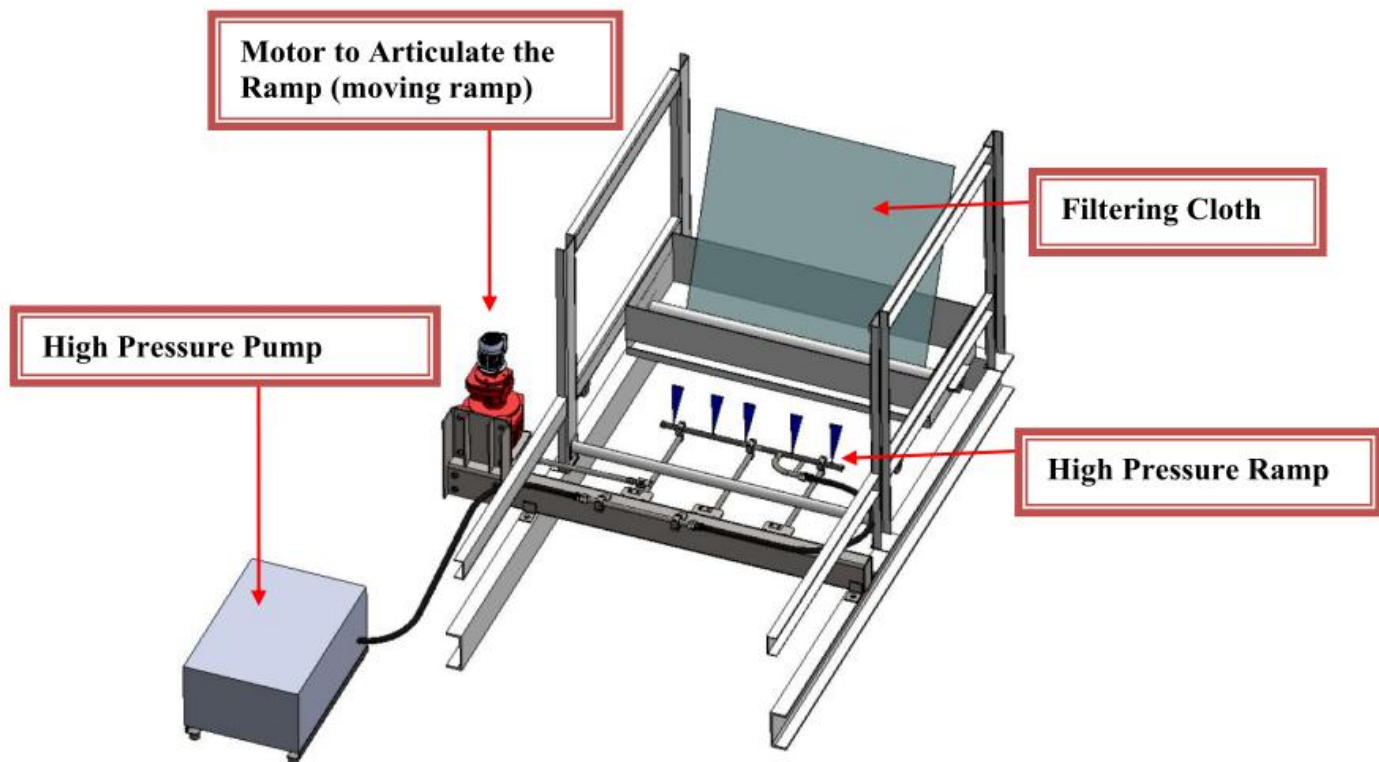
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Accessories:

- o One manometer in 316L
- o Pressure regulator in 316L
- o One anti-pulsating bottle

Coupling with pulley-belt guard.

**Piping between High Pressure Pump & High Pressure Ramp, Electrical Cabinet EXCLUDED**



## Appendix "CLOTH AND BELT WASHING TANK & PUMP"

### CLOTH & BELT WASHING RECIRCULATION PUMP

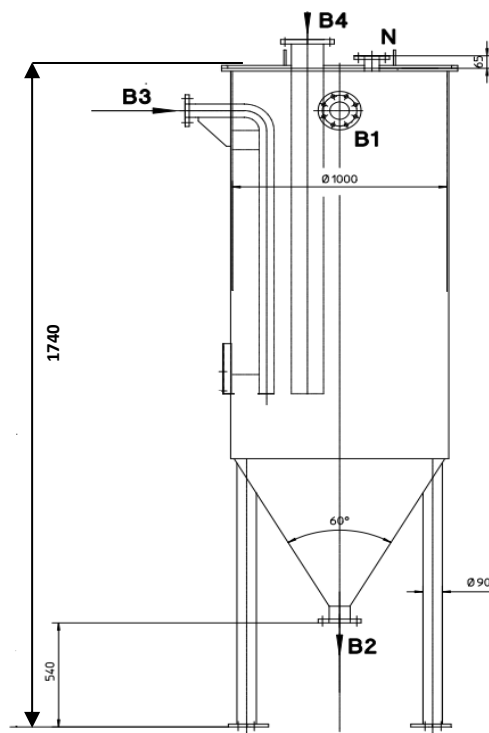
- Type: Centrifugal
  - Capacity: 3,8 m<sup>3</sup>/h
  - H.M.T.: 40 m To be confirmed during detail design
  - N.P.S.H. (required): To be confirmed
  - Material: PE-UHMW
  - Shaft sealing: Standardized Simple Mechanical Seal
  - Absorbed power: 2,8 kW corrected
  - Installed power: 5,5 kW corrected
  - Weight (with motor): to be given by supplier
- will be refined during detail design with right HMT

#### Accessories :

- Base for pump and motor.
- standard electrical motor
- Coupling and guard
- Painting: Protection class C5

### CLOTH & BELT WASHING RECIRCULATION TANK

- Material: FRP + Vinyl resin coating outer
- Qty: 1
- Capacity: 1 m<sup>3</sup>
- Diameter: 1000 mm
- Height : 1200 mm
- Conical height : 300 mm
- Supporting legs : Included
- Level detector: (Qty 1) Ultrasonic level transmitter



#### Connections \*:

- B1** Pump connection
- B2** Outlet
- B3** Water inter (Make-up)
- B4** washing water inlet
- N** Level
- (\*) DN of these connections will be precised later.

## Appendix "LOCAL CONTROL PANEL"

### II - LOCAL CONTROL PANEL

The Local Control Panel is used to start, stop the belt filter, and adjust the belt filter speed, locally close the filtration unit.

It will be **316 L** enclosure IP66 Nema 4X, manufacturer RITTAL or similar, size 600 mm high, 400 mm wide, 200 mm deep (wall mounting) and will be installed on site by customer close to the belt filter. **The area classification is non-hazardous.**

The Local Control Panel includes:

- 1 panel 600 mm high x 400 mm wide x 200 mm deep with front door equipped with handle and lock and key.

#### Components located on the front door:

- 1 "Emergency stop" push button.
- 1 belt filter motor "START" push button.
- 1 belt filter motor "STOP" push button.
- 1 belt filter motor "FASTER" push button.
- 1 belt filter motor "SLOWER" push button.
- 1 "BELT FILTER SPEED" numeric indicator.

Components located inside the control panel:

- 1 "CLOTH CHANGE" key operated handswitch selector.
- 1 Horn for belt filter "ALARM START-UP" located on the top of the control panel.
- 1 Terminal block set allowing the control panel internal components wiring connections of the hereabove signals and the external wiring connections between the Local Control Panel and the Customer's PLC/DCS inputs/outputs.
- Analog input signal for numeric indicator: 4-20 mA from Customer's PLC/DCS or Variable Frequency Drive.
- Voltage supply for numeric indicator: 230 Vac-/50HZ or 24 Vdc supplied by the Customer.
- Internal wiring will be laid with PVC wiring ducts.
- Wiring and parts labelling will be in accordance with electrical scheme identification numbers.
- Each end of wire will be provided with vinyl sleeve type marker for numbering identification.

**NOTE:**

The use of "CLOTH CHANGE" key operated handswitch selector is allowed only in maintenance mode and local mode, and at fixed minimum belt filter speed, and reserved only for authorized personnel.

The Local control panel will be completely assembled, wired, adjusted, and tested at HASLER Group's factory.

**III - VACUUM BELT FILTER JUNCTION BOX**

The Vacuum Belt Filter Junction box is used to wire all instruments located on the belt filter. It will be **316 L** enclosure IP66 Nema 4X manufacturer RITTAL or similar, size 530 mm high, 430 mm wide, 200 mm deep and will be installed on the belt filter.

**The area classification is non-hazardous.**

The Vacuum Belt Filter Junction box includes:

- 1 cabinet 530 mm high x 430 mm wide x 200 mm deep with front door equipped with lock and key.
- 1 terminal block set allowing the internal components wiring connections with the external wiring connections between the belt filter instruments.
- 1 set of polyamide cable glands fitting.
- Internal wiring will be laid with PVC wiring ducts.
- Wiring and parts labelling will be in accordance with electrical scheme identification numbers.
- Each end of wire will be provided with vinyl sleeve type marker for numbering identification.

The Vacuum Belt Filter Junction box will be completely assembled, wired, adjusted, and tested at HASLER Group's factory.

#### **IV - INSTRUMENTATION CABLES, CONDUITS AND TAGS**

- All the instrumentation cables and conduits between the Junction box located on the belt filter and the instruments located on the belt filter will be supplied by HASLER Group.
- All the instrumentation cables labelling supplied by HASLER Group will be in accordance with electrical scheme identification numbers.
- Fitting and wiring of these instrument cables will be done by the Customer under HASLER Group's supervision.

#### **V - TECHNICAL DOCUMENTATION**

The Technical Documentation in **English** includes:

- The Electrical scheme.
- The Local Control Panel equipment with part list.
- The Vacuum Belt Filter Junction box equipment with part list.
- The Instrument list.
- The Instrument data sheets.
- The Functional analysis.
- The logic diagrams.
- The technical documentation of instruments and electrical components.

#### **VI - LIMIT OF SUPPLY**

- Not included in our offer:

- The safety and logic sequences of the filtration unit are controlled by the Customer's PLC/DCS according the logic diagrams and the functional analysis supplied by HASLER Group.
- The software programming works will be done by the Customer.
- All control cables, instrumentation cables, network cables and conduits between the Junction box located on the belt filter and the local control panel, the motors, the field instruments (not located on the belt filter), the Customer's PLC/DCS and MCC will be supplied and installed on site by the Customer.
- Cable glands fitting (or conduit fitting) for the Customer's cables will be supplied and installed on site by the Customer.
- Wiring up to the junction box. After the junction boxes, this is a supply from RVA.

## VII - LIST OF ELECTRICAL SUPPLIER

| LOCAL CONTROL PANEL                                 |                                                                                              |                        |                                                                                        |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------|
| DESIGNATION                                         | TYPE                                                                                         | MANUFACTURER           | REMARKS                                                                                |
| Enclosure                                           | Type AX                                                                                      | Rittal                 | 316 L                                                                                  |
| Pushbuttons, hand switches, signalling pilot lights | Type XB4-XB5...                                                                              | Schneider Electric     | IP66                                                                                   |
| Horn                                                | Type T100                                                                                    | AET                    | IP66                                                                                   |
| Terminal blocks                                     |                                                                                              | ABB - Entrelec         |                                                                                        |
| Cables glands                                       | 316 L                                                                                        |                        | Iso Metric                                                                             |
| Internal control wiring                             | Isolated wires and ferrules                                                                  |                        | Execution according to EN 60204                                                        |
| JUNCTION BOX                                        |                                                                                              |                        |                                                                                        |
| DESIGNATION                                         | TYPE                                                                                         | MANUFACTURER           | REMARKS                                                                                |
| Enclosure                                           | Type PLM                                                                                     | Schneider Electric     | 316 L                                                                                  |
| Terminal blocks                                     |                                                                                              | ABB - Entrelec         |                                                                                        |
| Cables glands                                       | 316 L                                                                                        |                        | Iso Metric                                                                             |
| Internal control wiring                             | Isolated wires and ferrules                                                                  |                        | Execution according to EN 60204                                                        |
| INSTRUMENTATION CABLES FOR VACUUM BELT FILTER       |                                                                                              |                        |                                                                                        |
| DESIGNATION                                         | TYPE                                                                                         | MANUFACTURER           | REMARKS                                                                                |
| Instrumentation cables                              | Control cable JZ-500 black (digital signal)<br>Shielded cable JZ-500-C black (analog signal) | Helukabel<br>Lappkabel | PVC flexible control and Cu-screened cable, 300/500V<br>Temperature range: -5 to +80°C |

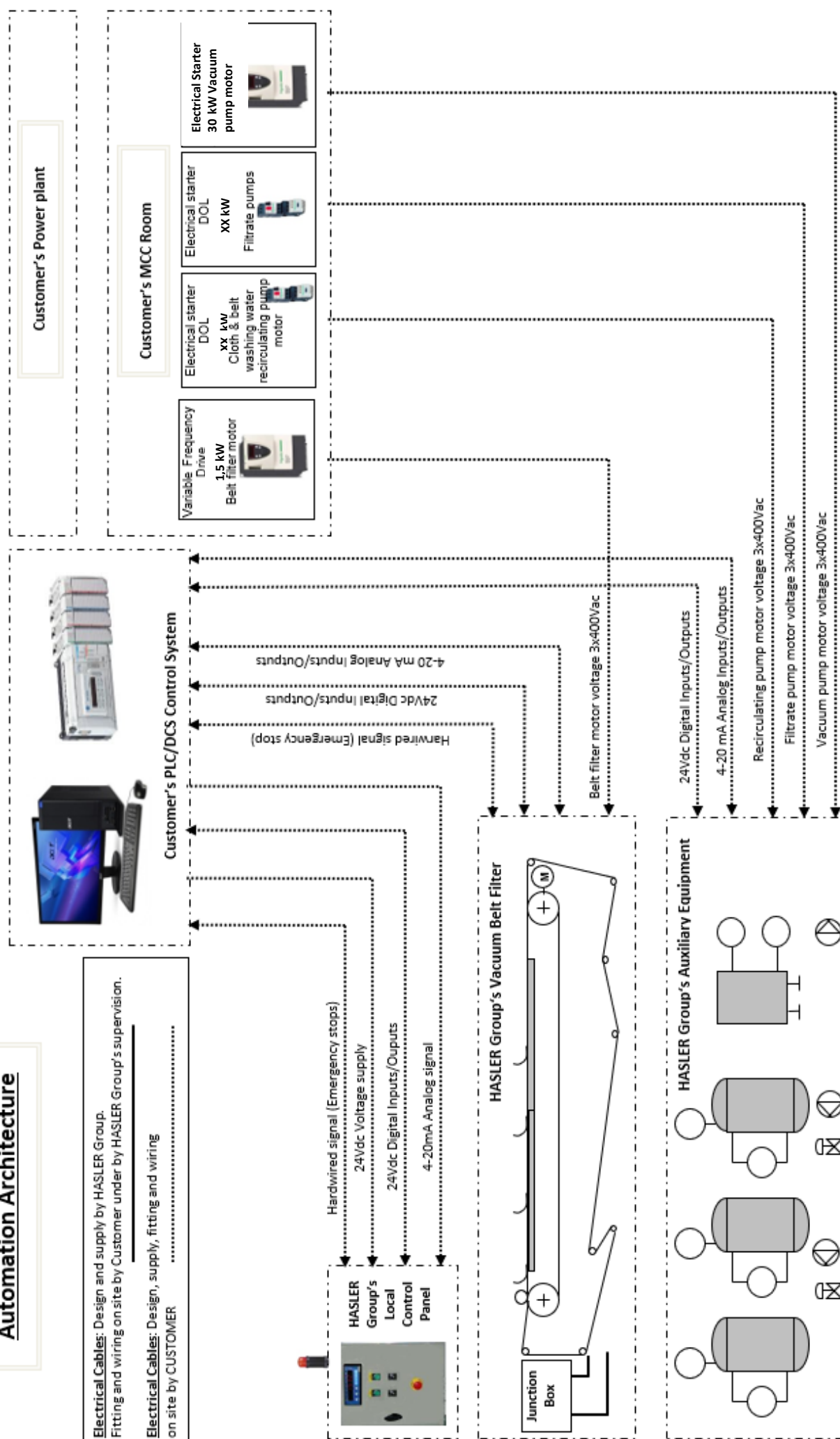
Boliden requirement :

Note : For motor : ABB or WEG  
For motors with gearbox: SEW or ABB

## Automation Architecture

**Electrical Cables:** Design and supply by HASLER Group.  
Fitting and wiring on site by Customer under by HASLER Group's supervision.

**Electrical Cables:** Design, supply, fitting and wiring  
on site by CUSTOMER .....



## Appendix "ERECTION ON SITE"

### ERECTION ON SITE (\*)

According to HASLER Group's enclosed daily contractual fees.

Depending of the means, manpower supplied by the client and the site conditions. The here after estimations should be discussed.

For erection, customer will provide all specified equipments for lifting, handling, power.

|          | <u>HASLER Group<br/>manpower</u> | <u>Customer<br/>manpower per filter</u> |
|----------|----------------------------------|-----------------------------------------|
| Erection | One supervisor                   | See planning                            |

Estimated duration: 3 weeks - to be confirmed during KOM

Filter will be delivered in elementary pieces, erected on customer site during this time.

#### Special tools for erection supplied by HASLER Group

- Special tools and accessories (which are specific to HASLER Group) for cold bonding of the curbs. These equipments are imported temporary by HASLER Group.
  - Specific supports according HASLER Group drawing
- NOTE:** Transportation cost for these equipments will be charged to Customer.

#### Tools for erection to be provided by customer

- Means of lifting, cranes, pulley block.... Heavy piece = 2000 kg.
- One (1) theodolite.
- One (1) welding generator (TIG).
- Standard tools and safety accessories necessary for each filter.
- Two (2) Wooden floor length 10 meters for each filter.
- Two (2) Textil slings length 2 meters, 2 tons.
- Two (2) Textil slings length 1 meters, 2 tons.
- Two (2) Textil slings length 2 meters, 4 tons.
- Two (2) Textil slings length 4 meters, 6 tons.
- Three (3) Textil slings length 6 meters, 6 tons.
- Four (4) shackles 10 tons.
- Two (2) Pulley blocks 1 ton.
- One (1) lifting beam 10 ton according the HASLER Group specifications.
- Two (2) ladders 3 meters.
- One (1) jacks 6 tons.
- Two (2) winch cables 5 tons.
- Two (2) pneumatic machine bolts
- One (1) dynamometrical spanner machine bolts

#### Utilities for filter erection

- Compressed air: 7 bar.
- Electricity: 240 V with electrical junction box.
- Power electricity with inverter at disposal 3 weeks after the beginning of filter erection.
- Storage for small equipments as screws, nuts..... near each filter.
- Lifting.

Note : Before order, we must discuss about the footprint and handling materials available on your site for the filter erection due to filter equipment dimensions and weights.

## Appendix SPARE PARTS - MAINTENANCE SCHEDULE

We offer following spare parts:

Commissioning spare parts

| Description           | Qty on filter | Recommended qty |
|-----------------------|---------------|-----------------|
| Filter cloth          | 1             | 1               |
| Table wear belt       | 4             | 2               |
| Vacuum box wear belts | 2             | 2               |
| Spray nozzle          | 61            | 10              |

In option are offered 2 years recommended spare parts:

| Description                | Qty on filter | Recommended qty |
|----------------------------|---------------|-----------------|
| Cloth tracking edge sensor | 1             | 2               |
| Filter cloth               | 1             | 3               |
| Table wear belt            | 4             | 4               |
| Set of V-Belt              | 1             | 1               |
| Vacuum box sliding rules   | 1             | 1               |
| Vacuum box wear belts      | 2             | 2               |
| Rubber sleeve              | 4             | 4               |
| Scraper                    | 1             | 2               |
| Spray nozzle               | 61            | 61              |

## **Below an estimation schedule for maintenance operations**

### **FRAME**

Once a week, in the case of pulp overflow, wash the framework completely, taking care not to splash the bearing blocks

### **BELT SUPPORT TABLE**

Check the wear of the wear belts and the absence of cuts. If the wear belts are damaged, replace them.

If necessary, retighten the wear belts with the clevis tensioner rods located at the ends of the longitudinal support rails

Check the state of wear of the sliding strips and replace them if they are too worn

### **CONVEYOR BELT**

The definitive tension of the belt is obtained after a certain operating time, necessary to release internal manufacturing stress

For at least a month, make sure that the belt turns correctly.

It is necessary to act on the screw of the tensioner slides of the tail pulley and on the lateral belt guiding rollers in order to tension and stabilize the lateral movement of the belt.

Regularly do the following:

check that the belt is properly washed by the spray bars

check the state of the curbs as they are quite fragile

adjust the belt tension and correct position of the lateral guiding rollers

### **TAIL and HEAD PULLEY**

Check that the bearing block lubrication is correct

Coat the threaded rods on both sides of the drum with grease

Once a year, check the state of the rubber lining.

### **ROLLERS**

Check that the rollers are horizontal and parallel to one another

Every day, check that the rollers do not clog

Check that the lubrication is correct

### **DRIVING GROUP**

Check that the oil level of the gear box is correct

### **CLOTH AND BELT WASHING**

Regularly ensure that the spray nozzles are not blocked and, if necessary, change them

### **CAKE SCRAPER BLADE**

Verify that all of the scraper blades are aligned and in contact with the filter cloth.

Every year, check the scraper's fixing sets.

### **UPPER ACCESSORIES : Feeder, dams, washing pipes**

In the case of overflow and at each stop, thoroughly wash the internal and external feeder parts.

Check the wear of the rubber flaps

| Mechanical Operations                                                                            | Cloth Replacement | Weekly | Fortnightly | Monthly | Half Yearly | Yearly |
|--------------------------------------------------------------------------------------------------|-------------------|--------|-------------|---------|-------------|--------|
| Cloth replacement                                                                                |                   |        |             |         |             |        |
| Cloth tension adjustment and cleaning                                                            |                   |        |             |         |             |        |
| Cloth guiding adjustment and cleaning                                                            |                   |        |             |         |             |        |
| Clean the cloth and belt spray nozzles                                                           |                   |        |             |         |             |        |
| Scraper adjustment                                                                               |                   |        |             |         |             |        |
| Clean the cloth and belt washing recovery tray                                                   |                   |        |             |         |             |        |
| Clean all parts (frame, rollers)                                                                 |                   |        |             |         |             |        |
| Check the lubrication of the plummer blocks<br>(*) = if the Automatic Lubricator is not supplied |                   | (*)    | (*)         |         |             |        |
| Clean the feeder                                                                                 |                   |        |             |         |             |        |
| Tilt and check the vacuum box                                                                    |                   |        |             |         |             |        |
| Check the vacuum box and table sliding belts for fraying, cuts and wear                          |                   |        |             |         |             |        |
| Check the vacuum box and table sliding strip for wear                                            |                   |        |             |         |             |        |
| Replace the upper accessories rubber flap                                                        |                   |        |             |         |             |        |
| Check the lubrication of the vacuum box and table sliding belts                                  |                   |        |             |         |             |        |
| Survey the state of the guiding roll rubber lining                                               |                   |        |             |         |             |        |
| Check all bearings                                                                               |                   |        |             |         |             |        |
| Check the rubber belt tension                                                                    |                   |        |             |         |             |        |
| Drain the reducer oil                                                                            |                   |        |             |         |             |        |
| Check the paint and repair if necessary                                                          |                   |        |             |         |             |        |

## Appendix "COMMISSIONING ON SITE"

Estimated duration: 2 weeks

During the period provided for commissioning, our engineer with customer technicians will do:

- Mechanical start-up.
- Check all components.
- Adjust technical parameters.
- Feed filter with slurry.
- Optimize technical parameters.

Training of customer technicians:

- Theory of vacuum filtration, explanation and questions-and-answers.
- Description of the installation
  - General description of the main components.
  - Filter.
  - Receivers, vacuum pump, filtrate pumps...
- Details of filter
  - Description of the main components and their function.
  - Theoretical.
  - Practice on site including demonstration.
- Start-up – Commissioning of the filter
  - Without product
  - With product
- Comments and verification of people knowledge

**Appendix "Water Content quality - Vacuum Wear Belt and Table Wear Belt lubrication"**

| <b>Water Content quality - Vacuum Wear Belt</b>                        | <b>Range</b>                                |
|------------------------------------------------------------------------|---------------------------------------------|
| Floating particles mg/l                                                | No particles to avoid clogging on wear belt |
| Temperature in °C                                                      | <45                                         |
| Particles size, mm                                                     | <0,5                                        |
| Conductivity , µS/cm                                                   | 1 - 1000                                    |
| pH                                                                     | 8,5 > > 5                                   |
| water hardness in °dH                                                  | 5 - 15                                      |
| carbonate hardness in °dH                                              | <15                                         |
| Chloride (Cl-) mg/l                                                    | <250                                        |
| Sulphate (SO4 2-) mg/l                                                 | <350                                        |
| free carbonic acid mg/l                                                | 0                                           |
| Nitrate (NO3-) mg/l                                                    | <50                                         |
| Potassium permanganate usage mg/l                                      | 25                                          |
| ammonium NH4+ mg/l                                                     | <5                                          |
| Organics - Hydrocarbures                                               | Forbidden                                   |
| Demineralized water                                                    | Forbidden                                   |
| Belt support wear belt lubrication water flow in l/hr for 6B10 Filters | Non!                                        |
| Vacuum box wear belt lubrication water flow in l/hr for 6B10 Filters   | 120                                         |
| Pressure for Vacuum box and Table lubrication in bar                   | 1 (<4 mandatory)                            |

#### Appendix "Water Content quality - Cloth and Belt washing water"

| Water Content quality - Cloth and Belt washing water        | Range     |
|-------------------------------------------------------------|-----------|
| Floating particles, mg/l                                    | <200      |
| Particles size, mm                                          | <0,5      |
| Temperature in °C                                           | <45       |
| Conductivity , µS/cm                                        | 1 - 1000  |
| water hardness in °dH                                       | 5 - 15    |
| carbonate hardness in °dH                                   | <15       |
| Chloride (Cl-) mg/l                                         | <250      |
| Sulphate (SO4 2-) mg/l                                      | <350      |
| free carbonic acid mg/l                                     | 0         |
| Nitrate (NO3-) mg/l                                         | <50       |
| Potassium permanganate usage mg/l                           | 25        |
| ammonium NH4+ mg/l                                          | <5        |
| Organics - Hydrocarbures                                    | Forbidden |
| Demineralized water                                         | Forbidden |
| Belt and Cloth washing water flow in m3/hr for 6B10 Filters | 3,05      |
| Pressure for Cloth and Belt washing water in bar            | 3         |

Boliden process water composition : (For make-up water)

| temperature, temperature |     | pH  | conductivity [mS] | Pressure | solids  | SO4 [g/l] | As [µg/l] | Cu [µg/l] | Ni [µg/l] |
|--------------------------|-----|-----|-------------------|----------|---------|-----------|-----------|-----------|-----------|
| min                      | max |     |                   |          |         |           |           |           |           |
| 30                       | 45  | 3-5 | 5-20              |          | minimal | <1        | 107-515   | 39-301    | 11-236    |

The material choosen for Cloth & belt collecting tank, Recirculation pump, High pressure pump and Spray nozzles are compatible with Boliden water composition given above in first cycle, and for the recirculation one.

## Appendix "PROCESS PERFORMANCE GUARANTEE "

According to the technical specifications of the inquiry and the enclosed general flow-sheet (based on the nominal flow rates) and provided that main characteristics the slurry shall be as follows:

|                                                                          |                                  |                                                                                 |
|--------------------------------------------------------------------------|----------------------------------|---------------------------------------------------------------------------------|
| Sin                                                                      | Slurry                           | Black acid (~70 wt% H <sub>2</sub> SO <sub>4</sub> ) + Nickel Sulphate crystals |
| <b>Slurry Characteristics</b><br><br><b>(for performances guarantee)</b> | Production (m <sup>3</sup> /h)   | 3-5<br>sized on 5                                                               |
|                                                                          | Density (T/m <sup>3</sup> )      | 1,66 (+/- 0,1)                                                                  |
|                                                                          | Solids Concentration (%w/w)      | 15-20%                                                                          |
|                                                                          | Production Dry Solids (T/h)      | 1                                                                               |
|                                                                          | Dry Solid SG (T/m <sup>3</sup> ) | 2 - 2,1                                                                         |
|                                                                          | Temperature (°C)                 | Nom : 30-50 °C; Design 80 °C                                                    |
|                                                                          | pH                               | < 0                                                                             |

|                                                                              |                                                                     |                                                           |
|------------------------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Wash Water Characteristics</b><br><br><b>(for performances guarantee)</b> | Nature of fluid                                                     | Water                                                     |
|                                                                              | Density (T/m <sup>3</sup> )                                         | 1                                                         |
|                                                                              | Wash ratio (total) m <sup>3</sup> /h of water per Ton of dry solids | 0,3                                                       |
|                                                                              | Type of cake washing                                                | 1 x Direct Wash                                           |
|                                                                              | Temperature (°C)                                                    | 30-45                                                     |
|                                                                              | pH                                                                  | 3-7                                                       |
| <b>Customer Goals</b><br><i>(client expectations)</i>                        | Slurry (m <sup>3</sup> /h)                                          | 3-5                                                       |
|                                                                              | Solid (T/h)                                                         | 0,7- 1,35<br>Max : 1,35 --> 16% w/w of slurry for SG 1,66 |
|                                                                              | Residual moisture (wet cake)                                        | < 20                                                      |
|                                                                              | Cake content (H <sub>2</sub> SO <sub>4</sub> )                      | max 10 %                                                  |
| <b>HASLER GROUP Process Guarantees (*)</b>                                   | Filter size                                                         | 6 m <sup>2</sup>                                          |
|                                                                              | Slurry (m <sup>3</sup> /h)                                          | 3-5                                                       |
|                                                                              | Solid (T/h)                                                         | 0,7- 1,35<br>Max : 1,35 --> 16% w/w of slurry for SG:1,66 |
|                                                                              | Residual moisture (wet cake)                                        | <20<br>sized on 19%                                       |
|                                                                              | Cake content (H <sub>2</sub> SO <sub>4</sub> )                      | max 10 %                                                  |

(\*) : Since the filter is designed without Hasler lab tests and only based on the data provided by Boliden, its performances will be confirmed and guarantee under lab test conducted by Hasler during filter hot commissioning on your site. The goal will be to validate some design parameters and adjust them if necessary.