SECTION 'A': WATER SUPPLY

Chapter 1 : Introduction to water supply, quantity and quality of water

1.1 Necessity of treated water supply
1.2 Per capita demand, variation in demand and factors affecting demand
1.3 Methods of forecasting population, Numerical problem using diff. mtds.
1.4 Impurities in water - organic and inorganic, harmful effects of impurities
1.5 Analysis of water - physical, chemical, and bacteriological
1.6 Water quality standard for different uses.

1.1 necessity of treated water supply:

- No life can exist without water, as it is essential for life as air is.
- It is necessary that water required must be good enough and it should satisfy all the physical, chemical and biological parameters/stds.
- treated water means free from unwanted impurities, or harmful chemical compounds or bacteria in it.
- Besides promoting overall hygiene and public health, it should ensure safety against fire, and should also satisfy the industrial needs.
- a perfect water supply means it should ensure that clean water remains clean up until it reaches the customer/taps.
- Treated water is the 'best' way to prevent spread of many diseases that can cause havoc to the humanity or to a city.

1.2 Per capita demand of water (q):-

- It is the annual average amount of daily water required by one person and includes the domestic use, industrial use, commercial use, public use, wastes, thefts etc.

- Per capita demand represented in lpcd or gpcd.

  lpcd – litres per capita per day.

  (Per capita - Per Person)

  gpcd – gallons per capita per day

- Simply lpcd means – requirement of water per person per day.

- Total water demand to a city = lpcd x population of city

- $\text{Lpcd of a city} = \dfrac{\text{total yearly water req. of the city in litres}}{365 \times \text{design population}}$

- For an average indian city, as per I.S code, the per capita demand may be taken as

use	demand (lpcd)
(i) domestic use (residential)	200
(ii) Industrial use	50
(iii) commercial use (hotels, malls, offices)	20
(iv) public use	10
(v) wastes, thefts etc	55
total	335

= per capita demand.

Variation in demands :-

(i) Seasonal variations – summer – higher
  winter lesser
  rainy – much lesser

(ii) daily variations – sundays/holidays/festivals – higher demand
  weekdays – lesser

(III) hourly variations - morning ↑
afternoon lesser
evening - higher demand
night - lesser

assessment of normal variations -

(1) maximum daily demand = 1.8 × avg daily demand (q)

(2) maximum hourly demand = 1.5 × avg hourly demand of max^m day

$$= 1.5 \times \frac{\text{maximum daily demand}}{24}$$

$$= 1.5 \times \frac{(1.8 \times \text{avg daily demand})}{24}$$

$$= 2.7 \times (q/24) \quad \text{or}$$

$$= 2.7 \times \text{annual avg hourly demand}$$

also by Goodrich formula :

(1) daily variation ; $\frac{\text{maximum daily}}{\text{avg daily}} = 180\%$

(2) weekly variation ; $\frac{\text{maximum weekly}}{\text{avg weekly}} = 148\%$

(3) monthly variation : $\frac{\text{max}^m \text{ monthly}}{\text{avg monthly}} = 128\%$

- Sources of supply - max^m daily
- Pipe main - max^m daily
- distribution pipe - max^m hourly

Factors affecting demand

1. Size of city (big cities, population)
2. Climatic conditions (hotter/dry, colder)
3. Type of gentry and habits of people. (rich, middle class)
4. Industrial and commercial activities

(5) quality of water supply

(6) pressure in distribution system

(7) development of sewerage facilities

(8) System of supply (either continuous supply / only for peak period)

(9) cost of water

(10) Policy of metering or method of charging.

1.3 Methods of forecasting the population :-

as we know,

total water demand to a city = lpcd × population of city

so population of the city to be calculated/estimated.

Factors affecting

(1) Birth rate ↑

(2) Death rate ↓

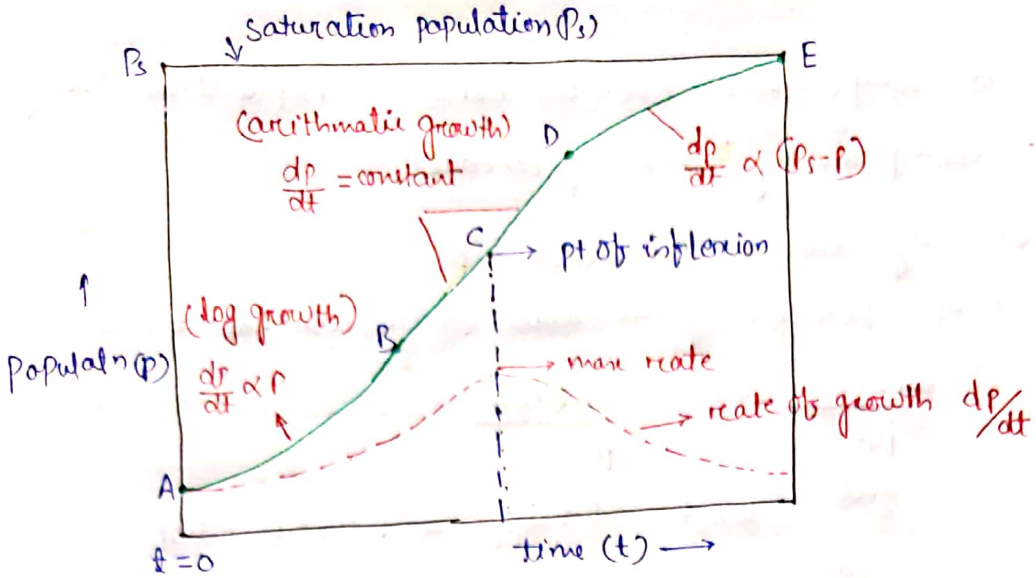
(3) migration ↑ or ↓

industrialization → migration ↑

immigration restriction → migration ↓

Note population follows the logistic - curve for growth.

The curve is S - shaped.



Logistic curve for population growth

AB - new city population increasing (log growth)

BD - straight line (linear growth) → arithmatic growth

DE - growth rate starts decreasing

methods

① Arithmetic increase method :-

- assumption: that population increases at a constant rate.

i.e dp/dt = constant

- city which are large and old. dev has taken place

$$P_n = P_0 + \bar{x} n$$

where, P_n = Forecasted population after 'n' decades from present

P_0 = Population at present

$\bar{x}$ = average of population increase.

n = no. of decades between now and future

② Geometric Increase method :-

- assumption : percentage increase between each decade is constant. or

constant percentage growth rate.