CMR Institute of Technology, Bangalore
DEPARTMENT OF CIVIL ENGINEERING
III - INTERNAL ASSESSMENT

Semester: 4-CBCS 2018
Subject: WATER SUPPLY AND TREATMENT ENGINEERING (18CV46)
Faculty: Prof Usha A

Date: 29 Jul 2021
Time: 01:00 PM - 03:40 PM
Max Marks: 50

Instructions to Students :

Assume any missing data data required.

Answer All Questions

Q.No		Marks	CO	PO	BT/CL
1	Explain the theory of chlorination of water with chemical equations.	10	CO3	PO1,PO7	L2
2	Explain the De-fluoridation and fluoridation in detail	10	CO3	PO1,PO2	L2
3	A sample of raw water contained 200 mg/l alkalinity, 50 mg/l hardness as CaCl2 and 75 mg/ l of hardness as MgSO4. Compute the quantities of lime and soda required to treat 1 million liters of water. If slaked lime 85 % purity is available in place of pure lime. What will be the required quantity of slaked lime?	10	CO3	PO2,PO3	L4
4	It is required to supply water to the population of 20000 at per capita demand of 150 liters per day. The disinfectant used for chlorination is bleaching powder which contains 30% of available chlorine. Determine how much of bleaching powder is required annually at the waterworks. If 0.3 ppm of chlorine dose is required for disinfection.	10	CO3	PO2,PO3	L3
5	Explain any 5 different types of pipe materials used in water supply system with their advantages and disadvantages.	10	CO4	PO1,PO2	L2

Solution

1) Chlorination

Chlorination is the addition of chlorine to kill the bacteria chlorination of very widely adopted in all developing countries for treatment of water for public supply.

Chlorine is available in gas, liquid or solid form.

* Advantages of chlorine

* Chlorine is manufactured easily by electrolysis of common salts (NaCl)

* Dosage can be controlled precisely

* can be easily detected by simple orthotidine test

* traces required residues in water to neutralise recontamination later.

Precautions is using chlorine

1. chlorine gas & liquid is highly corrosive and lethal to Inhale. Hence it is to be stored carefully in sealed container at a distance
2. If the water contains phenolic compounds, then is a reaction with chlorine can result in cancer causing substances.

Behaviour of chloride in water:

When chlorine is dissolved in water forms hypo chlorous acid and hydro chloric acid

$$Cl_2 + H_2O \longrightarrow HOCl + HCl \quad ----> (1)$$

After some time hydrochlorous acid further Ionizes as follows

$$HOCL \longleftrightarrow H^+ + OCL^- ----> (2)$$

The two prevailing species (HOCl) and (OCL-) are called free available chlorine are responsible for the disinfection of water chlorine reacts with ammonia in water to form Monochloramine, (NH_2Cl), dichloramine ($NHCl_2$) and trichloramine, (NCl_3) released and their distribution depends on the pH - value of water.

2) Fluoridation

When fluoride concentration in water supply is than an optimum value of about 1mg/l the water proves harmful, as it may result in dental caries of children. It has been believed that during the formation of permanent teeth in children, scarcity of fluoride in consumed water, may lead to formation of weaker tooth enamel leading to easy tooth decay. It had also been widely suggested that fluoride also proves benefial to older people in reducing hardening of the arteries and as fluoride stimulates bone formation. It is helpful in the treatment of osteoporosis. Due to such age old beliefs about the advantages of fluorides.

Defluoridation

Fluoride mainly enters the human body through drinking water 96-99% of it combines with bones, since fluoride has affinity for Calcium phosphate in the bones. Excess intake of fluride can lead to dental fluorosis, skeletal fluorosis & non-skeletal fluorosis. Dental fluorosis is characterised by discoloured, blotched chalky teeth white teeth. Skeletal fluorosis leads to severe and permanent bone and joint deformation. Non-skeletal fluorosis lead to gastro-intestinal problems and neurological disorders. Fluoride can damage a foetus, and adversely affect IQ of children. Inspite of all the symptoms, fluorosis commonly remains undiagnosed for a long time.

3>

⇒ i> Lime required for alkality ($CaCO_3$)

Molecule weight of $CaO = 40+16 = 56$

Molecule weight of $CaCO_3 = 40+12+3\times16 = 100$

∴ CaO required for 200 mg/l alkality

$= 200 \times \frac{56}{100} = 112$ mg/l $= 112$ kg/ml

ii) Lime required for $MgSO_4$

Molecule weight of $MgSO_4 = 24+32+4\times16 = 120$

∴ CaO required for 75 mg/l of $MgSO_4$

$= 75 \times \frac{56}{120} = 35$ mg/l $= 35$ kg/ml

∴ Total lime required $= 112+35 = 147$ kg/ml

iii) Soda required for $MgSO_4$

Molecule weight of Soda $= 2\times23+12+3\times16 = 106$

Molecule weight of $MgSO_4 = 24+32+4\times16 = 120$

∴ Soda required for 75 mg/l of $MgSO_4$

$= \frac{106}{120} \times 75 = 66.25$ mg/l $= 66.25$ kg/ml

∴ Total soda required $= 47.75+66.25 = 114$ mg/ml

Amount of slaked lime required

Molecule weight of slaked lime $Ca(OH)_2$

$= 40+2\times16+2\times1 = 74$

Molecule weight of pure lime (CaO) $= 40+16 = 56$

∴ Quantity of slaked lime required $= \frac{74}{56} \times 147 = 194.35$ kg/ml

But the available slaked lime has purity of 85%. only

∴ Actual quantity of market available slaked lime

$= \frac{194.25}{0.85} = 228.5$ kg/ml

4)

⇒ Average daily water demand

= Population × per capita demand

= 20,000 × 150 l

= 30,00,000 l = 3×10^6 l

∴ amount of chlorine required daily

$= 0.3 \times \frac{mg}{l} \times 3 \times 10^6 l$

$= 0.9 \times 10^6$ mg

= 0.9 kg

Since the chlorine content in bleaching powder is 30%.

(meaning 30 kg of chlorine is contained in 100 kg of bleaching powder)

∴ Amount of bleaching powder required daily

$= \frac{0.9 \times 100}{30} = 3$ kg

∴ Annual consumption of bleaching powder

= 3 × 365

= 1095 kg = 1.095 tonnes.

5) Different pipes materials used in water supply

1) Steel pipes

Advantage :- No of joining are less because there are available in long length.

* The pipe are cheap in first cost.

disadvantages

* Maintenance cost is high

* The pipes are likely to rusted by acidic or alkaline water.

2) A.C pipes

Advantages

* The inside surface of pipes are very smooth.

* The joining of pipes is very good and flexible

* The pipes are anticorrosive and cheap in cost

disdvantages

* The pipes are brittle and therefore handling is different.

* The pipes are not durable.

* The pipe cannot laid in exposed places.

3) R.C.C. pipes

Advantages

* These are pipes most durable with usual life of about 75 years
* Maintenance cost is less.
* Inside surface of pipes can made smooth.

disadvantage

* Transportation is difficult repair work is difficult.
* Initial cost is high.
* These pipes are effected by acids, alkalies and salty water.

4) prestressed concrete pipes

Advantages

* The inside surface of pipes can be made smooth.
* Maintance cost is less.
* The pipes are durable with life period 75 years.
* No danger is rusting.

Disadvantages

* The pipes are heavy and difficult to transport.
* Repairs of these pipes are difficult
* The pipes are likely to crack during transport and handling operations.

5) Galvanished Iron pipes

Advantages

* The pipes are cheap
* Light in weight and easy to handle
* The pipes are easy to join.

Disadvantages

* The pipes are affected by acidic and alkaline waters.
* The useful life of pipes is short about 7 to 10 years.