Preview Assessment: Softening

Name	Softening
Instructions	Answer the questions in small groups (2 persons). Think well and you are allowed to consult your lecture notes or other sources.
Multiple Attempts	Not allowed. This Test can only be taken once.
Force Completion	This Test can be saved and resumed later.

Question Completion Status:

Question 1 **10 points** Save

Softening is amongst others applied to decrease the release of heavy metals from the distribution network and to reduce scaling of household equipment.

- True
- False

Question 2 **10 points** Save

A water hardness of 6 oD (German Degrees) is equivalent to ..

- 6 mmol/l
- 1.6 mmol/l
- 1 mmol/l
- 0.6 mmol/l

Question 3 **10 points** Save

Which of the following chemicals can be used for softening of drinking water

- Caustic soda (NaOH)
- Iron chloride (FeCl3)
- Aluminium sulphate (Al2(SO4)3)
- Sodium carbonate (Na2CO3)
- Lime water (Ca(OH)2)
- Gipsum (CaSO4)

Question 4 **10 points** Save

One of the disadvantages of softening in the storage lakes compared to softening in pellet softeners are the high investment costs.

- True
- False

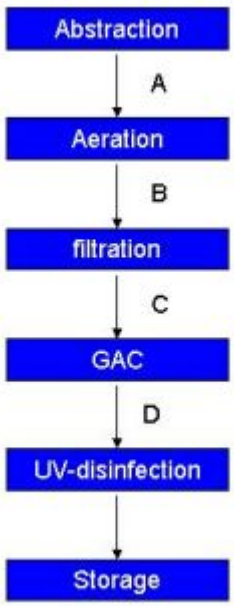
Question 5 **10 points** Save

Water with a concentration Na of 63 mg/l, K of 5 mg/l, Ca of 45 mg/l, Mg of 9 mg/l and Fe of 4 mg/l has a hardness of 1.5 mmol/l.

- True
- False

Question 6 **10 points** Save

Indicate possible locations for softening in the following ground water treatment train



- A
- B
- C
- D

Question 7 **10 points** Save

The disadvantage of softening aerated groundwater is that is has a high carbondioxide concentration.

- True
- False

Question 8 **10 points** Save

Assume a water with the following characteristics: ca2+ = 3 mmol/l; Mg2+ = 0.5 mmol/l; HCO3- = 6 mmol/l; CO2 = 2 mmol/l.

Determine the lime dosing and the effluent HCO3- at an effluent total hardness of 1.5 mmol/l

- Ca(OH)2 = 4 mmol/l; HCO3- = 2 mmol/l.
- Ca(OH)2 = 2 mmol/l; HCO3- = 2 mmol/l.

- Ca(OH)2 = 4 mmol/l; HCO3- = 4 mmol/l.
- Ca(OH)2 = 2 mmol/l; HCO3- = 4 mmol/l.

Question 9 **10 points** Save

The softening of water for the ¿Berenplaat¿ is performed by dosing $Ca(OH)_2$ to the storage pond of the ¿Brabantse Biesbosch¿. The water quality of the river Meuse is (the river Meuse is the feed of the storage lakes): Ca^{2+} = 53 mg/l; Mg^{2+} = 17,5 mg/l; Na^{+} = 37 mg/l; HCO_3^{-} = 154 mg/l;
PH = 7,9; Temperature = 10°C.
What is the hardness of the raw water in mmol/l and the amount of $Ca(OH)_2$ needed to lower the hardness to the regulated value of 1.5 mmol/l

- Hardness is 1.33 mmol/l

  Dosing of Ca(OH)2 is 0.6 mmol/l
- Hardness is 2.04 mmol/l

  Dosing of Ca(OH)2 is 0.6 mmol/l
- Hardness is 1.33 mmol/l

  Dosing of Ca(OH)2 is 0.65 mmol/l
- Hardness is 2.04 mmol/l

  Dosing of Ca(OH)2 is 0.65 mmol/l

Question 10 **10 points** Save

One of the advantages of using $Ca(OH)_2$ for softening is that no Na^{+}-increase takes place. One of the disadvantages of using $Ca(OH)_2$ is that the buffering capacity of the water decreases more than by using NaOH

- True
- False

Question 11 **10 points** Save

Of a water type the water composition is known: Ca^{2+} = 100 mg/l; Mg^{2+} = 6.1 mg/l; HCO_3^{-} = 347.7 mg/l; CO_2 = 11.44 mg/l; Na^{+} = 10.8 mg/l;
The legislation for the water composition is: total hardness = 1.5 mmol/l; concentration HCO_3^{-} > 2 mmol/l; concentration Na^{+} < 5.2 mmol/l

NaOH is the chemical for softening that is most suited for this water.

- True
- False

Question 12 **10 points** Save

The most important reason that split treatment during softening is not applied, is:

- Supersaturation of calcium carbonate in the mixed effluent.
- Low temperatures during winter and thus slow crystallisation.

- Costs of construction of the softening reactors.
- High magnesium concentrations in the raw water.

Question 13 **10 points** Save

The most important reason(s) why split treatment is applied, is/are:

(more answers can be right)

- [ ] Supersaturation of calcium carbonate in the mixed effluent.
- [ ] Low temperatures during winter, thus kinetics of crystallisation are slow.
- [ ] Construction costs of the pellet reactors.
- [ ] High magnesium concentrations in the raw water.

Question 14 **10 points** Save

Of a water type the water composition is known: Ca^{2+} = 100 mg/l; Mg^{2+} = 6.1 mg/l; HCO_3^- = 347.7 mg/l; CO_2 = 11.44 mg/l; Na^+ = 10.8 mg/l;
The legislation for the water composition is: total hardness = 1.5 mmol/l; concentration HCO_3^- > 2 mmol/l; concentration Na^+ < 5.2 mmol/l

There is a possibility to soften in a split stream. How large should the split stream be if this spilt stream can be softened to 0.7 mmol/l?

- 0.61 times total flow
- 0.39 times total flow
- 0.77 times total flow
- 0.23 times total flow

Question 15 **10 points** Save

The kinetics of crystallisation of calcium carbonate on the pellets, depends amongst others on temperature, grain size and flow velocity

- True
- False

Question 16 **10 points** Save

With an increase of temperature the specific surface area in a fluidised bed increases, because of a decrease in porosity

- True
- False

Question 17 **10 points** Save

The head loss in a fluidised bed is amongst others dependent on the filterbed height, the density of the pellets and the flow velocity.

- True

- False

Question 18 **10 points** Save

What is the head loss in a fluidised bed, assuming the following data:

Fixed bed height = 2 m; maximum pellet grain size 1 mm; fixed bed porosity = 0.4; minimum fluidised bed porosity = 0.5; density pellets = 2700 kg/m3; flow velocity = 80 m/h; temperature = 10 oC.

- 2 m
- 2.04 m
- 1 m
- 1.02

Question 19 **10 points** Save

What is the bed height of a fluidised bed, assuming the following data:

Fixed bed height = 2 m; pellet grain size 1 mm; fixed bed porosity = 0.4; density pellets = 2700 kg/m3; flow velocity = 80 m/h; temperature = 10 oC.

- 2.68 m
- 3.27 m
- 4.13 m
- 5.39 m

Question 20 **10 points** Save

Normally, several softening reactors are placed in parallel. What is the main reason for that?

- The limited size of the steel reactors.
- Flexibility in operation.
- Equal distribution of chemicals over the bottom.
- Construction costs of softening reactors

Question 21 **10 points** Save

What type of reactor you see on the photograph

- Spiractor
- Blackpool reactor
- Amsterdam reactor
- Woerden reactor

Save Submit