Sustainability in commercial laundering processes

Module 1
Usage of water

Chapter 3b

Water softening

Content

- Water hardness (repetition)
- Water softening
- Ion exchangers

Learning targets

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After finishing this chapter, you will

- Be able to explain the item of water hardness
- Be able to exemplify the impact of water hardness on laundries
- know the principle of water softening
- Be able to explain the principle of ion exchanger

Water ingredients (repetition)

Not all water resources provide the good-quality water for washing

- For instance, water close to peat contains humic substances
  - cause yellow even brownish-yellow color of the washed textiles
- Ground/well water of laundries
  - higher content of Fe or Mn
- trapped rain water
  - contains dissolved acid gases (NOx, CO2)
  - can shift the pH value up to 3,5
- Central issue: dissolved mineral salts

- High contents of dissolved mineral salts can make washing impossible at all

Water ingredients (repetition)

- Water from supply network is mostly treated
  - hardness of this water is between 0,7 – 1,3 mmol/l

  ⇨ soft water

- Partly usage of well water causes growing up of water hardness
  - to 1,3 – 3,75 mmol/l

  ⇨ hard water

- Many wells provide water with hardness above 3,75 mmol/l

  ⇨ very hard water

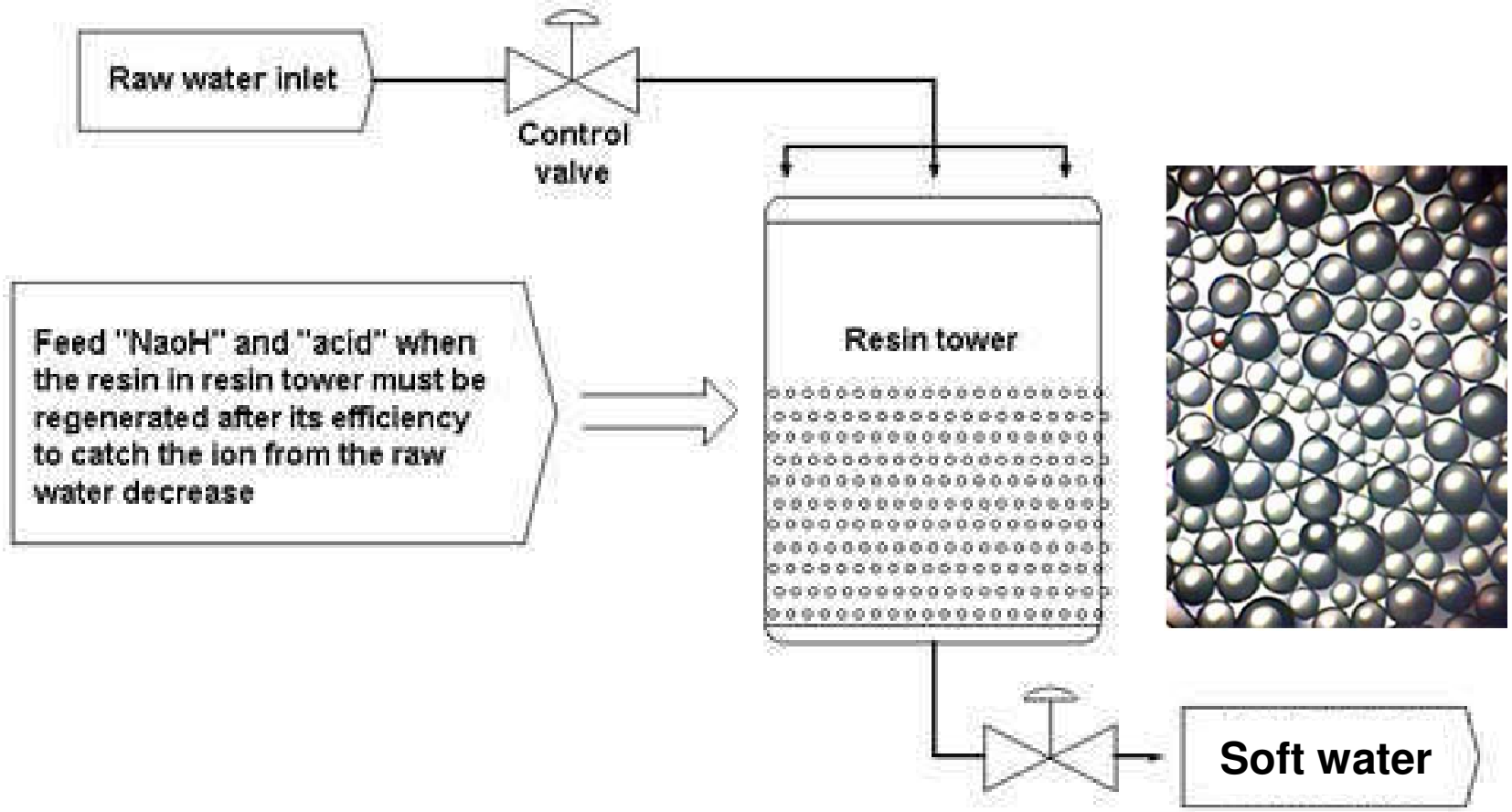
The ion exchange technology is mostly applied for removal of water hardness causing ions

- This procedure is
  - reliable,
  - technically sophisticated
  - economically acceptable

Principal of ion exchange technology

- The water is purified by filtering it through a tank containing small beads of synthetic resin
- The beads are chemically treated to adsorb either positively charged cations (catex) or negatively charged anions (annex)
- Ions Ca and Mg are replaced by cation Na during water treatment

Process diagram of water demineralization



Process diagram of water Demineralized

Examples of automatic catex units usually used in industrial laundries

Resin tower

Ion exchange capacity

- Ion exchange capacity is a very important factor
  - defined as amount of ions exchanged in 1 liter of exchanger
  - expressed in mol or gram CaO per 1 liter

- Proposed volume of the ion exchanger is according to the capacity required
  - example: Purolite C-100 – capacity is

2 mol/liter of catex

Regeneration of cation exchanger

- When the resin is exhausted, regeneration must be carried out
  - application of sodium chloride solution
- Na+ has higher affinity to catex function groups than Ca and Mg
  - Na-ions displace Ca and Mg ions from the ionex grid and settle their places
- Theoretical consumption of regenerating agent corresponds with ion exchange capacity
  - practical is higher
- Number of regenerating cycles is from the theoretical point of view unlimited
  - life-time of catex exchanger is dependent on mechanical ruggedness of its grid

Practical aspects of regeneration

- for regeneration 15 – 20 % solution of NaCl is applied, prepared in brine tank
  - salt is used mostly as tablet or cushion
- consumption of NaCl is usually expressed per 1 liter of catex
- theoretical consumption: hardness 1 °d and 1 m3 water = 20,7 g NaCl
- practical consumption: 35 – 50 g NaCl
- 100 – 200 g in case of smaller and old type devices

Ion exchange filters

- Old types of exchange filters are steel or steel cast protected by brine resist coating
  - require manual operation
  - filter operator monitors amount of treated water and its hardness
  - operator carries out a regeneration and fulfills maintenance report

- Common combination are two filters and one brine tank
  - The filters are working in turn

Demineralisation

- Repetition
  - Water softening means removal of Ca^{2+} an $Mg^{2}+$ Ions
- Demineralisation
  - Removal of all salts and ions which may occur in tap- or well water
  - Demineralisation is achieved by ion exchange on the basis of tap water
  - Other method: reverse osmosis

Demineralisation

reverse osmosis

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- Water is pressed through membranes by application of higher pressures
- The osmotic pressure of drinking water is usually less than 2 bar
- Size of filtered particles depends on permeability of the membrane
- Depending on the plant, applied pressure is about 4 – 30 bar
- Detailed description of reverse osmosis in chapter 1 – 5 (Filtration technology)

Water quality

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- Water softening causes danger of fixing germs in filters and beads of resins
- Water softening device can become a source of contamination

- Constantly maintaining and/or disinfection of softened water is therefore necessary
- Also see chapter 1-3 fresh water disinfection