

**Water and Waste
water treatment**

CT 274

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Water Disinfection

- **Purpose:**
 1. kill harmful bacteria
 2. prevent future pollution in water network
- **Types of disinfectants:**
 1. Chlorine(Cl_2)
 2. Chloramine(ammonia + Cl_2)
 3. Ozone
 4. ultra-violet rays

Method	Chlorination	Chloramination	ozone	Ultra violet
dose	(0.5-1.5) mg/l <u>demand</u> (0.3-0.5) <u>Residual</u> (0.1-0.3)	Cl_2 (0.1-0.3) <u>Ammonia</u> (0.2-0.8)	1.5 mg/l	
Contact time	10-60 min	45-75 min	10-20 min	1-2 sec
Advantages & disadvantages	<ul style="list-style-type: none"> • the cost is cheap • give residual • available • easy to store • simple equipment • corrosive to iron pipes 	<ul style="list-style-type: none"> • decrease Cl_2 • no taste or odor • has no effect on pipes • cost is cheaper 	<ul style="list-style-type: none"> • no residual (chemical) • has no effect on pipes • no taste or odor • expensive • complex equipment • no safety in network 	<ul style="list-style-type: none"> • very effective and clean method • very expensive • no residual

Chlorination:

- **Purposes of water chlorination:**
 1. Kill bacteria that rested after filtration
 2. Give safety to pipe network against any pollution

- **Theory of bacterial destruction by chlorine :**

1. الكلور يعتبر مادة سامة للبكتيريا
2. الكلور يتحد مع جدار خلية البكتيريا فتتموت في المياه
3. الكلور يتحد مع النواة ويشكل جدار حولها ويفصلها عن جسم الخلية
4. الكلور يتفاعل مع الماء مكونا حمض الهيدروكلوريك ويتفاعل مع البكتيريا فيدمرها

- **Factors affect chlorination:**

1. pH value
2. temperature
3. chlorine dose
4. bacterial load
5. contact time

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- advantages of chlorination :

1. kill bacteria
2. give safety to network
3. rapid action
4. low cost

- disadvantages of chlorination :

1. may act with iron pipes making corrosion
2. may act with organics causing carcinogenic compounds

- Types of chlorination(different application points)

	Type	Position	Dose	Purpose
1	Simple chlorination	After filtration	0.5-1.5 mg/l	- killing bacteria - give safety factor for the network
2	Prechlorination	Before coagulation after LLP	5 – 10 mg/l	- decrease bacterial load on filter - prevent algae growth in sedimentation tank
3	super chlorination	After filtration	2 – 3 ppm	- Providing safety for network
4	double chlorination	(1)+(2)	(1)+(2)	(1)+(2)
5	Break point chlorination	From curve	From curve	- to insure that residual chlorine is free chlorine

Ozonization

- **Advantages**

1. Kill bacteria
2. Clean action
3. No action with pipes
4. Rapid effect

- **Disadvantages**

1. No safety for network
2. High cost
3. High doses

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Design criteria:

- Chlorine dose
- Residual chlorination = 0.1-0.3 ppm

Example

a WTP of daily output 40000 m³ and works 20 hr/d, calculate the amount of chlorine.

Given

Q_{mm} = 40000 m³/d

W_p = 20 hr

Required

- Amount of chlorine per day

Solution

Assume chlorine dose = 1 ppm

Amount of chlorine/d = 40 000 m³/d x 1 gm/m³ = 40 000 gm/d
= 40000/10⁶ = 0.04 ton/d

Example

Given

Q_{mm} = 2000 m³/hr

W_p = 18 hr

Amount of chlorine = 36 kg/d

Residual = 0.2 mg/l

Required

- Total dose of chlorine
- Chlorine demand

Solution

Amount of chlorine/d = Q_d m³/d x tot dose gm/m³

36 kg/d = 2000 x 18 x tot dose / 10³

tot dose = 1 gm/m³ = 1 mg/l
= demand + residual

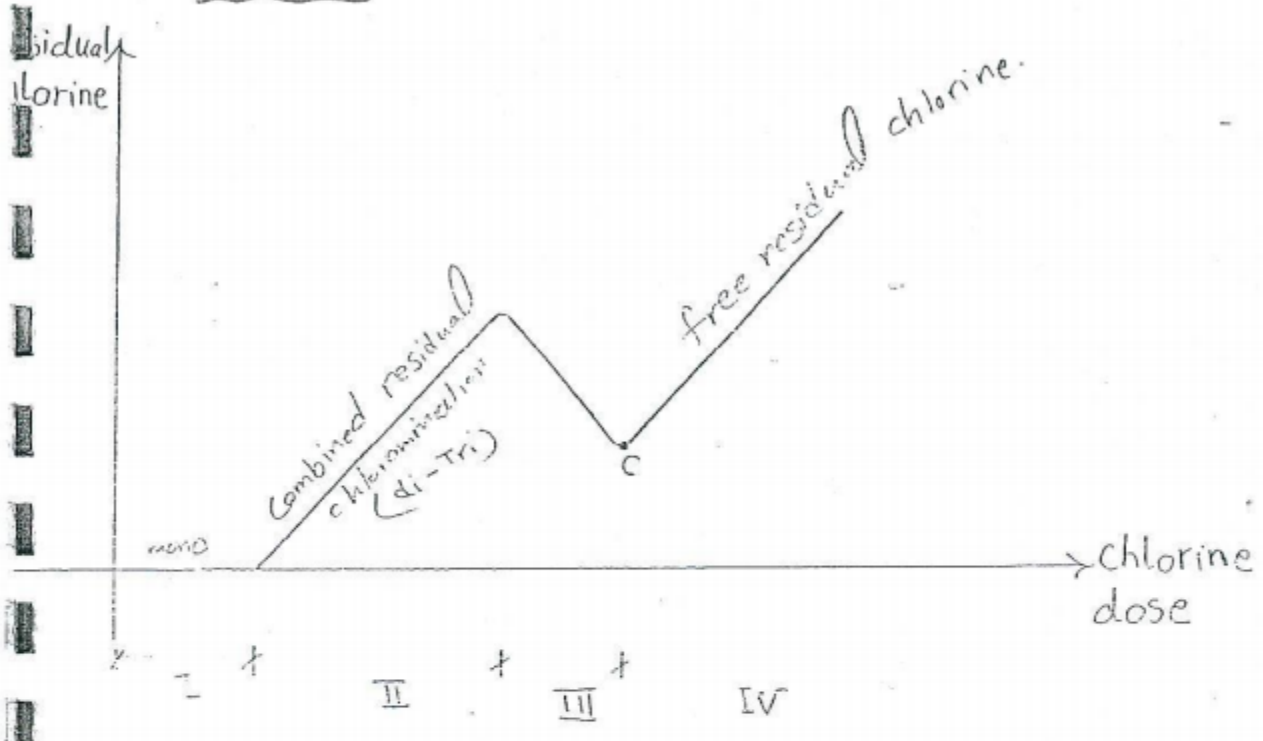
demand = 1 - 0.2 = 0.8 mg/l

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Break point chlorination

Break point curves (c)

هذه أدلة جزيئية على تفاعل الكلور مع الأمونيا في صورة
 حيث يتكون الكلورامينات في صورة



(mono) أحادي

I - الكلور يستهلك في إطفاء على الكلور

II - الكلور يتكون الكلورامينات ammonia كوني

chloramine ثنائي و ثلاثي (di-Tri)

III - تكون الكلورامينات chloramine أي باع كلوريد أمونيا ليس له تأثير فعال من عليه
 (ammonium chloride)

IV - يكون كلور متبقى في صورة حرة

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