Polishing Unit

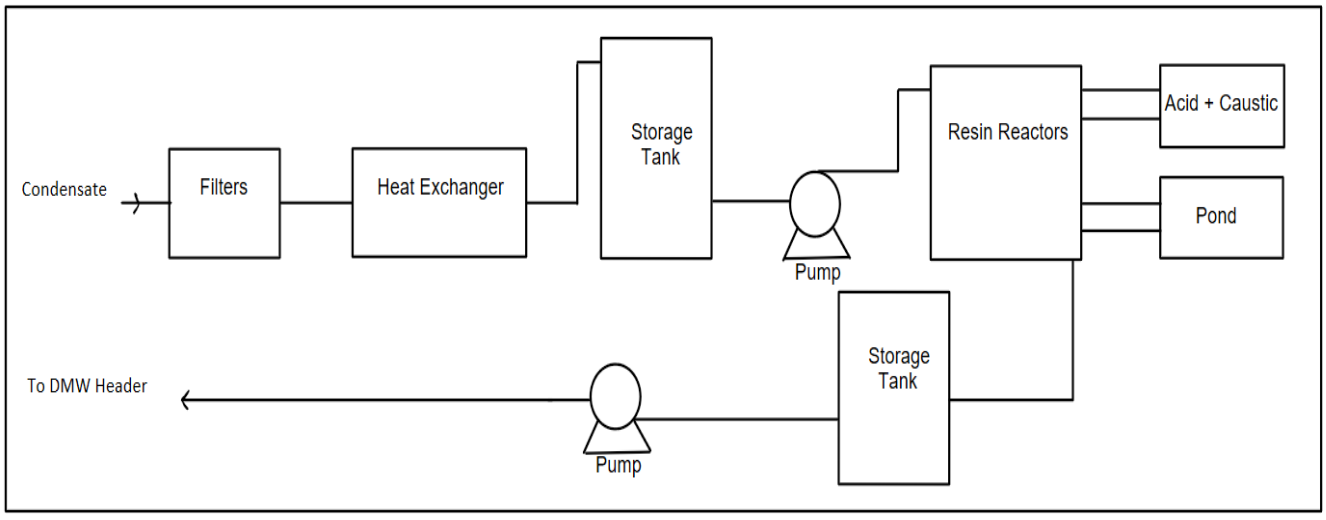
Description

Purpose of polishing unit: to remove salt ions from condensate

Polishing wit components

- Cartridge filters: to remove large particles from water
- Resin (polymer-based material) to absorb ions such as Silica
- Heat exchanger: to protect resins against high temperature.
- Storage tanks: in order to store water we need storage tanks.
- Pumps: they are need to transfer and pressurize water
- Acidy Caustic soda storage tanks: to regenerate resins. Resins are saturated after a period of time.
- Pond: they are used to store waste from regeneration of resins.

So, the first edition of PFD is like this:



Let's detail it:

1.Cartridge filters — Since we have high flow of condensate and plus, we have DMW from Outside Battery Limit (OSBL), then we need more than one for condensate, one for DMW, and standby for each.

2.Heat exchanger — Because of operating condition, it is efficient to use plate heat exchangers.

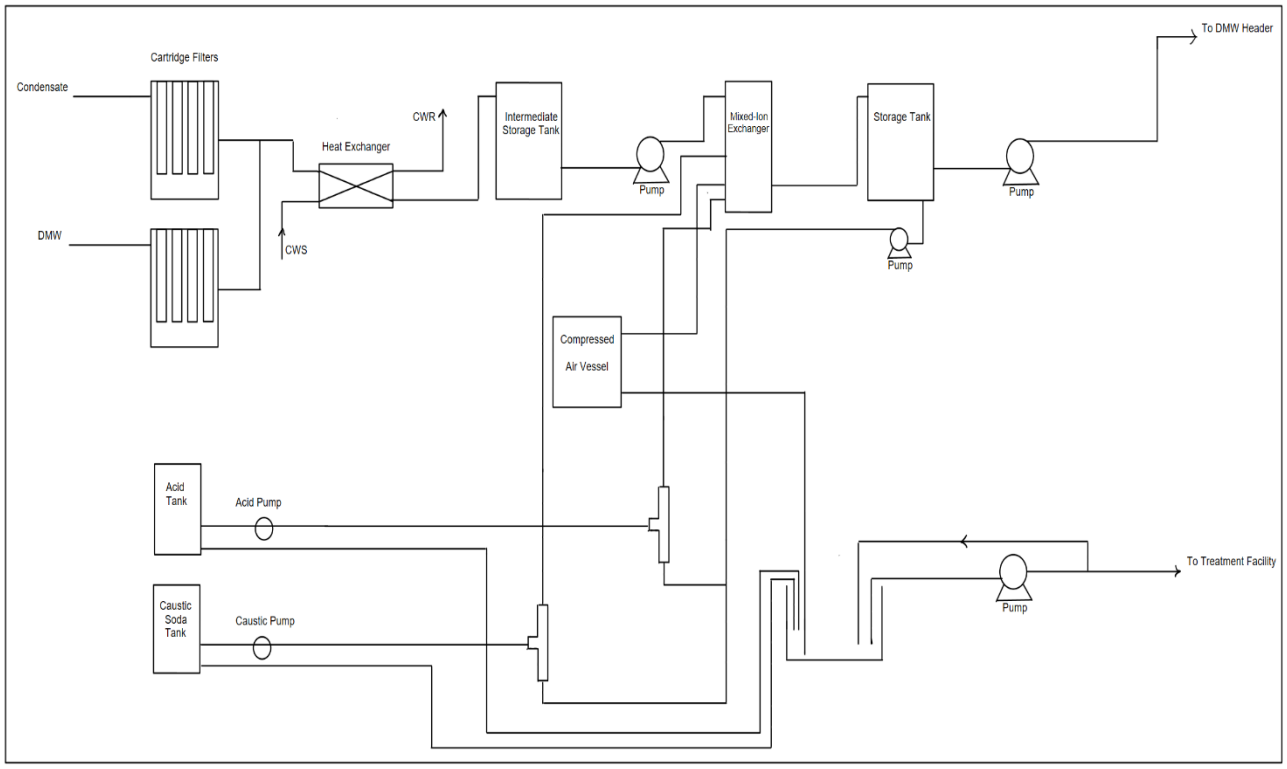
3.Intermediate Tank — Since water is going to be stored, then it is not toxic. Thus, we use atmospheric tanks.

4.Regeneration
- We need to regenerate resins from time to time based on sequential procedure. In the procedure low concentrated acid should be used, otherwise, it might damage the resins. It means that we have to mix water with the acid before injecting the acid to mixed-ion exchanger. To do so, we need a pump to transfer water and a reciprocating pump to transfer acid. In addition, we also need a mixer to mix them.
- We need to regenerate resins from time to time based on sequential procedure. In the procedure low concentrated NaOH should be used, otherwise, it might damage the resins. It means that we have to mix water with the caustic soda before injecting the acid to mixed-ion exchanger. To do so, we need a pump to transfer water and a reciprocating pump to transfer acid. In addition, we also need a mixer to mix them.

5.Pond — The waste produced during regeneration of resins is discharged to the pond. Since the waste cannot be treated inside the plant, we have to use a pump in the design to send the waste water outside the plant.

5.Compressed air vessel
- A part of the regeneration procedure incorporates air injection. So we need to have a compressed air vessel to supply the air.
- The waste water which is going to be transferred to outside the plant, should be approximately neutralized. So we are supposed to also consider a pipe from caustic tank to the pond and a pipe from acid tank to the pond. To perform the mixing better we use two strategies, first, we consider a circulation route for the pump and secondly, we install pipes with holes at the bottom of the pond, through which the compressed air is injected and creates turbulency.

By considering the aforementioned, then our PFD becomes like below:



As last we need to demonstrate operating flowrates, pressures, and temperatures and very simple control system like in attached document named PFD-Polishing Unit.

Detailed Description

In order to ensure the high parameter and large capacity generating unit's water quality requirements, (OSBL) has set up the polishing unit. Condensate water and demineralized water from (OSBL) shall be polished. The total capacity of polishing unit is 250m3/h. Flow rate of steam turbine condensate will be 101 m3/h (normal) and 126m3/h (maximum). The other capacity shall be supplemented through DMW from OSBL. The DMW capacity after polishing unit is 250 m3/h. The suggested scheme of polishing unit shall follow the sequence as cartridge filter, heat exchanger and mix-ion exchangers. Condensate water and demin water from (OSBL) go through cartridge filter respectively, the combined water cools down with heat exchanger, and then go into the intermediate tank (TK 7201). Intermediate water pumps the water into mixed-ion exchanger then stored into the demineralized water tanks, finally demineralized water pumps the water to the user.

Filters and heat exchanger section

Steam turbine condensate and DMW from OSBL shall be filtrated separately by vertical cartridge filter. After that, the two-stream water shall be mixed and cooled down to 40 by heat exchanger. Two vertical cartridge filters shall be considered for steam turbine condensate, one in running and another on standby. One vertical cartridge filter shall be considered for DMW from OSBL and share the stand by filter with condensate. The filters material is SS304, and PP filter element for the internal material. 6μm precision filter element shall be adopted for cartridge filters. Two heat exchangers, one in operation, one on standby.

Cartridge filter

The cartridge filters are set in front of the heater and ion-exchanger to remove larger particles, preventing the filter elements and resin from scratching, contaminating and blocking. Filtering medium go through filter to remove the larger particles of impurities. There are three filters, one is set for demineralized water and the others are set for turbine condensate. Filter shell is made of SS304 and filter elements are made of PP. The filter of filtering accuracy is less than 6μm.

Note:

The function of cartridge filter is to intercept the particles larger than 5 μm from the raw water to prevent it from entering the subsequent membrane system. This kind of particles may puncture the membrane component after the pump accelerates. Filter element is large flow folded filter element, when differential pressure between inlet outlet is greater than the set value (usually 0.07-0.10 MPa), the filter element shall be replaced, its normal service life is 3 to 6 months. The cartridge filter is made of SS304.
The large flow folded filter element, its characteristic are as follows:
1) Conical structure;
2) Deep filtration;
3) Large carrying amount and long serving life;
4) Large flow of single filter element;
5) Facilitate quick replacement.

Heat exchanger

The heat exchangers are used for decreasing the temperature of outlet from cartridges. Because the operating temperature of resin can't too be high, two heat exchangers are, one in running operation, one on standby. The heat exchanger adopts plate heat exchanger, and the material of plate is SS304.The heat exchanger shall settled temperature automatic control system, and can keep the outlet temperature to be less than 40℃.

Mixed-ion exchanger section

After cooled down, the water will be stored in the 450 m3 intermediate water tank (TK 7201) and pumped to mixed-on exchanger (R 7201 A/B) by one operation intermediate water pump (P7201A/B). There are two mixed-ion exchangers (E 7201 A/B), with one in running and one on standby, capacity is100%. Residual cation and anion can almost be simultaneously exchanged to obtain qualified demined water. One flow gauge on mixed-ion exchanger inlet pipe, one pressure difference gauge at inlet and outlet pipe, SiO2 gauge at outlet pipe will be set. When the pressure difference between inlet and outlet increases to the set point or the conductivity reaches to the set point, the mixed-ion exchanger will starts the regeneration process. 1~3% H2SO4 solution and 4 % NaOH solution will be utilized as regeneration chemical regents.
The produced water from mixed-ion exchanger flows into the demined water tanks (TK 7001 1/2) for storage. The effective volume for each tank is 3500m3. There are two demineralized water pumps (P 7002A/B) with capacity of 265m3 and head of 85m. pH gauge, conductivity gauge, SiO2 gauge, flow gauge and pressure gauge will be set in the demineralized water pipe to monitor produced demineralized water quality.

Mix-ion exchanger

The ion-exchangers are used to remove salt ions in the water. Two mix-ion exchangers is one in operation and one on standby. According to the design and production of ion-exchanger is 250t/h, work for a period of about 15 days. Mix-ion exchangers are regenerated by H2SO4 and NaOH in the inner of mix-ion exchanger. The ion-exchangers have four independent internal distributor: Inlet distributor, alkali inlet distributor, middle drainage distributor and effluent distributor. Inlet distributor, alkali inlet distributor material is SS304. Middle drainage distributor adopt main and branch pipe and material are SS316L, and effluent distributor adopts a porous plate and water cap type and material requirements of porous plate is CS+Rubber and the material of water caps are ABS. The diameter of ion-exchangers is DN2500mm, operation velocity of mixed bed is 40~60m/h, the resin layer height 1.5m (Cation resin is 0.5m, and anion resin is 1.0m). The expansion height is 100% of the height of resin layer . The ion-exchanger should be equipped with anti-corrosion window, to monitor the working state of resin and anion resin layer.

Note

Mixed- ion exchange is that the anionic exchange resins and the cationic exchange resins are placed in the same exchanger, mixing them before running in the exchanger, formation of the anionic exchange resins and the cationic exchange resins staggered multistage compound- bed. The negative ion and positive ion contained in the water are exchanged by resin and obtained highly purified water. In the mixing bed, the anion exchange resins and the cation exchange resins

are mixed together, so negative ion and positive ion exchange reactions are almost simultaneous. In other words, cation exchange and anion exchange of water are staggered many times, hydrogen ion (H+) generated by the H exchange and hydroxide ion (OH -) generated by the OH exchange can't be accumulated, basically eliminate the influence of the counterion and exchange more thoroughly.

Resin trap

The Seller supply 2 sets of T type resin traps, which is made of SS304. The trap should be stainless steel filter element, filter element gap is less than or equal to 0.25mm, when the trap is completely blocked, it can withstand the pressure inside the pipeline without rupture. Resin catcher shall have manual backwash function, each resin catcher shall provide manual drain valve. Each resin trap shall be provided with differential pressure transmitter.

Acid and alkali regeneration section

The regeneration reagents adopt H2SO4 (wt 98%) and NaOH (wt 46%), which are carried by trucks to the polishing unit and unloaded to the acid metering tank V=25m3 (TK 7202) and alkali metering tank V=25m3 (TK 7204) by acid transfer pump (P 7202) and alkali transfer pump (P 7203). The liquid levels of metering tanks are interlocked with the transfer pumps. Dosing pumps (P7206 AB/P7207AB) and pipe mixers (X 7202/X7203) will be selected for diluting acid and alkali with demin water. The diluted acid and alkali will be pumped to mixed-ion exchanger for regeneration. Concentration meters are set on metering pump outlets to monitor the concentrations of regeneration solutions online.

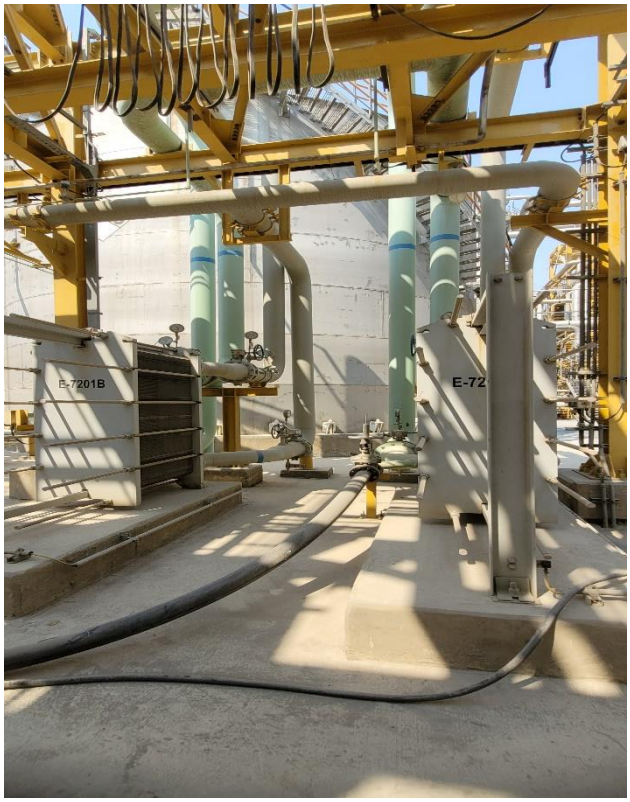
Wastewater collection section

The mixed-ion exchanger regeneration wastewater, acid and alkali dike drain, will be discharged into neutralization pit by trench. There are two neutralization water discharge pumps (P 7205 A/B), one operation one standby. The pump capacity is defined at Q=25m3/h, H=50m.
Backflow pipe at the outlet pipe of pump and compressed air feed from compressed air vessel (D 7205) to the pit will be set to fully mixed the wastewater when neutralize the pH value in the pit with dosing certain amount of acid and alkali. The neutralization system shall be controlled automatically by on-off valves and PH transmitter in PLC. The qualified waste water will be pumped outside.

Pictures

Filters

Heat Exchanger



Intermidiate Tank and its pump

Ion exchange reactor

Compressed air vessel

Pond

Acid and caustic tanks

Mixing point

Material Selection

Due to corrosiveness of DMW the general material used is SS. Now let’s move with the process!

1.All of the piping used shall have a material of SS, typically SS304.
2.DMW tank materials are generally CS but with internal painting resistant to DMW.
3.The material used for cartridge filters is SS, typically SS304
4.The material used for ion-exchange reactors is
5.The materials used for pumps casing and impeller are
6.The material used for caustic tank is
7.The material used for acid tank is

Cautions + Our mistakes