LECTURES NOTE
ON
WATER SUPPLY AND WASTE WATER ENGINEERING
FOR
5TH SEMESTER DIPLOMA CIVIL ENGG.

PREPARED BY: ER. SOUMYA SUCHARITA MAHARANA
QUALIFICATION: BTECH IN CIVIL ENGINEERING

Chapter-1

Introduction to Water Supply. Quantity and Quality of Water

Goldmedal SWITCHES & SYSTEMS

Necessity of treated water supply :-

Water is used for drinking. Water production contains water molecules & a large variety of other substances. One of the property of water is that, it is easily dissolves other substances. Water that falls to earth during rain shower dissolves substances, particles & gasses, such as oxygen, which can be found in air. Contaminants that are present in air also disolve in rain water. When surface water flows on earth, it also dissolves several different contamination; such as sand particle, organic matter, micro-organisms & minerals. Water that settled into the ground & becomes ground water often contains large amount of dissolved minerals as a result of contact with soils & rocks. Human activities, such as agriculture & industrial waste & sewer water discharge cause a number of pollutants to enter into the water.

Water has the capacity to clean itself. Contaminants are removed from water during biological processess. When water settled onto the ground, ground layers will cause filtration to occur. Contaminants are broken down or will stay behind in the ground layer. The self cleaning capacity of water is not strong enough to produce clean drinking

Switch to the amazing

www.goldmedalindia.com

water. This is a consequence of the quantity & variety of industrial & agricultural contaminants that have entered surface & ground water for many decades. In 1970 it was discovered that industrial discharges & waste water discharges were the cause of water contamination. Immediately after this discovery measures were taken to prevent water pollution. Waste water must meet legal standard before it can be discharged. To meet the standards water is purified before it is discharged.

Despite of these measures water often still needs treatment before it is suitable for use as drinking water. During water purification waste water is treated to become drinking water which meets legal standards in the physical, bacteriological & chemical area. The water may not contain an odour or flavor & it should be bright & chemically stable (non-corrosive). The kind of treatment of water needs strongly depends upon the composition & quality of the water. Water treatment contains 2 process, (i) physical removal of solid particles, mainly minerals and organic matter & (ii) chemical dis-infection, killing or de-activating micro-organisms in watere.

Watere requirements fore different uses :-

A. Use of watere in preimarey terms :-

- Washing and bathing
- Laundry
- Cleaning (Floore, doore, window, etc)
- Watereing lawns & gardens
- Heating and cooling system
- Spreinkling & cleaning streeets
- Filling swimming & wading pools
- Display in fountains & cascades
- Preoduction of hydreaulic & steam powere
- Varried industrerial preocess.
- Fire fighting (Preotecting life/preoperty)
- Removal of offensive & potential dangereous waste.
- From household (sewage) & industrey (Industrerial waste)

B. Importance of watere in breoad terem :-

- Agreiculture (Irrerigation)
- Industrerial purepose
- Domestic use
- Recreeation
- Commercial
- Hydreo-electreic powere
- Sewere flushing
- Public supply

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

Watere Demand

→ Domestic demand

This includes the watere requirred in private building fore drinking, bathing, gardening, sanitarey purpose, etc.

As pere IS -

200 litree/day/pereson (with fully flushing system)
135 litree/day/pereson (fore weaneric section & LIG)

→ Public demand

It reepresents the watere demand fore public utility purepose, line washing of public parens, garedening, washing of roads, public fountain. As pere IS
20 litree/day/pereson.

→ Industrial demand

It reepresents the watere demand of industreries which aree earliere existing or aree likely to be started in future.

As pere IS - 50 litree/day/pereson (fore normal industrey)
450 litree/day/pereson (industreal city)

Goldmedal
SWITCHES & SYSTEMS

→ Commercial demand

Watere requirement fore institutions, hotels, schools, colleges, offices.

As pere IS -

20litree/day/pereson (Fore noremal commercial area)
50litree/day/pereson (highly commercial area)

→ Free demand

In populated ore industrial area fires generally breeakout & may lead to serious preoblem. Fore control that situation required sufficient quantity of watere that is called free demand.

→ Watere demands require fore thefts & wastes

This includes the watere lost in leakage & stolen watere due to unauthorised watere connection.

Watere requirement fore different use

→ Domestic demand	135 l/d/p
→ Public "	20 l/d/p
→ Industrial "	50 l/d/p
→ Commercial "	20 l/d/p
→ Free "	15 l/d/p
→ Loss & waste	50 l/d/p
	270 l/d/p

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

The per capita demand (q)

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

It may be expressed as per capita demand (q) in litre per day per head. is equal to total yearly water requirement of the city (in litre)

$$q = \frac{\text{Total water requirement}}{365 \times \text{design population}}$$

Factors affecting per capita demand.

- Size of the city
- Climatic condition
- Habits of people
- Industrial & commercial activities
- Quality of water supply
- Pressure in the distribution system
- Development of sewerage facilities
- System of supply
- Cost of water
- Method of charging.

Size of the city

The pere capita demand fore big cities is generally large as compared to that fore small towns. Because in big cities huge quantity of watere required fore maintaining clean & healthy environment.

Climate Condition

At hot & drey places the consumption of watere is generally more because more of bathing, cleaning, aire cooling, spreinkling in lawn & garden are involved.

Habits of people

Rich & uppere class communities generally consumed more watere due to theire affluent leaving standards.

Middle class communities consume average amount while the poore slum dwelleres consumes very low amount.

Industreial & commercial activity

The presence of industreial and commercial activities of a particulare place increases the watere consumption by large amount.

Many industrees required really huge amount of watere such as increase the watere demand considerably.

Quality of water supply

If the quality and test of the supplied water is good, it will be consumed more. Because in that case people will not use the other sources such as private wells, hand pump etc.

Pressure in distribution system

If the pressure in the distribution pipe is high and sufficient to make the water consumption shall definitely be more.

This water consumption increases because of two reasons.

- People living in upper storey will use water freely as compared to the case when water is available scantily to them.
- The losses and wastage due to leakage are considerably increased if this pressure is high.

Development of sewerage facility

As pointed out earlier the water consumption will be more, if the city is provided with flush system and shall be less if the old conservation system of toilets aree provided.

System of supply — The watere may be supplied eithere continuously fore all the 24 houres of the day ore may be supplied only fore peak periods during the morning and evening.

Cost of watere

If the watere rates aree high less quantity of watere may be consumed by the people.

Method of charging

Watere tax is generally charged in two different ways.

→ On the basis of metere reading

→ Certain fixed monthly flat rate.

In the second case, ie when the supplies aree unmetered and the charges are fixed, people generally don't practice economy in the use of watere because they think that they have to pay only a fixed amount irrespective of the quantity of watere used by them.

Goldmedal SWITCHES & SYSTEMS

Switch to the amazing

www.goldmedalindia.com

Varelation in reate of demand

Average daily perc capita demand = $\frac{\text{Quantity required in 12month}}{365 \times \text{design population}}$

In this, avercage demand is supplied at all the times.

It will not be sufficient to meet the varelation.

Varelations may be of following types.

Seasonal Varelation

The demand deals durering summere, firee breeanouts arce generally moree in summere, increeasing the demands That is seasonal varelation.

Daily Varelation

It depends on the activity. people dreawout morce watere on sunday & festival days. Thus increeasing demand on these days.

Goldmedal
SWITCHES & SYSTEMS

Hourly variation

Hourly variations are very important as they have a wide range. During active house hold working hours (i.e from 6-10 am in the morning & 4-8pm in the evening) the bulk of the daily requirement is taken. During other hours the requirement is less.

So an adequate quantity of water must be available to meet peak demand. To meet all the variation the supply pipes, service reservoirs & distribution pipes must be designed to meet the peak demand. The effect of monthly variation influences the design of storage reservoirs & hourly variation influences the design of pumps & service reservoirs.

As the population decreases the variation rate increases.

Maximum daily demand = 1.8 x average daily demand

Maximum hourly demand of max^m day i.e peak demand

= 1.5 x average hourly demand =

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

Switch on the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

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

⇒ Maximum daily consumption is generally taken as 180 % of the average daily consumption.

Maximum daily demand = 180 % × average daily demand

$$= \frac{180}{100} \times \text{average daily demand}$$

$$= 1.8 \times \text{average daily demand.}$$

⇒ Maximum hourly consumption is generally taken as 150% of its average hourly consumption. Thereeforce maximum hourly consumption of maximum day, i.e peak demand

Maximum hourly consumption =

150 % × average hourly consumption

$$= \frac{150}{100} \times \text{average hourly consumption}$$

$$= 1.5 \times \frac{\text{max}^m \text{ daily demand}}{24}$$

$$= 1.5 \times \frac{1.8 \times \text{average daily demand}}{24}$$

$$= 2.7 \left(\frac{q}{24}\right)$$

Goldmedal
SWITCHES & SYSTEMS

= 2.7 × Annual average hourly demand.

Design periods & Population Forecast

This quantity should be worked out with due provision fore the estimated requirements of the future.

The future period fore which a provision is made in the watere supply scheme is known as the design period.

Design period is estimated based on the following

- Useful life of the component.
- Expandability aspect
- Anticipated rate of growth of population including industrial, commercial development
- Available resources.
- Performance of the system during initial period.

Population Forecasting Method

The various methods adopted fore estimating future population are given below. The particulare method to be adopted fore a particulare case ore fore a particulare city depends largely on the factores discussed in the methods & the selection is left to the discreation & inteligence of the designere.

Switch the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

- Arithmetic increase method
- Geometric increase method
- Incremental increase method
- Decreasing rate of growth method
- Simple graphical method
- Comparative graphical method
- Ratio method
- Logistic curve method.

Arithmetic Increase Method

This method is based upon the assumption that the population increases at a constant rate (i.e the rate of change of population with time, $\frac{dP}{dt}$ is constant).

$$\frac{dP}{dt} = K$$

$$\Rightarrow dP = K.dt$$

$$\Rightarrow \int_{P_1}^{P_2} dP = K \int_{t_1}^{t_2} dt$$

$$\Rightarrow P_2 - P_1 = K(t_2 - t_1)$$

where suffix 1 & 2 represent the last & first decades respectively.

$t_2 - t_1$ = number of decades.

The population data for the last 4-5 decades is therefore obtained & the population

Goldmedal
SWITCHES & SYSTEMS

increase per decade (x) is calculated & the average of which $\bar{x}$ is then used as the design growth rate for computing future population. Thus

P_1 = Population after 1 decade from present

$$P_1 = P_0 + 1.\bar{x}$$
$$P_2 = P_1 + 2\bar{x}$$
$$P_3 = P_2 + 3\bar{x}$$

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

Where,

P_n = forecasted population after 'n' decades from the present.

P_0 = population of present.

n = no. of decades betn now & future

$\bar{x}$ = Average of population increases in the non-decade.

Ex The population of 5decades from 1930-1970 are given below in the table find out the population after 1, 2, & 3 decade. beyond the last non-decade by using arithmetic increase method.

Switch to the amazing

year	population	Increase in population
1930	25,000	
		3000
1940	28,000	
		6000
1950	34,000	
		8000
1960	42,000	
		5000 $= \bar{x}$
1970	47,000	

Soln

$P_{1980} = P_{1970} + 1 \times \bar{x}$

$= 47000 + 1 \times 500$

$= 52,000$

$P_{1990} = P_{1970} + 2 \times \bar{x}$

$= 47000 + 2 \times 5000$

$= 57,000$

$P_{2000} = P_{1970} + 3 \times \bar{x}$

$= 47000 + 3 \times 5000$

$= 62,000$

Goldmedal
SWITCHES & SYSTEMS

Geometric Increase Method

In this method the per decade percentage increase or percentage growth rate (r) is assume to be constant & the increase in compounded over the existing population every decade. This method is therefore known as uniform increase method.

The basic difference betⁿ arithmetic & geometric progressive method for forecasting future population is that - In arithmetic method no compounding is done & in geometric method compounding is done every decade.

The above geometric increase can be expressed as

P_1 = population after 1 decade.

$$P_1 = P_0 + \frac{r}{100} \times P_0$$

$$P_2 = P_1 + \frac{r}{100} \times P_1$$

$$P_1\left(1+\frac{r}{100}\right) = \left(P_0 + \frac{r}{100} \times P_0\right)\cdot\left(1+\frac{r}{100}\right)$$

$$= P_0\left(1+\frac{r}{100}\right)^2$$

$$\boxed{P_n = P_0\left(1+\frac{r}{100}\right)^n}$$

Switch to the amazing

www.goldmedalindia.com

Wheree,

P_n = futurce population after n decades.

P_0 = Initial population

re = Assume growth rate in percentage.

The assume growth rate (re) can be computed in several ways.

$$re = \sqrt[n]{\frac{P_2}{P_1}} - 1$$

$$= \frac{\text{increasing population}}{\text{original population}} \times 100$$

The geometric average = $re = \sqrt[n]{re_1 \times re_2 \times re_3 \cdots re_n}$

Incremental Increase Method

In this method the per decade growth rate is not assume to be constant as in the arithmetic or geometric progression method but progressively increasing or decreasing depending upon whether the average of the incremental increases in the past data is positive or negative.

$$P_n = P_0 + n\bar{x} + \frac{n(n+1)}{2}\bar{y}$$

Goldmedal SWITCHES & SYSTEMS

Where,

P_n = population after 1 decades from present.

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

$\bar{y}$ = average of incremental increases of the known decades.

Ex

Year	Population	Increase in population	Incremental increases
1930	25,000		
1940	28,000	3000.	
1950	34,000	6000.	+ 3000
1960	42,000	8000.	+ 2000
1970	47,000	5000.	- 3000
		$\bar{x} = \frac{22000}{4} = 5500$	$\bar{y} = \frac{2000}{3} = 667$

1st decade

$P_{1980} = 47000 + 1 \times 5500 + \frac{1(1+1)}{2} \times 667$

$= 53,167$

2nd decade

$P_{1990} = 47000 + 2 \times 5500 + \frac{2(2+1)}{2} \times 667$

$= 60,001$

3rd decade

$P_{2000} = 47000 + 3 \times 5500 + \frac{3(3+1)}{2} \times 667$

$= 67,502$

Switch to the amazing

Decreasing rate of growth method

Since the rate of increase in population goes on reducing as the city reach towards saturation. A method which makes use of the decreases in the percentage increase is many a time used & gives quite rational results.

In this method the average decrease in the percent increase is worked out & is then subtracted from the latest percentage increase for each successive decades.

$$P_n = P_0 + \left(\frac{r_n - t}{100}\right) P_0$$

$$r_n = \frac{P_1 - P_0}{P_1} \times 100$$

$$t = \frac{(r_1 - r_2) + (r_2 - r_3) + (r_3 - r_4) + \dots}{n}$$

Ex

Year	Population	Increase in population (x)	Percentage increase in population
1930	25,000		
1940	28,000	3,000	$\frac{3000}{25000} \times 100 = 12\%$
1950	34,000	6,000	$\frac{6000}{28000} \times 100 = 21.4\%$
1960	42,000	8,000	$\frac{8000}{34000} \times 100 = 23.5\%$
1970	47,000	5,000	$\frac{5000}{42,000} \times 100 = 11.9\%$

Goldmedal
SWITCHES & SYSTEMS

Decrease in the perecent increase

$12 - 21.4 = -9.4\%$

$21.4 - 23.5 = -2.1\%$

$23.5 - 11.9 = +11.6\%$

$$\frac{-9.4 - 2.1 + 11.6}{3} = 0.03\% \text{ (decreases)}$$

The expected population at the end of year (1980) first decade.

$$P_{1980} = P_{1970} + \frac{r - t}{100} \times P_{1970}$$

$$= 47000 + \frac{11.9 - 0.03}{100} \times 47000$$

$$= 52,579$$

The expected population at the end of year (1990)

$$P_{1990} = P_{1980} + \frac{r - t}{100} \times P_{1980}$$

$$r = \frac{5,579}{47,000} \times 100 = 11.87$$

$$= 52,579 + \frac{11.87 - 0.03}{100} \times 52,579$$

$$= 58,804$$

The expected population at the end of year (2000)

$$P_{2000} = P_{1990} + \frac{r - t}{100} \times P_{1990}$$

$$r = \frac{6225}{52,579} \times 100 = 11.84$$

$$= 58,804 + \frac{11.84 - 0.03}{100} \times 58,804$$

$$= 65,748.$$

Switch to the amazing

Simple graphical method

In this method a graph is plotted from the available data between time & population. The curve is then smoothly extended upto the desired year. The method however gives very approximate results as the extension of the curve is done by the intelligence of the designer.

Comparative graphical method

In this method the cities having conditioned & characteristics similar to the city, whose future population is to be estimated as, first of all selected. It is then assume that the city under consideration will develop as the selected similar cities have developed in the past.

This method has a logical background & its statistics of development of similar cities are available, quite precise & reliable results can be obtained.

However it is rather difficult to find identical cities with respect to population growth.

Factors for source selection

→ **Purity of the raw water**

This is with respect to the possibility of treatment (cost).

→ **Volume of water**

Volume of water available to be enough to satisfy minimum requirement. Normally inflow should be greater than overflow.

→ **Permanency of the source**

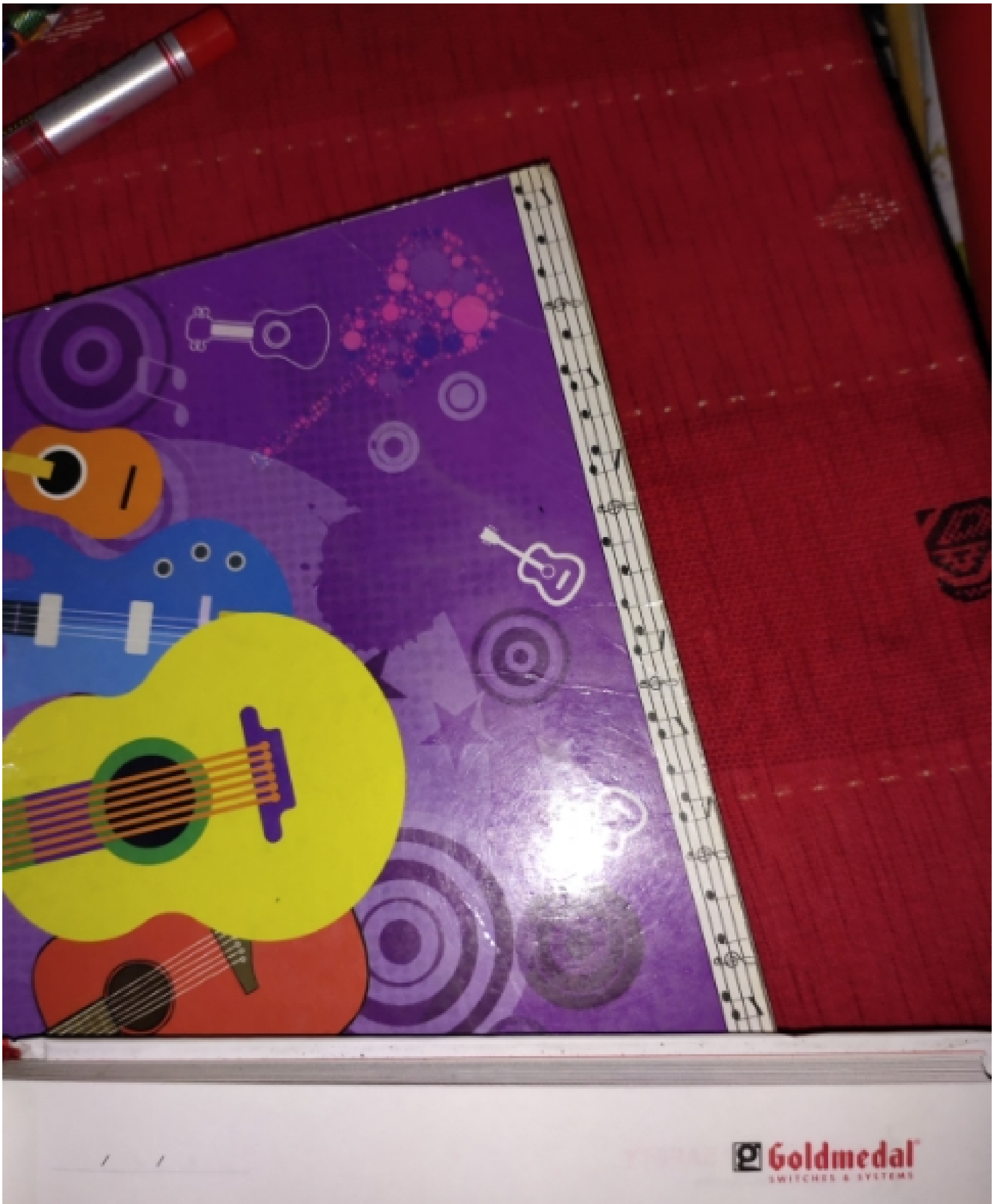
Available in large quantity with a continuous discharge.

→ **Elevation of the water level with respect to the area to be supplied**

Cost of lifting the water to a higher elevation will be higher than that from lower elevation & may requires the use of pumps.

→ **Availability of finance**

To carry out the design.



construction, running & maintenance. This is related to the kind of structures.

Sources of Water

Goldmedal SWITCHES & SYSTEMS

There are 2 sources of water.

→ Surface source
→ Underground source

Surface sources of Water

Natural Sources

Streams

In mountaneous region streams are ~~found~~ formed by the runoff. The discharge in streams is much in rainy season than other season.

Ponds

These are depressions in planes like lane of mountains, in which water is collected during rainy season.

Rivers

Rivers are born in the hills, when the discharge of large number of springs and streams combine together. In mountains the quantity of water in rivers remains small, so it is known as small river.

Artificial Sources

Impounded reservoirs

In summer season, the discharge of some river is insufficient to meet the water requirement. In such cases it becomes essential to store the water for summer

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

season. The water can be stored in the river by constructing a weir or dam across the river is known as impounded reservoir.

Underground source of water

→ Springs

Sometimes ground water reappears at the ground surface in the form of springs. Generally springs can supply small quantity of water. Hence these cannot be used as source of water to big towns.

→ Infiltration gallery

We have seen that ground water travels towards lakes, rivers or streams.

This water which is travelling can be intercepted by digging a trench or by constructing a tunnel with holes on sides at right angle to the direction of flow of under ground water.

These underground tunnel used for tapping underground water near rivers, lakes or streams, are known as infiltration gallery.

Goldmedal
SWITCHES & SYSTEMS

→ **Infiltercation Well**

The shallow wells constructed under the beds of rivers and nallas is known as infiltercation well.

These wells are very suitable for Indian conditions where there are deposits of sand & porous material at least 3m deep in river beds.

In order to obtain large quantity of water infiltercation well are sunk in series in the bank of river.

Types of well

There are 2 types of well.

→ Open well.
→ Tube well

Open well

The well which is constructed by digging earth, whose diameter varies from 1m to 2m & depth varies from 10m to 20m. is known as open well.

There are 2 types of open well.

→ **Shallow open well**

The well which is constructed in the top permeable strata is known as shallow open well.

This well is lonely to get dried up in summer.

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

Deep Open Well

The well which is constructed in the deeper permeable strata is known as deep open well.

This well is ~~timely to~~ not dried up in summer.

Tubewell

The well which is constructed by using G.I pipes of diameter varying from 3.75cm to 15cm. & length varying from 7m to 8m is known as tube well.

There are 2 types of tubewell.

Shallow tube well

The tubewell in which the diameter varies from ~~30m~~ 3.75cm to ~~40m~~ 5cm ~~is known as~~ and depth varies from 30m to 40m is known as shallow tubewell.

It draws water from the top most aquifer, hence the water of the well may be dried up in summer.

Deep tubewell

The tubewell in which the diameter varies from 10cm to 15cm & depth varies from 200m to 300m is known as deep tubewell.

It draws water from the

Goldmedal
SWITCHES & SYSTEMS

deeper most aquifer, hence the water is available through out the year.

Aquifer

A permeable stratum which is capable of yielding appreciable quantities of ground water under gravity is known as aquifer.

Types of Aquifer

There are three types of aquifer.

- Perched aquifer
- Confined "
- Unconfined "

Perched aquifer

The aquifer which contains water but can't pass water is known as perched aquifer.

Unconfined aquifer

The top most ~~layer~~ water bearing stratum, is known as unconfined aquifer.

Confined aquifer

The aquifer which is sandwiched between two impervious layer is known as confined aquifer.

Yield of Well

The rate of pumping of water from the well without causing the failure of the well is known as yield of well.

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

Methods of deteremination of yield of well

The yield of open well can be determine by the following test.

- → Constant level test
- → Recuperation test.

to the kind of structures.

Sinking of well

The tubewells are generally sunk by two methods.

- Wash boring method
- Water jet "

Wash boring method

In this method, a pit of depth about 1m and diameter 10cm is first excavated at the position where the well is proposed to be sunk.

A GI pipe of diameter 3.75cm & length 6m is held vertically in the pit by the lever.

The pipe is completely filled with water & an operator standing on the bamboo frame covers the upper end of the pipe with palm of his hand sufficient quantity of water is poured continuously on the pit.

Now the pipe is removed up & down with the lever which is operated by a group of labours.

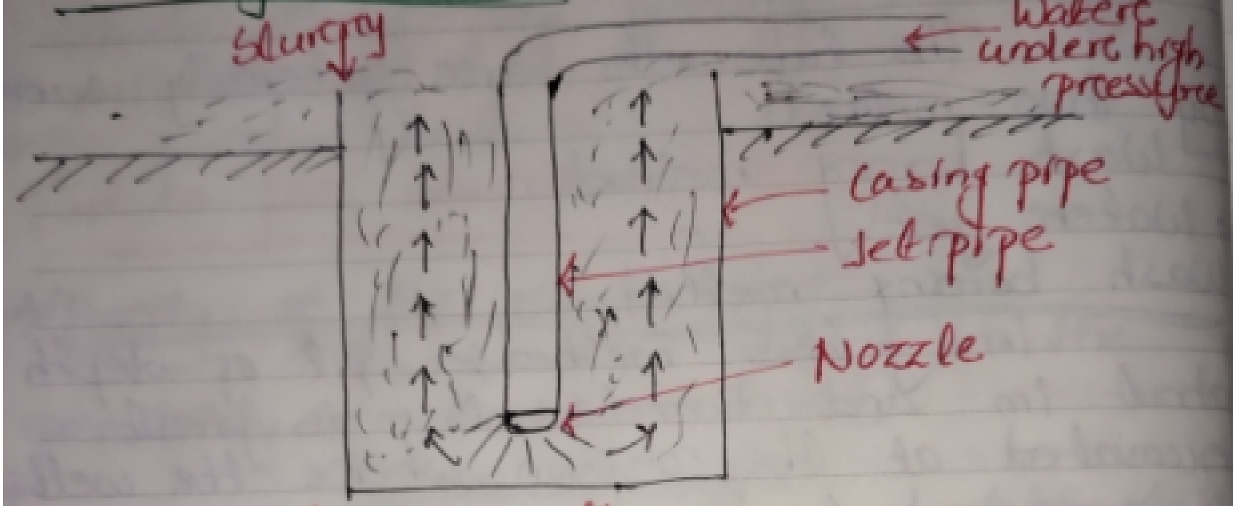
The washing of the pipe is done until the clear water comes out.

Switch to the amazing

www.goldmedalindia.com

This method is suitable for sandy & clayey soil.

Water jet method



Components of well

Following are the components of well.

- Suction pipe
- Drainage channel
- Pump
- Rock lining
- Concrete seal
- Well cover.

Development of Well

The method of extracting and removing the fine sand particles from the soil around the strainer is termed as development.

The development is done for the following reasons.

→ To prevent the sand particles from entering the well.

→ To increase the specific capacity of well.

→ To increase the life of well.

Sanitary protection of well

The most important features missing from most private wells are sanitary protection. The sanitary protections are required by most states because they help protect ground water by sealing the well from potential contamination. There are two types of sanitary protection.

→ Sanitary well cap

→ Grout cap.

Sanitary well cap

A sanitary well cap is a rubber gasket, hole for electrical conduit & screen holes for ventilation.

Grout cap

Grout cap is a neat cement (no aggregate) that is pumped into the space between the drilled hole & the casing.

Goldmedal SWITCHES & SYSTEMS

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

Maintenance of well

The method of cleaning or replacing the streamers or tube wells pipes to make it workable for longer ~~period~~ period is known as maintenance of well.

The following measures are generally taken.

- If the yield of well is reduced due to the clogging streamer, then the streamer may be cleaned by surging with the help of a plunger.
- Compressed air also forced through the well pipe to remove the clogging.
- The internal corrosion of the well pipe or streamer may be removed by sulphuric acid.

Pump

The mechanism by which the water is lifted from the under ground sources to some height or some place is known as pump.

There are 4 types of pump.

- Reciprocating pump
- Centrifugal pump
- Air lift pump
- Rotary pump.

Goldmedal SWITCHES & SYSTEMS

Receprocating pump

This consist of a close cylindere in which a piston moves to and from by connecting road.

The connecting road is again hinged with a wheel which is reotated by a motore.

Dureing the suction streone the suction valve is opened and deliverey valve reemains closed & watere enterced the cylindere.

Dureing the deliverey stoke, the deliverey valve is open & the suction valve reemain closed & watere is forceed through the deliverey pipe.

Centrerfugal pump

The centrerfugal pump involve the preinciple of centrerfugal forece.

When the watere in the casing of a pump is reotated by the impelleres about the centreal point, the centrerfugal forece develop which forces the watere towareds the perexphercy of the casing.

Thus the velocity head is converected to preessurce head & this head forces the watere through the deliverey pipe.

Switch to the amazing

Aire lift pump

It consist of a casing pipe in which an educatore pipe is introduce.

An aire pipe is also introduce into the casing pipe.

The bottom end of the aire pipe carreries an aire diffusere which is introduced into the educatore pipe in upward direction.

When the compreessed aire is forced through the aire pipe, a mixture of aire & watere is foremed & rises up in the forem of bubbles.

Then the preessure of the watere in the educatore pipe becomes less than the preessure of watere in the ~~casting~~ casing pipe.

The efficient worcking of the pump depends on the aire pipes submeregence depth.

Rotary pump

It consists of two cams which are pivoted in a casing.

These cams rotate in opposite direction and there by the suction takes place through the suction pipe.

The rotation of the cams

Goldmedal
SWITCHES & SYSTEMS

pushes the watere in upward directron through the deliverey pipe.

Site Selection

While selecting the site fore pumps following points aree kept to be reememberecd.

- The location of the pumps should be above HFL.
- Requirced quantity of watere should be available as the site.
- The pumping station should be at highere level above all the sources of contamination,
- The location site should be such that future growth & expansion may be possible.
- The source of watere should be permanent.

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

Conveyance of Water

Intake

An intake is a structure which is constructed across the surface of water so as to permit the withdrawl of water from the source.

The structure may be of stone masonry, brick masonry, RCC or concrete block.

Types of Intake

Rivere intake
Reserevoire intake
Canal intake.

River Intake

→ It is circular masonry tower of 4 to 7 meters in diameter constructed along the bank of the river at the place from where required quantity of water can be obtained even in the dry period.

→ The water enters in the lower portion of the intake known as sump-well from penstocks.

→ The penstocks are fitted with screens to check the entry of the suspended solids may only enter sump well. The penstocks with screens are providing with streainer at its lower end.

Goldmedal
SWITCHES & SYSTEMS

→ The watere from jacnwell is pumped & sent to the treeatment plant.

→ To preevent the back flow of watere due to greavity, a valve should also be provided on the reising main leading to the treeatment plant.

→ To reach upto the bottom of intake from the floore of pump reoom, the laddere ore steps in zigzag mannere should be provided.

Reserevoire Intake

→ Reserevoire intakes which is mostly used to dreaw the watere from earethen dam reeserevoire.

→ It essentially consists of an intake towere constreucted on the slope of the dam at such from wheree intake can dreaw sufficient quantity of watere even in the dreiest period.

→ Intake pipes aree located levels with a common verctical pipe. The valves of intake pipes aree opereated freom the top & they aree installed in a valve reoom.

→ Screeens aree preovided at the mouth of all intake pipes to preevent the floating & suspended matere in them.

→ The watere which enteres the vertical pipe is taken to the othere side of the dam by means of an outlet pipe.

→ At the top of the sluice valves aree

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

provided to control the flow of water.

→ The valve tower is connected to the top of the dam.

Canal Intake

→ An intake chamber is constructed in the canal section. This results in the reduction of waterway which increases the velocity of flow.

→ The entry of water in the intake chamber takes through the course screen & the top of outlet pipe is providing with fine screen.

→ The inlet to outlet pipe is of bell-mouth shape with fine screen on its surface.

→ The outlet valve is operated from the top and it controls the entry of water into the outlet pipe from where it is taken to the treatment plant.

→ As the water level in the canal section partially remains constant, it is not necessary to provide intake pipes at various levels.

Goldmedal
SWITCHES & SYSTEMS

Pipe material (Necessity)

- → Carrying capacity of the pipe.
- → Durability & life of the pipe.
- → Types of water to be conveyed & its corrosive effect on the pipe material.
- → Availability of fund
- → Easy maintenance & repair.

Types of pipes

- → Cast iron pipes
- → Wrought iron pipes
- → Steel pipes
- → Concrete pipes
- → Cement lined pipes
- → Asbestos cement pipes
- → Copper & lead pipes
- → Wooden pipes
- → Vitrified clay pipes.

Cast iron pipes

Merits

- → The cost is moderate.
- → The pipes are strong & durable.

Demerits

- → The breakage of these pipes are large.
- → The pipes are heavier & uneconomical.

Switch on the amazing

www.goldmedalindia.com

Wreought ircon pipes

Mereit

→ These pipes arce light in weight.

→ They can be easily cut, threead & worcked.

Demereit

→ They arce found to be costly.

→ The pipes arce less durcable as compare to the cast ircon.

Steel pipes

Mereit

→ The pipes arce available in long length & hence, the number of joints becomes less.

→ The pipes arce light in weight.

Demereit

→ The maintenance cost is high.

→ The pipes arce requiread more time for reepairs.

Concreete pipes

Mereit

→ The maintenance cost is low.

→ These arce not corcroded by the watere.

Demereit

→ They are heavy & difficult to handle & treansport.

→ They can not withstand high pressure.

Cement lined cast iron pipe

Merit

→ Their life is more about 75 years.

→ They can be easily constructed in the factories.

Demerit

→ They are affected by acids, salty waters.

→ Their repaires are very difficult.

Wooden pipes

Merit

→ The pipes are light in weight.

Demerit

→ They can not bear high pressure.

Plastic pipes

Merit

→ The pipes are cheap.

→ The pipes are free from corrosion.

Demerit

→ The pipes are less resistance to heat.

→ The coefficient of expansion for plastic is high.

Pipe joints

→ For the facilities in handling, transporting & placing in position, pipes are manufactured in small lengths of

WIRED FOR SAFETY
www.goldmedalindia.com

2 to 6 meteres.

→ These small pieces of pipes are then joined togethere aftere placing in position, to make one continuous line.

Types of joints

- → Spigot & socket joint
- → Expansion joint
- → Flanged joint
- → Mechanical joint
- → Flexible joint
- → Screwed joint
- → Collare joint
- → A.C. pipe joint.

Spigot & Socket joint

Methods of jointing – Fore the construction of this joint the spigot ore normal end of one pipe is slipped in socket ore bell end of ~~end one pipe is slipped in socket~~ othere pipe until contact is made at the base of the bell.

Aftere this yarn of hemp is wrapped around the spigot end of the pipe & tightly filled in the joint by means of yarening iron upto 5cm ~~length~~ depth.

The hemp is tightly packed to maintain regulare annulare space & fore preventing jointing material from falling inside the pipe.

After packing of hemp a joint runnere is clamped in place round the joint so that it fits tightly against the outere edge of the bell.

Flanged joint

The pipe in this case has flange on its both ends, cast, welded ore screwed with the pipe.

The 2ends of the pipes which aree to be ~~jointed~~ jointed togethere aree brought in perfect level neare one anothere & aftere placing one hared rubbere, washere, coppere ore lead between flanges aree bolted. placing of washere ore gasket of rubbere between the 2ends of flanges is very necessarey fore securing a perfect watere tight joint.

Flexible joint

This is a special type of joint. The socket end is cast in a sphercical shape. The spigot end is plane but has a bead at the end.

Fore the assembling of this joint

Goldmedal SWITCHES & SYSTEMS
Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

The spigot end of one pipe is kept in the spherical end of the other pipe.

After this retainer ring is slipped which is stretched over the bead.

Then a rubber gasket is moved which touches the retainer high.

After it split cast iron gland is placed, the outer surface of which has the same shape in inner of socket end.

Over this finally cast iron follower ring is moved.

Screwed joint

This joint is mostly used for connecting small diameter, cast iron, wrought iron, & galvanized pipes.

The ends of the pipes have threads on outside, while socket has threads on the inner side.

The same socket is screwed on both the ends of the pipes to join them.

Collar joint

This type of joint is mostly used for joining big diameter concrete & asbestos cement pipes.

The ends of the 2 pipes are

brought in one level before each other.
Then prepare gasket between steel ring & jute rope soaked in cement is kept in the groove & the collar is placed at the joint so that it should have the same lap on both the pipes. Now 1:1 cement mortar is filled in the space between the pipes.

A.C. pipe joint

For joining small diameter A.C. pipes, the 2 end of pipe are butted against each other, & then 2 rubber rings will be slipped over the pipes.
The rubber rings make the joint water proof.

Laying of water supply pipes

Methods

First of all detailed map showing all roads, streets, lanes etc. is prepared. On this map the proposed pipe line with as sizes & length will be marked the position of existing pipe line, curb lines, sewer lines etc. will also may be marked on it. In addition to this position of valves & other pipe specials, stand post etc. will also be made so that at the time of laying there should be no difficulty in

Goldmedal SWITCHES & SYSTEMS
Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

this connection.

→ After the general planning the centre line of the pipe line will be transferred on the ground from the detailed plan. The centre line will be marked by means of stakes driven at 30m. interval on straight lines on curves the stakes will be driven at 7m to 15m spacing. If the roads are streets have curbs, the distance of centre pipe line from the curb will be marked.

→ When the centre line has been marked on the ground the excavation for the trenches will be started.

→ After the excavation of trenches the pipe are lowed in it.

→ After laying the pipes in position, they are tested for water leakage & pressure.

→ When the pipe line is tested, the back filling of the excavated material will be done.

Tests

Pressure test

At a pressure of at least durable the maximum working pressure pipe & joints shall be absolutely water-

Goldmedal SWITCHES & SYSTEMS

tight undere the test.

Leanage test

Leanage is defined as the quantity of watere to be supplied into the newly laid pipe. It is ~~nece~~ necessary to maintain the specified leanage test pressure after the pipe has been filled with watere & the aire is expelled.

Pipe Correrosion

The pipe correrosion is used to indicate the loss of pipe matereral due to the action of watere.

Cause

~~Alka~~ Acidity

This is rathere than the most importrtant factore in correrosion & the watere having low pH value due to the presence of carbonic acid are othere acids is invarerably correrosive.

Alkalinity

The watere possessing sufficient calcium bicarbonate alkalinity is anti-correrosive in naturee.

Biological action

The growth of iron bacterera & sulphure bacterera may develop aerobic & anaerobic correrosion respectively.

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

Chlorination

The presence of free chlorine or chloramines makes the water corrosive.

Material or organic constituents

The presence of high total solid in water accelerates the process of corrosion. The calcium & magnesium chlorides are particularly active in hot water system.

Oxygen

The presence of oxygen is found in both the corrosive & non-corrosive water & under ordinary conditions, it is not the sole or primary cause of pipe corrosion.

Prevention of pipe corrosion

~~Catho~~.

Cathodic protection

It is found that if entire pipe lines acts as cathode, the pipe corrosion may be minimized.

Proper pipe material

The pipe material, if metallic, should be able to resist the dissolving effect of water. The alloys of iron or steel with chromium, copper or nickel are found to be more resistant to the corrosion.

Protective lining

The pipe surfaces should be coated with anti-corrosive linings. The usual coatings employed are those of asphalt, bitumen, cement mortar, paints etc. The degree of prevention achieved will depend on the individual properties of the coating material.

Treatment of water

The water should be given proper treatment to prevent pipe corrosion. The usual treatments employed are adjustment of pH value, control of calcium carbonate, removal of dissolved oxygen and dioxide, addition of sodium silicate, etc.

Goldmedal SWITCHES & SYSTEMS

Switch to the amazing

Quality of water

Water quality standards for different uses

Absolutely pure water is never found in nature. The rain water which is originally pure also absorbs various gases dust & other impurities while falling & this water when moves on the ground for the carries silt, organic & inorganic impurities.

Now this water before supplying to the public should be treated & purified.

Complete purification is very difficult & absolutely purified water is not good for health.

So before supplying the water to public it goes for some type of testing & then it shows the quality of water.

Impurities in Water

There are basically three types of impurities in water.

- Suspended impurities
- Colloidal "
- Dissolved "

Suspended impurities

The suspended particles which have the same specific gravity as that of water are mixed in the water.

Goldmedal
SWITCHES & SYSTEMS

Just like clay, fungi, organic & inorganic matters & mineral matter etc.

These all impurities are microscopic & the size of these impurities ranges from 0-0001mm.

Dissolved impurities

Some impurities are dissolved in water when it moves over the rocks soil etc. These dissolve impurities may contain organic compounds, inorganic salts & gases etc.

Colloidal impurities

It is very finely divided dispersion of particles in water. All the colloidal impurities are electrically charged & remain in continuous motion.

The electric charge is due to the presence of ions, acid materials, like silica glass, acquire negative charge where as basic materials such as metallic oxide, aluminium oxide, ferrous oxide are positively charged.

Due to the electric charge action all the colloidal particles remain in motion & don't settle, that's why there removal is very difficult.

Most of colour of water is due to colloidal impurities the size of colloidal particle in between 1micron to 1milli micron.

Switch to the amazing

www.goldmedalindia.com

Haremful effects of impurities

Bacterias - Cause disease
Protozoa - Cause odoure
clay, Silt - Cause turbidity
Carbonate - Cause hardness
Sulphate - Cause hardness
Bicarbonate - Cause alkalinity & hardness.
Flourides - Cause molted enamel of teeth.
Chlorides - Taste & salinity
Manganese - Cause black & breown coloure
Iron Oxide - Cause taste, corerosiveness, hardness & coloure.
Metal lead - Cause lead poisoning.

Analysis of Watere

The analysis of watere of the source is determined the various impurities present in it on the basis of these impurities the treatment plant will be designed fore treated watere before supplying to the public is checked for its quality whether is fulfills the reequirement of the standards laid down by the public health department.

The following tests which are done during watere analysis.

- ⇒ Physical test
- ⇒ Chemical test
- ⇒ Bacteriological test.

Goldmedal SWITCHES & SYSTEMS

Physical test

The physical test include the following test.

- Temperature test
- Colour test
- Turbidity test
- Taste & odour test
- Specific conductivity of water.

Temperature Test

The temperature of water is measured by means of ordinary thermometers. from the temperature the density, viscosity, vapour pressure & surface tension of water can be determined.

The most desirable temperature for public supply is between 4.4°c to 10°c.

Colour Test

Before testing the colour of the water first of all suspended matter should be removed from the water by centrifugal force in a special apparatus.

The colour produced by one any of platinum in a liter of distilled water has been fixed as the unit of colour.

The permissible colour for domestic water is 20 ppm. on platinum cobalt scale.

Switch on the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

Turbidity Test

It is caused due to presence of suspended & colloidal matter in the water. The character & amount of turbidity depends on type of soil over which the water has ~~~~ moved.

Turbidity is a measure of resistance of water to the passage of light through it.

Turbidity is measured by Jackson candle Turbidity units.

Taste & Odour test

Taste & odour in water may be due to the presence of dead or live micro-organism, dissolved gases, mineral substances, etc.

The water having bad smell or odour is objectionable & should not supply to the public.

The intensities of the odours are measure in terms the threshold odour numbers.

First we take the odourless water sample when the sample giving typical smell the quantity of sample is done first at 20°c & then at 80°c. The increase in temperature is done to liberate the dissolved gases which cause odours.

Goldmedal
SWITCHES & SYSTEMS

Specific Conductivity test

The total amount of dissolved salts present in water can be easily estimated by measuring the specific conductivity of water.

The specific conductivity of water in micro-mhoes per cm. at 25°C is multiplied by a co-efficient (generally 0.05) so as to directly obtain the dissolved salt content in ppm.

Chemical Test

The following are the methods of doing various chemical tests.

- → Total solids test
- → Hardness test
- → Chloride test
- → Chlorine test
- → Iron & manganese test
- → pH value test
- → Dissolved gases test.

Total Solid Test

Total solids include the solids in suspension, colloidal & in dissolved form.

The quantity of suspended solids is determined by filtering the sample of water through a fine filter, drying & weighing.

Switch to the amazing

The quantity of dissolved & colloidal solids is determined by evaporating the filtered water & weighing the residue.

The total solids in a water sample can be directly determined by evaporating the water & weighing the residue.

Hardness test

It is the property of water which prevents the lather of the soap. It is caused due to the presence of carbonate & sulphate of calcium & magnesium in the water.

Hardness is generally determined by soap test, in which the standard soap solution was added in the water & it was vigorously shaked to see the formation of lather for 5 min. The hardness of water was calculated on the basis of soap solution added & the lather factor.

Chloride test

Sodium chloride is the main substances in chloride water. The natural water near the mines & sea has dissolve sodium chloride.

Excess of chlorides is dangerous & unfit for use. The chloride can be

Goldmedal
SWITCHES & SYSTEMS

reduced by deluting watere. Chloreides above 250ppm are not permissible in watere.

The chloreide can be determined by titreating the watere with silvere nitreate & pottosium chreomate in this titreation process reeddish colour will be formed if chloreides preesent.

Chlorcine test

Dissolved free chlorcine is nevere found in natureal watere.

Residue chlorcine is determined by the starch-iodide test. In this test, potassium iodide & starch solution are added to the sample of watere due to which blue coloure is formed. This blue coloure is then removed by titreating with N/100 sodium thiosulphate solution & the quantity of chlorcine is calculated.

The reesidue chlorcine should reemain between 0.5ppm in the watere so that it reemains safe against bactercia.

Iron & Manganese test

These are generally found in ground watere if it present in watere then the watere is not suitable fore domestic, bleaching, dying & laundreing purposes.

The presence of iron & manganese in watere makes brownish reed coloure in it, leads to the growth micro-organism & correodes the watere pipes.

Switch to the amazing

WIRED FOR SAFETY
www.goldmedalindia.com

The quantity of iron & manganese is determined by colorimetric methods. In this method some colouring agents are added in the water & colours so formed are compared with standard colour solution.

It is generally in 0.3ppm.

pH value test

Depending upon the nature of dissolved salts in minerals, the water found in natural sources may be acidic or alkaline.

For the pure water pH is 7. The pH value of water is generally determined by colorimetric method or electrometric method.

In colorimetric method some indicator is added in the same of water & colour so formed is compared with standard colour discs or solutions. The standard colour discs & solutions are supplied by the manufacturers, on comparing with them pH value of water can be determined.

If the pH value of water comes less than 7 then it is acid & if the pH value comes greater than 7 then the water is alkaline.

Goldmedal
SWITCHES & SYSTEMS

/ /

Dissolved gases test

Oxygen Surface waters contain large amount of dissolved oxygen, because they absorb it from the atmosphere. The presence of oxygen in water is necessary to keep it fresh & sparkling, but more quantity of oxygen causes corrosion to the pipe materials.

Carbon dioxide

The water absorbs carbon-dioxide from the atmosphere. It causes hardness in water.

The presence of carbon-dioxide can be easily determined by mixing of the lime solution in the water. If it gives milky white colour then carbon-dioxide is present in the water.

Nitrogen

The presence of nitrogen in the water indicates the presence of organic matters in the water.

The presence of nitrates is not so harmful, but in no case its quantity should increase 45ppm, because excess presence of nitrate will cause disease to the children.

It is determined by colour matching methods. In this method the colour is obtained if phenol-di-sulphonic acid & potassium hydroxide are added. The colours so developed are compared

Switch to the amazing

www.goldmedalindia.com

with standard colours.

Bacterciological test

In bacterciological analysis the following two tests are done.

- Total count of bactercia
- Bactercia coli test

Total Count of bactercia

In this method total number of bactercia present in a millilitre of water is counted. The sample of water is diluted. 1ml of sample water is diluted in 99ml of sterilized water. Then 1ml of diluted water is mixed with 10 millilitre of agar of gelatin.

This mixture is then kept in incubator at 37 degree centigrade for 24 hours or at 20°c for 48 hours. After the sample will be taken out from the incubator & colonies of bactercia are counted by means of microscope.

Bactercia Coli test

Now a day a new technique of finding out the B-coli is developed which is called "membrance filter technique".

In this method the sample of water is filtered through a sterilized membrance of special design due to which all the bactercia are retained on the membreance.

The membere is then put in contact of culturee medium - M-Endos medium in the incubatore fore 24hauers at 37°c. The membreance aftere incubating is taken out & the colonies of bacteria are counted by means of microscope.

Fore drinking watere it is necessary that it must be free from pathogenic bacteria.

Watere quality standared

The following aree the standards of watere to be used fore domestic purposes.

Temperaturee - 10-15.6°c
Odoure - 0-4
colour - 10-20ppm
Turbidity - 5-10ppm
Taste - no objectionable taste
Total solids - upto 500ppm.
Haredness - 75-115ppm.
Chlorides - upto 250ppm.
Iron & manganese - upto 0.3ppm.
PH value - 6.5 - 8
Lead - 0.1ppm.
Aresenic - 0.05ppm.
Sulphate - upto 250 ppm.
Carbonate alkalinity - upto 120 ppm.
dissolve oxygen - 5-6 ppm
BOD - Nil
B-Coli - no B-Coli in 100ml.