Experiment - 04

Aim :- To study the modern instrument used in surveying.

Electronic Distance Measuring Instrument (EDMI)

Direct measurement of Distances & their direction can be obtained by using electronics instrument that rely on propagation, reflection & reception of either light waves or radiowaves. They may be broadly classified in to three types.

(a) Infra red waves instruments
(b) Light wave instruments
(c) Microwave instruments.

Infrared wave instruments :- The instruments measure distances by using amplitude modulated infrared waves. At the end of the lines prisms mounted on tangents are used to reflect the waves. These instruments are light & economical & can be mounted on the theodolites for angular measurements. The range of such an instrument will be 3 km & the accuracy achieved is ±10mm.

E.g. Distomat D1 1000 & Distomat D15

It is very small, compact EDM, particularly useful in building construction & other ~~with~~ civil engineering works where distance measurements are less than 500 m.

Linear measurement can be taken without the use of conventional tapes & chains thus reducing the number of instruments. To measure distances, one has to simply point the instrument to the reflector, and a the touch of a key the measurements are displayed.

Light wave instruments :- These are instruments which measure distances based on propagation of modulated light waves based on propagation of modulated light waves. The accuracy of such an instruments varies from 0.5 mm to 5 mm/km distance & has a range of nearly 3 km.
E.g. Inodimeter.
This instrument which works base on the propagation of modulated light waves, was developed by E Bergstand of the Swedish geographical Survey in collaboration with the manufacturing M/s AGA of Sweden. The instrument is more suitable for night time observations & requires a prism system at the end of the line for reflecting the waves.

Microwave instruments :- These instruments make use of high frequency radio waves. These instruments were invented as early as 1980 in South Afric by Dr. T.L. Wadley. The range of these instruments is up to 100 km & can be used during both day & night.

Eg: Tellurometer

It was the first successful microwave electronic distance measurement equipment. The name derives from the Greek tellus, meaning Earth.

The Tellurometer emits an electronics wave; the remote station rerodiates the incoming wave in a similar wave of more complex modulation, and the resulting phase shift was a measure of the distance travelled. The results appear on a cathode ray tube with circular sweep. This instrument penetrates haze & mist in daylight or darkness and has a normal range of 30-50 km but can extend up to 70km.

For measuring distance using a Tellurometer, two such instruments are required, one to be stationed at each end of the line, with two highly skilled persons to ~~talk~~ take observations. One instruments is used as a master unit & the other as a remote unit. Just by ~~prepare~~ pressing a button a master can be converted to a remote unit & vice versa. A speech facility (communication facility) is provided to each operator to interact during measurement.

Total Station:- A total station is an electronic/optical instrument used in modern surveying. The total station is an electronic theodolite (transit) integrated with an electronic distance meter (EDM) to read slope distances from the instrument to a following function.

- It can perform the following function:-
- Distance measurement
- Angular measurement
- Data processing
- Storing of data in an electronic field book.

The important feature of total station are

Key board control:-

Digital panel:- The panel displays the values of distance, angle, height and the co-ordinates of the observed point where the reflector is kept.

Remote height object:- The height of some inaccessible objects such as towers can be read directly. The microprocessor provided in the instrument applies the correction for curvature & mean refraction automatically.

Traversing program:- The coordinates of the ~~in.~~ reflector & the angle of bearing of the reflector can be stored & can be recalled for next set up of the instrument.

setting out for distance, direction & height - where never a particular direction & a horizontal distance is to be ~~ground~~, using entered for the purpose of locating.

The point on ground using a ~~r~~target, then the instrument displays the angle through which the theodolite has to be turned and the distance by which the reflector should move.

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Automatic level:- An automatic level is a special surveying (levelling) instrument which contains an optical compensation which maintain a horizontal line of sight or line of collimation even though the instrument is slightly tilted

Result:- The various modern instruments used in surveying were studied.

Viva Question

Q1 What is total station?

Ans Total station is an electronic / optical instrument used in modern surveying & building construction.

Q2 What is combination of T.S.?

A total station is a combination of an electronic theodolite, an electronic distance measuring device (EDM) and a microprocessor with memory unit.

Q3 What is EDM in surveying?

Electronic distance measurement [EDM] is a method of determining the length between two points using electromagnetic waves.

Q4 What are the main parts of total station?
Ans A total station is composed of four main components -
(i) EDM (Electronic distance measurement)
(ii) Electronic theodolite.
(iii) Microprocessor
(iv) Electronic display.

Q5 What is a total station in surveying used for?
Ans Total station measure angle, distance & co-ordinates to provide the surveyor with a precise description of a place land and its feature.

Q6 What is the advantage of using EDM?
Ans For precise measurement of distance.

Q7 What is the formula for principle of operation of EDM?
Ans velocity = $\frac{\text{Distance}}{\text{time}}$ $\Rightarrow$ $\boxed{v = D/t}$

Q8 Where is data storded in total station?
Ans micro processor.

Q9 What is the disadvantage of total station?
Ans The instrument is costly.

Q10 What is the advantage of total station?
Ans Greater accuracy in arm computation

Experiment - 5

Aim - To determine pH, hardness & turbility of the given sample of water.

(i) To perform turbidity and colour tests on a given set set of water sample & to examine their progressive change as the water flows from one treatment unit to another in a waterworks.

(ii) To perform pH & alkalinity analyses on a given set of water samples & to examine the results with respect to the water treatment processes.

Theory :-

Turbidity Turbidity is caused by suspended materials which absorb & scatter light. These colloidal & finely dispersed turbidity-causing materials do not settle under quiescent conditions & are difficut to remove by sedimentation. Turbidity is a key parameter in water supply engineering because turbidity will both cause water to be aesthetically unpleasant & cause problems in water treatment processes, such as filtration & disinfection. Turbidity is also often used as indicative evidence of the possibility of bacteria being present.

Turbidity measurements performed using proprietary nephelomatric instruments are expressed as nephelometric Turbidity Units (NTU). The

effectiveness ...

nephelometric apparatus is designed to measure forward scattering of light at 90° to path of an incandescent light beam. Suspended particles present in water sample reflect a portion of the incident light off the particle surface. The light reflected at 90° is measured by a photoelectric detector & is compared against light reflected by a refrence standard. No interference exists for the turbidity test. Locally the public Utilities Boards (PUB) of Singapore requires all water treatment facilities to produce water containing less than 1 NTU

<u>pH and Alkalinity</u> :- pH is a way of expressing the hydrogen-ion concentration of a solution. As acids & bases in solution dissociate to yield hydrogen ions [H^+] & hydroxyl ions [OH^-] respectively, pH is used to indicate the intensity of the acidic or alkaline condition of a solution.

Alkalinity is a measure of a acid-neutralizing capacity of dissolved substances in water & equals the amount of strong acid required to lower the solution from initial pH to about 4.5. Many material may contribute to the alkalinity of water. For most practical purpose. It is due primarily to presence of salts of weak acids (mainly bicarbonate & carbonate) & hydroxide (at high pH)

effectiveness

pH and alkalinity are key water quality parameters in enviornmental engineering practice. In the water supply & treatment fields, the parameters have great influence on the chemical coagulation, disinfection & softening processes & corrosion control for water distribution pipe networks. Effective chemical coagulation of water, for ~~insare~~ instance, occurs only within a specific pH range. Chemicals used for coagulation release, as a by-product of their reactions with water to form insoluble hydroxide precipitates, hydrogen ions (acid-causing). If unchecked, these hydrogen ions could lower the pH of water sufficiently to render the & remove the hydrogen ions released by the coagulants, thus buffering the water in the pH range where the coagulant can be effective.

In pure water, water molecules dissociate into equal amounts of hydrogen & hydroxyl ions (10^{-7} moles/L). From the law of mass action, it can be shown that, for pure water at about 25°C

$$[H^+][OH^-] = K_w = 10^{-14}$$

The pH value of a solution has been defined to be the negative log of the hydrogen ion concentration

$$pH = -\log [H^+]$$

The pH scale runs from 0 to 14, with pH 7 representing neutrality. Acid conditions

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increase as pH values decrease, & alkaline (base) conditions increase as the pH values increase. Measurement of the hydrogen ion concentration is made by pH meters via a glass electrode & a calomel refrence electrode.

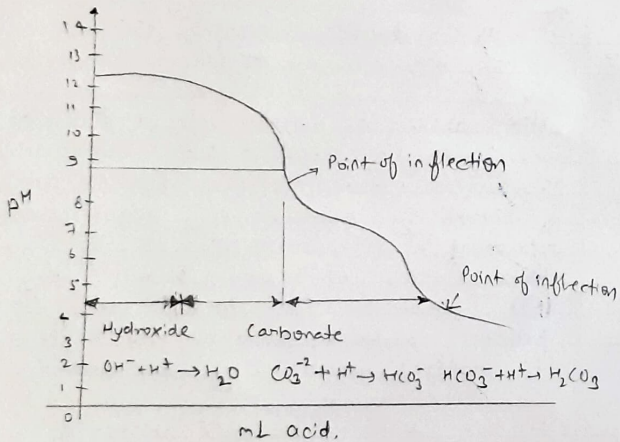
The alkalinity of water is its quanititative capacity to neutralize acids. The ~~tree~~ three major forms of alkalinity ranked in order of their association with high pH values are

(i) Hydroxide alkalinity $[OH^-]$
(ii) Carbonate alkalinity $[CO_3^{2-}]$
(iii) bicarbonate alkalinity $[HCO_3^-]$

Their ability to react with H^+ ends at pH 4.5 when both have turned into carbonic acid (H_2CO_3). In nature, biacarbonates are the major from of alkalinity because they resut from the reacting of CO_2 on calcium & magnisium rocks. Some $CaCO_3$ (up to about 20 mg/L) may also go into solution as Ca^{+2} & CO^{-2} ions. For all practical purposes, alkalinity due to other sources in natural waters may be ignored.

Alkalinity of waters is measured by means of titration with a standard solution of a strong acid ~~depends~~ (usually H_2SO_4) to designed pH's. & is reported in terms of equivalent $CaCO_3$. Alkalinity depends on the end-point pH or indicator used. ~~Eat~~ Either titration curve technique or colour indicator can be used for the determination. The

effectiveness ...



Titration curve for a hydroxide-carbonate-bicarbonate mixture.

Alkalinity measurement is based on the titration curve for a hydroxide - carbonate - bicarbonate mixture, as shown in Fig. 1.

For sample whose initial pH is above 8.3, the titration is made in two steps. In the first step, the titration is conducted until the phenolphthalein indicator end point is reached (i.e. pH of about 8.3) with a colour change from pink to colourless. During this first phase, the acid added to sample reacts with $[OH^-]$ alkalinity, if present, and $[CO^{-2}]$ alkalinity as follows

$$OH^- + H^+ \rightarrow H_2O$$

$$CO^{-2} + H^+ \rightarrow HCO^-$$

In the second phase, the titration is continued until the methyl orange indicator end-point is reached with a colour change from yellow to red (i.e. pH of about 4.5). During this phase, the addition of acid changes the HCO^- ions, initially present as well as those produced by reaction (1-4) into carbonic acid.

$$HCO_3^- + H^+ \rightarrow H_2CO_3$$

In the above titration, the result of first step is known as "phenolphthalein alkalinity" & the overall titration is known as "total alkalinity" (the amount of acid required to react with all the hydroxide, carbonates & bicarbonates in the sample) respectively.

when the pH of a sample is less than 8.3, a single titration is made to the methyl orange end point. Also for routine work. It is common that only the total alkalinity is determined. It is possible to determine the various components of alkalinity (i.e. hydroxide, carbonate & bicarbonate fraction) from a combination of titration pH measurements & chemical equilibrium equations.

An understanding of the buffering capicity of alkalinity can be derived from an evaluation of Figure 1. At the inflection points of pH 8.3 (phenolphthelein alkalinity) & pH 4.5 (total alkallnity) the carbonate system will react with a considerable pH change when only a small fraction of titrant is added. However, at the points ~~were~~ where only half of the initial carbonate has been converted to bicarbonate & only half of the resultant bicarbonate has been converted to carbonic acid, considerably more titrant is required to effect a pH change. It is during these conditions that the buffering capacity is exhibited. Quantifying the alkalinity to the inflaction points is a measure of this buffering capacity.

★ pH

(i) Calibrate the pH meter according to instruction supplied by the Lab staff.
(ii) Pour sample into a clean beaker.
(iii) Rinse the probe thoroughly with distilled water to prevent any carry-over. Switch to pH mode.
(iv) Immerse the probe in the sample.
(v) Establish equilibrium between probe & sample by stirring to insure homogeneity. Gently drop a stirring bar into the sample & place the beaker on a magnetic stirrer. Start the magnetic stirrer & adjust the speed to give thorough but gentle mixing.
(vi) Read & record the pH.
(vii) Rinse the electrode thoroughly with distilled water.
(viii) When not in use, the electrode should be replaced in the beaker containing water.

Test result of turbidity & pH of water sample of tap water.

Sample	pH	TDS
Raw water		

Viva Question

Q1 Define pH?
Ans pH is defined as the negative logarithm of H^+ ion concentration.

$$pH = -\log [H^+]$$

Q2 What is pH of a solution?
Ans pH is the measure of degree of acidity or basicity of a solution. pH range is 0 to 14 zero being most acidic & 14 is most basic.

Q3 What is the pH range of drinking water?
Ans The pH of most drinking water lies within the range of 6.5 to 8.5.

Q4 What is temporary hardness?
Ans Hardness of water due to presence of carbonate & bicarbonates of calcium & magnesium is called temporary hardness.

Q5 What is permanent hardness?
Ans Hardness of water due to presence of ~~carbonates & bicarbonates of calcium &~~ ~~mego~~ chlorides & sulphates of calcium & magnesium is called.

Q6 What is hard water & soft water?
Ans Water which readily lathers with soap is called soft water & which does not produce lather is known as hard water.

Q7 What is TDS means in water?
Ans TDS means for "Total dissolved solids" & refers to the total concentration of dissolved substances (Organic or inorganic) in drinking water.

Q8. What is the unit of TDS?
Ans The units for TDS usually are expressed as mg per liter (mg/L) which is the same as parts per million (PPm)

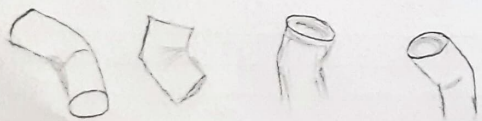
Q9 What is the TDS limit for drinking water?
Ans According to the Bureau of Indian standard (BIS) the permissible limit for TDS in drinking water is 500 mg/L & max limit is 2000 mg/L. However the world Health organization (WHO) recommends a TDS level of less than 300 mg/L for drinking water.

Q10 What is terbidity of water?

Ans Turbidity is the measure of relative clarity of a liquid. It is measure in NTU (nephelometric Turbidity unit). Turbidity of drinking water can range from 0.5 to 1.0 NTU. According to WHO turbidity of drinking water should not be more than 5NTU.

Collar

Gasket



Elbow

Experiment - 6

Aim :- To study various water supply fitting.

Pipe fitting :- Pipe fitting are an important component of the plumbing system. In plumbing, many types of fixtures are joined with the help of various types of material as per the requirement.

Types of fitting :-

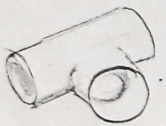
(i) Collar
(ii) Elbow
(iii) Gasket
(iv) Union
(v) Reducer
(vi) Tee
(vii) Nipple
(viii) Trap

Collar :- While joining two pipes in the same length, collar is used. Collar is fitted in the end of pipe.

Elbow :- It is installed at the time of joining two pipes. With the help of an elbow, the direction of liquid is changed. Normally a 45° or 90° elbow is used.

Gasket :- They are mechanical seals, generally ring shaped type and fitted for sealing flange joints. A flange joint is a plate or ring to form a rim at the end of a pipe when fastened to the pipe.

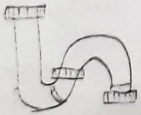
Union



Reducer

Tee

Nipple



S trap

P trap

Union :- When two ends of pipes are joined, the pipe fitting used is called union. A union is made of three parts namely a nut, a male end & a female end. The male end & female ends are assembled with the support of the nuts, & necessary pressure is made to connect the joint.

Reducer :- It is used to connect pipes of different diameters. A reducer may be of various types like reducer tee, reducer elbow & reducer socket.

Tee :- It is an important fitting with a side outlet at 90° to the run of the pipe. Tees connect pipes of various diameters & help in changing the direction of water or metarial in a pipe.

Nipple :- It is a piece of pipe having thread at both sides & could be used for short extension of plumbing lines.

Trap :- It is a fitting in a P.U.S. or J-shaped type. Traps are fitted near a plumbing fixture. The trap bend is fitted to prevent sewer gases from entering the building.

Viva Question

Q1 Which is used to make a branch right angle to the main line in pipe fitting?

Ans Tee.

Q2 What is used for connecting two pipes of different diameter?

Ans Reducer.

Q3 What is used to separate the connection with out disturbing the pipeline?

Ans Union.

Q4 What is the use of "Elbow" in pipe fitting?

Ans It is used to change the angle or direction of pipe & most commonly in 90° & 45° turns.

Q5 What is the use of plug in pipe fitting?

Ans Pipe plugs are used in the closing of the ends of various pipes. These are temporary stopping the fluid flow in a pipe line.