IER troubleshooting- Statuskontroll, felsökning, och rengöring av jonbytesmassa

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IEX Troubleshooting content

A. Statuskontroll

B. Felsökning

C. Rengöring

A. STATUSKONTROLL

1. RECORD KEEPING
2. MONITORING

Record Keeping

Changes in the following may affect running time or throughput :

- Feed water composition:
  - Minor salinity increase: proportional reduce running time
    - x% more salinity means x% shorter cycle
  - Radical water composition changes: Re-assess whole plant
- Feed water temperature:
  - Variations >10° C may affect resin operating capacity
    - (WAC & WBA particularly sensitive to low temperature)
  - High temperature decreases silica removal.
- Loss of capacity
  - After a long time in operation, gradual decrease of anion exchange resin capacity. May need to adjust running time or replace resin

Record Keeping

- Pressure drop

  Pressure drops >2.5 bar (35 psi) should be avoided due to possible equipment or resin damage.

  If the pressure drop in a vessel increases > 50 %, the resin should be backwashed to avoid channeling and resin damage.

- Loss of resin – replace immediately

- Rinse water consumption

  After regenerant injection, monitor the slow (displacement) rinse water volume required to reach 150 µS/cm.

  If the volume > 1.5 times the value for new resins, fouling or crosscontamination may have occurred and a cleaning should be made.

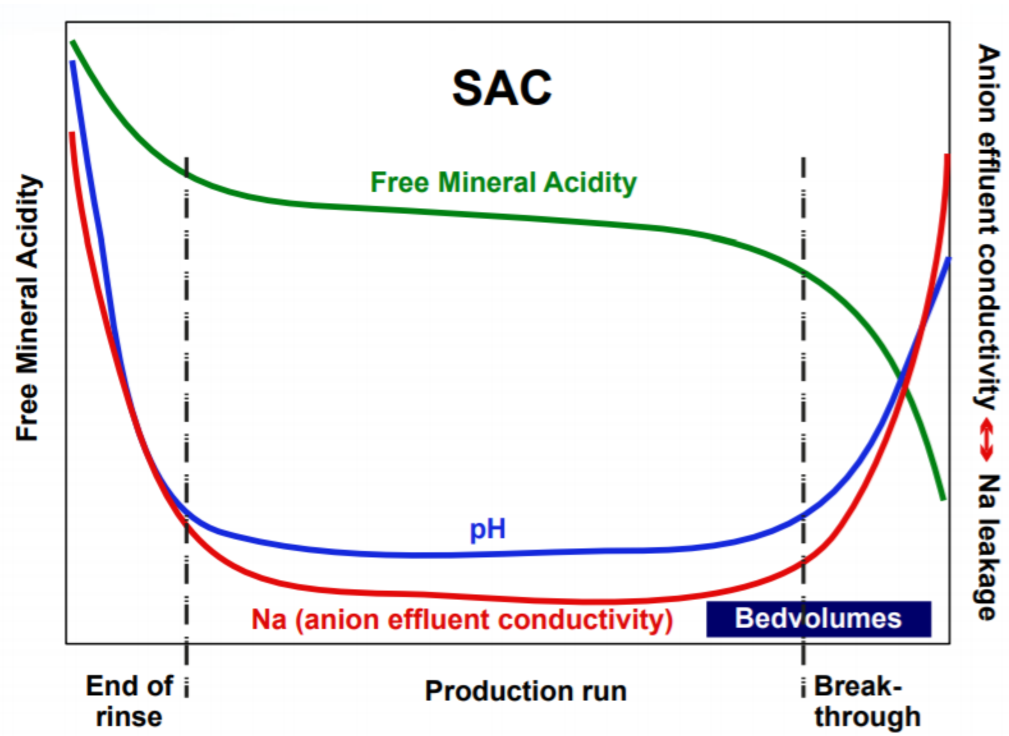
Monitoring Input

- Feed water analysis & Temperature
- Condition of the ion exchange resins
- Resin height
- Regenerant Conditions (level, concentrations, etc.)
- Pretreatment Operating Data (residual Cl2, level of suspended solids, dosing chemical consumption)
- Maintenance log
  - records routine maintenance, mechanical failures, equipment replacements, calibration of gauges and meters, all IX cleanings

Monitoring Output

- Conductivity
- pH
- Silica
- Throughput
- Flows
- Unusual incidents
- Check rinse water consumption ~ every 15 cycles (for resin fouling)

Monitoring output, example SAC



$2\,R'H + Ca^{++} \rightleftharpoons R_2Ca + 2\,H^+$

$R'H + Na^+ \rightleftharpoons R'Na + H^+$

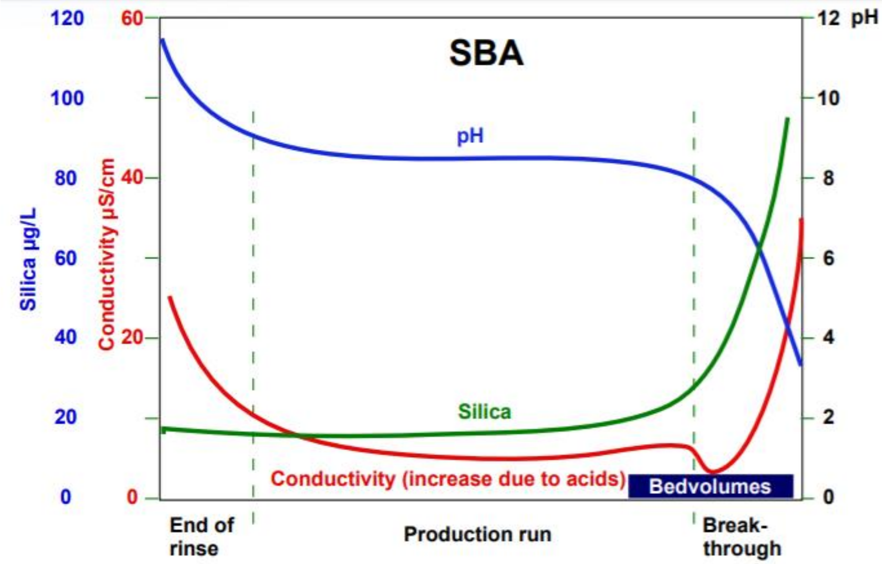
$2\,R'Na + Ca^{++} \rightleftharpoons R_2Ca + 2\,Na^+$

In effluent:

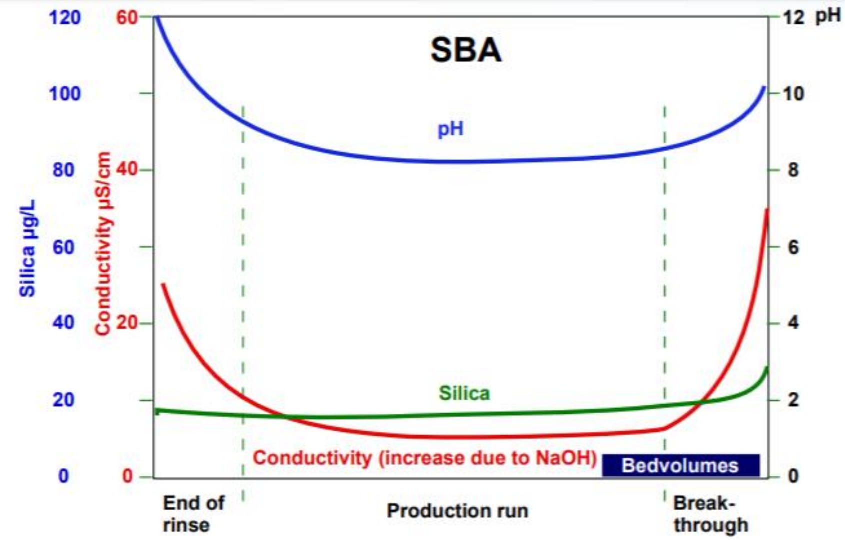
- H+ = key cation until exhaustion
- All anions still present

As exhaustion approaches, • [Na] increases. • Free Mineral Acidity (FMA) e.g. HCl, H2SO4 , HNO3 , respectively decreases, with [Na+] • pH at outlet of the SAC resin is low (2 to 4) until near exhaustion, then [H +] ↓ & pH ↑ • Conductivity at the outlet of the SBA resin downstream reflects Na+ leakage from the SAC resin: remains low until Na+ appear at the outlet of the cation column.

Monitoring output, example SBA



If SBA breaks first =>
H_2SiO_3 , etc. in effluent



If SAC breaks first =>
NaOH, $NaHSiO_3$ in effluent

$R''OH + Cl^- \rightleftharpoons R''Cl + OH^-$

$2\ R''OH + SO_4^{=} \rightleftharpoons R''_2SO_4 + 2\ OH^-$

$R''OH + HSiO_3^- \rightarrow R''SiHO_3$

$2R''SiHO_3 + SO_4^{=} \rightleftharpoons R''_2SO_4 + HSiO_3^-$

In effluent:

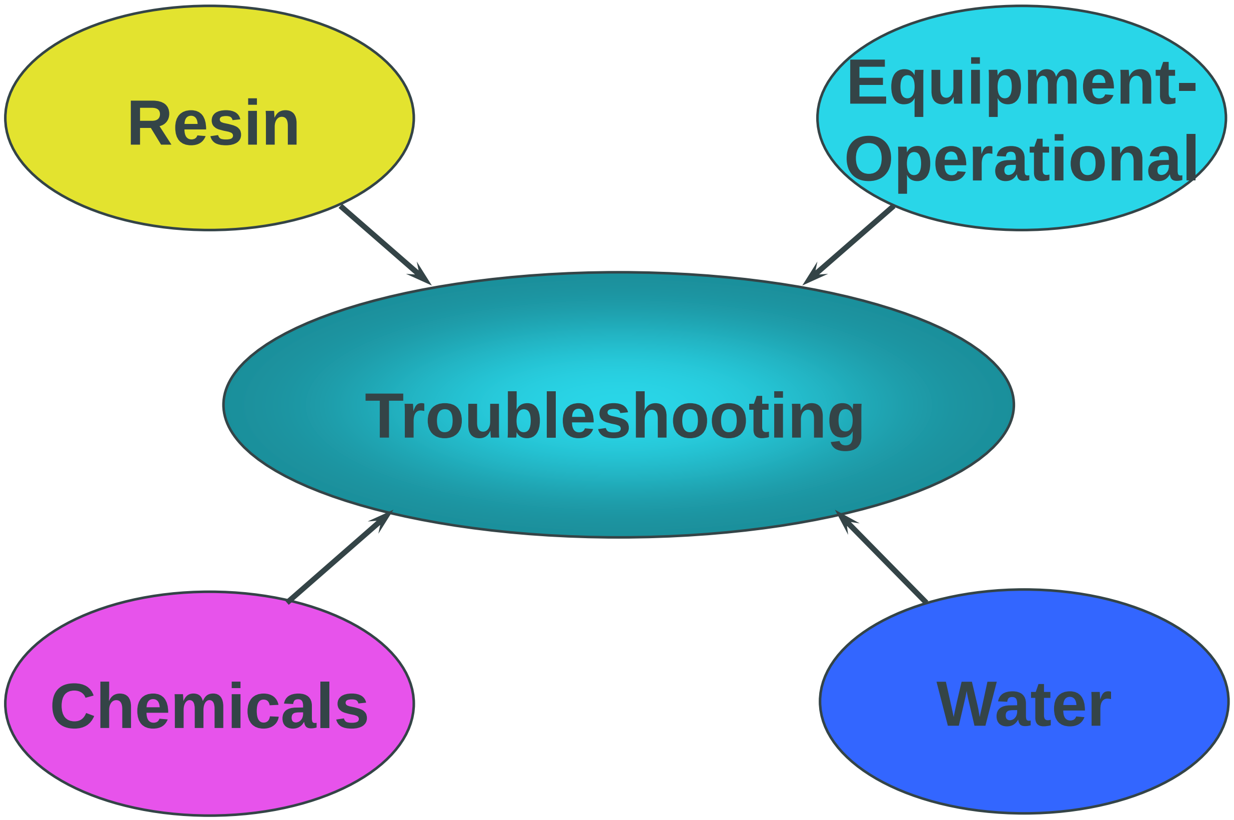
- H^+ = key cation unless SAC breaks first giving Na leakage
- Key anion = OH^- until exhaustion
- $H^+ + OH^- \rightarrow H_2O$
- 1st anion to break through = $HSiO_3^-$

Monitoring pH

pH out of each bed in a pretreatment system can give critical info especially when troubleshooting

- Weak Acid Cation Bed
  - Should be low <4 for 10-30% of the run (depends on FMA)
  - Will baseline at ~ 4.5
  - Change upward from 4.5 indicates breakthrough
- Cation Bed
  - Should be low <3 (depends on TDS) – understanding baseline is important
  - Change upward from typical baseline pH indicates increase in cation leakage, should correspond to higher conductivity and pH out of anion resin
- Weak Base Anion Bed
  - Should be between 4 and 7 depending on alkalinity
  - Drop in pH from baseline indicates exhaustion or channeling
- Strong Base Anion Bed
  - Should be between 7.5 and 9
  - Below 7 indicates exhaustion or channeling
  - Higher than 9 indicates chemical hideout, leaky NaOH valve, or problem with SAC resin

B. FELSÖKNING



OVERVIEW - Felsökning

MOST COMMON TROUBLES

MOST COMMON CAUSES

TROUBLESHOOTING PRINCIPLES

The most common troubles

1. Reduced throughput
2. Poor product water quality
3. Resin rinse issues
4. Increased pressure drop
5. *Resin damage*

OVERVIEW - Felsökning

MOST COMMON TROUBLES

MOST COMMON CAUSES

TROUBLESHOOTING PRINCIPLES

The most common causes

1. Impurities in the feedwater
2. Change of raw water composition
3. Incorrect process parameters
4. Equipment failure / issue
5. Poor resin performance

1. Impurities in the feed water

Suspended solids

Metal oxides/hydroxides

Oxidizing agents

Oil/grease

Algae/bacteria/molds

Polyelectrolites

Surfactants

Issues:

Pressure drop

Rinse water requirements

Change in capacity

Change in quality

Resin damage

2. Change of water composition

Total dissolved solids

Sodium

Alkalinity

Silica

Organics

Temperature

CO_2

Issues:

Change in capacity

Change in quality

Rinse requirements

Resin damage

3. Incorrect process parameters

Suspended solids accumulation

Organic matter

Silica loading

Regeneration conditions

Quality of regenerants

Establishing/Keeping polishing zone

Overrunning the endpoint

Issues:

Change in capacity

Change in quality

Pressure drop

Resin damage

4. Mechanical failure of equipment

Pumps

Valves

Distribution systems

Instruments

Piping / Construction

Issues:

Internal leakage

Rinse requirements

Change in capacity

Resin damage

Unexplainable issues....

5. Poor resin performance

Resins do age and will suffer chemical degradation in time.

Most common cause of resin failure is point 1 t/m 4:

1. Impurities in the feedwater
2. Change of raw water composition
3. Incorrect process parameters
4. Mechanical failure of the equipment
5. Poor resin performance

OVERVIEW - Felsökning

MOST COMMON TROUBLES

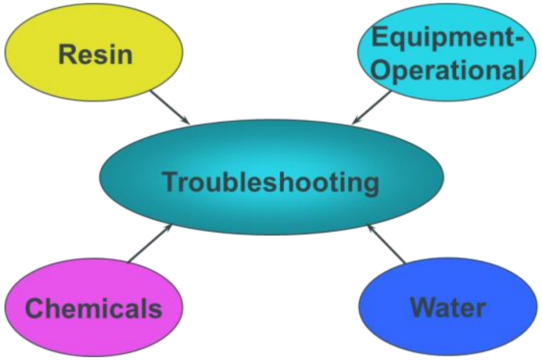
MOST COMMON CAUSES

TROUBLESHOOTING PRINCIPLES

Troubleshooting principles

1. Clearly understand the issue
2. Analyse and understand the symptom
3. Try to explain what could cause the symptom not what can solve it
4. Create a logic order if there are multiple possible causes
5. Try to find a way to exclude symtoms one by one if multiple
6. Once the symptom(s) is identified and cause is known, implement the solution.

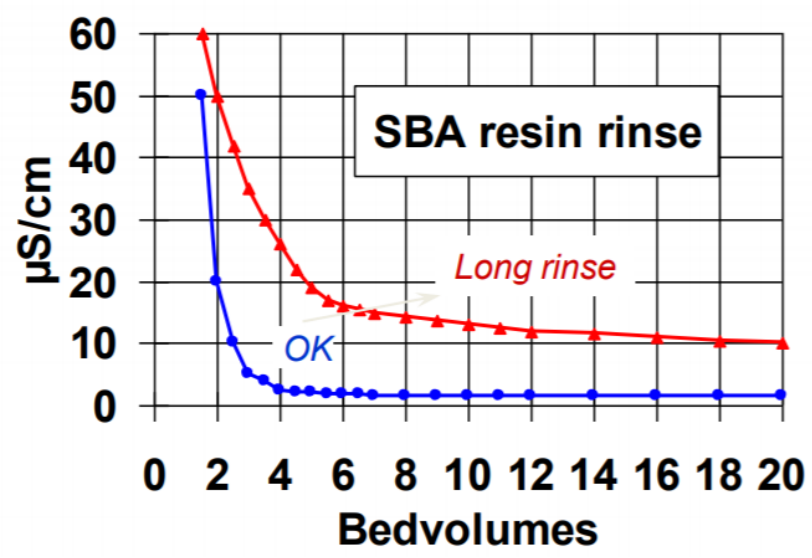
Follow logic



C. RENGÖRING – Example, Effects of organic fouling

Problems in plant operation

- During anion regeneration with NaOH
  - convert to -COONa
- Rinse is long
- Na leakage increases
- SiO2 leakage increases
- Capacity decreases
- Moisture content decreases



C. RENGÖRING

Recovering from fouling

- **Natural Organic, WBA, SBA resin**
  - 10% NaCl/2% NaOH soak for at least 8 hrs
  - Preferably at 45-50° C
  - Repeat soaks may be necessary
  - Use frequently and routinely for high organic waters
- **SiO2, WBA, SBA resin**
  - 8% NaOH soak for at least 8 hrs
  - preferably at 50° C
- **Iron or CaSO4, SBA resin**
  - 10% HCl soak for at least 4 hrs
  - Repeat soaks may be necessary
  - Materials of construction must be compatible

Rengöring / Appendix, Cleaning Procedures

1. Alkaline brine cleaning for anion resin – Alkalist salt tvätt för anjonbytare
2. Cleaning anion resins contaminated with calcium – Ca fouling på anjonmassa
3. Cleaning calcium-fouled cation resins with sodium citrate – Ca fouling på katjonmassa
4. Cleaning cation resin beds contaminated with polyelectrolytes – Polyelektrolyt fouling på katjonmassa
5. Cleaning resins fouled with iron – Järn fouling på katjon/anjonmassa
6. Hydrochloric acid cleaning of mixed bed resins – Saltsyra tvätt för blandbädd filter
7. Cleaning anion exchange resins fouled with silica, Hot caustic soda method – Silika fouling på anjonmassa
8. Preventing Bacteriological Growth on Ion Exchange Resins

DOW

General recommendations, Take home message

Good pre-treatment is essential

- Flocculation, Filtration

Keep good record of operation

- Water analysis & temperature
  - Ionic and organic load, suspended solids
- Regenerant quantities

Don’t overrun resins

- If feed water quality changes, recalculate run length
- Watch pressure drop

Backwash when necessary

- i.e. when Δp increases

Old resins may be expensive

- Capacity loss = regenerant cost

TACK

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