CONCRETE TECHNOLOGY (IV Sem)

UNIT-1

(Part-2 Water)

Water:

Water is the most important and least expensive ingredient of concrete. Mixing water is utilized in the hydration of cement to form the binding matrix (a semi-liquid mass) in which the inert aggregates are held in suspension until the matrix has hardened.

Water acts as a lubricant between the fine and coarse aggregates and make concrete work workable.

The minimum water cement ratio is 0.30. But the concrete containing in this proportion will be very hard and difficult to place. Additional water is required to lubricate the mix, which makes the concrete workable. The additional water should be kept minimum as too much water reduces the strength of concrete.

The water-cement ratio is influenced by:

1. Nature and Type of aggregates

2. Grade of concrete

3. Workability and durability etc.

Excess of water forms laitance and may also leak through the joints of the formwork and makes the concrete honeycombed.

Quality of Mixing water:

Water used for mixing and curing of concrete should be free from injurious amounts of deleterious materials. Portable water (Drinking water) is generally satisfactory for mixing concrete.

Effect of Impurities in water on Properties of concrete:

1. The strength and durability of concrete is reduced due to the presence of impurities in the mixing water.

2. It cause difference in the setting times.

3. Water containing excessive amounts of dissolved salts reduces the compressive strength by 10 to 30% of that obtained using potable water.

4. Water containing quantities of Calcium chlorides tends to cause persistent dampness, surface efflorescence and increases the corrosion of Steel reinforcement.

5. The effluents from sewage works, gasworks, paint, textile, sugar and fertilizer industry are harmful for concrete.

6. Water containing impurities cause straining, is objectionable for curing concrete members whose appearance or look is important. Straining is caused due to higher concentration of iron or organic matter in the water. Water containing more than 0.08 ppm of iron may be avoided for curing.

Suspended particles

The presence of suspended particles of clay and silt the mixing water up to 0.02 percent by weight of water does not affect the properties of concrete. The IS 456:2000 allows 2000 mg/litre of suspended matter.

Inorganic salts

The presence of salts of Manganese, tin, zinc, copper and lead in water causes reduction in the strength of concrete.

The Zinc chlorides retards the setting of concrete to such an extent that no strength tests are possible at 2 and 3 days.

The effect of Lead nitrate is completely destructive.

Some salts like Sodium iodate, Sodium phosphate, Sodium arsenate and Sodium borate reduce the initial strength of concrete to a very low degree. Another salt which is detrimental to the concrete is Sodium sulphide and even Sulphide content of 100 ppm requires testing.

The Carbonates of sodium and potassium may cause extremely rapid setting and in large concentrations, reduce the concrete strength. If some of these salts exceeds 1000 ppm tests for setting time and 28 days strength should be carried out.

Brackish water contains Chlorides and Sulphates. When the Chloride does not exceed 10,000 ppm and sulphate does not exceed 3,000 ppm the water is harmless.

The presence of Calcium chloride accelerate setting and hardening, the quantity of calcium chloride is restricted to 1.5 % by weight of cement.

Salts in seawater

Sea water generally contains 3.5 % of dissolved salts. The sulphate content of seawater is very problematic. The salts present in seawater reduce the ultimate strength of concrete. The reduction in strength of concrete may be of the order of 10 to 20%. The major concern is the risk of corrosion of reinforcing steel due to chlorides. The presence of chlorides in water is also responsible for efflorescence. It is advantageous to use cement with as much C_3A as it can be tolerated without incurring sulphate attack in concrete containing corrodible metal.

There are two sources for the presence of chloride ion in the concrete:

1. Calcium chloride added as an accelerating admixture

2. The intentional use of seawater as mixing water

The use of calcium chloride reduces the sulphate resistance, it acts as an accelerator and can be permitted in cold weather with sulphate resisting cement to the same limited extent as with ordinary cements.

The use of sea water is not advisable for plastering purpose.

The use of sea water must be avoided in prestressed concrete work because of stress corrosion and undue loss of cross section of small diameter wires.

Acids and Alkalies

Water containing acids or alkalies is usually is unsuitable for concrete construction. The water having pH value higher than 6 can be used. Accept water for making concrete, if the pH of water lies between 6 and 8 and the water is free of organic matter. The effect of acidity in water is best measured on the basis of total acidity, the extent of which should satisfy the following requirement.

The amount of 0.02 normal NaOH required to neutralize 100ml sample of water using phenolphthalein as an indicator should not be more than 5 ml.

This acidity is equivalent to 49 ppm of H_2SO_4 or 36 ppm of HCl.

Algae

It tends to cause reduction in the strength of concrete. The water containing algae has the water containing algae has the effect of entraining large quantities of air in concrete thus lowering the strength of concrete.

It combines with cement and reduces the bond between aggregates and cement paste.

Sugar

If the amount of sugar present in the mixing water is less than 0.05% by weight of water there is no adverse effect on the strength of concrete.

Small amounts of sugar up to 0.15% by weight of cement retard the setting of cement and the early strength may be reduced whereas the 28-day strength may be improved.

When the quantity of sugar is increased to 0.20% by weight of cement, setting is accelerated. When the quantity is further increased, rapid setting may result and 28-day strength is reduced.

Oil contamination

The concentration of Mineral oil is up to 2% by weight of cement, a significant increase in the strength has been noticed. For the percentage of Mineral oil, more than 8% the strength is slightly reduced. The vegetable oil has detrimental effect on the strength of concrete, particularly at later stages.

Tolerable Concentrations of Some Impurities in Mixing Water

Impurity	*Tolerable Concentration*
Sodium and potassium carbonates and bi-carbonates	1,000 ppm (total). If this is exceeded, it is advisable to make tests both for setting time and 28 day strength
Chlorides	10,000 ppm.
Sulphuric anhydride	3,000 ppm.
Calcium chloride	2 per cent by weight of cement in non-pre-stressed concrete
Sodium iodate, sodium sulphate, sodium arsenate, sodium borate	very low
Sodium sulphide	Even 100 ppm warrants testing
Sodium hydroxide	0.5 per cent by weight of cement, provided quick set is not induced.
Silt and suspended particles	2,000 ppm. Mixing water with a high content of suspended solids should be allowed to stand in a settling basin before use.
Total dissolved salts	15,000 ppm.
Organic material	3,000 ppm. Water containing humic acid or such organic acids may adversely affect the hardening of concrete; 780 ppm. of humic acid are reported to have seriously impaired the strength of concrete. In the case of such waters therefore, further testing is necessary.
pH	4.5 to 8.5