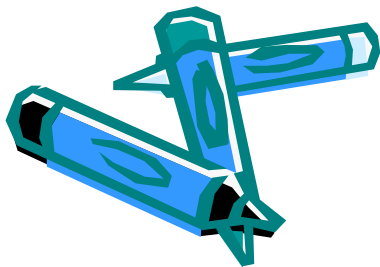
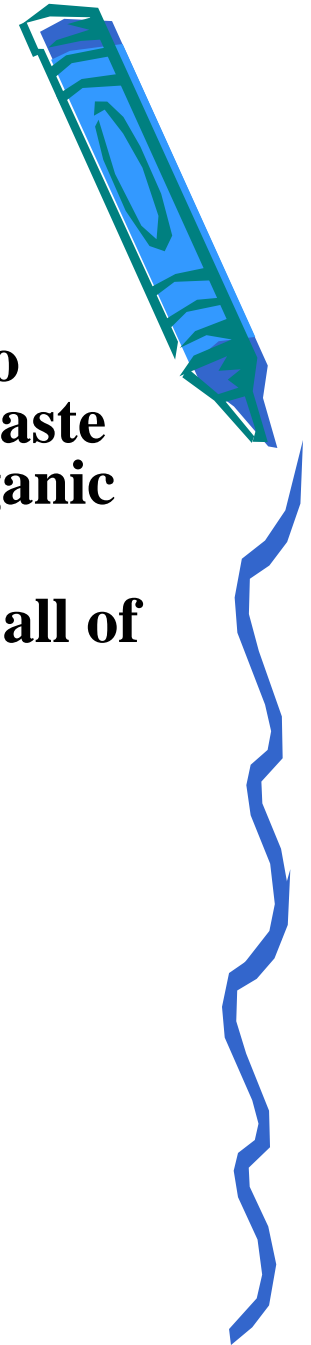


Water

Requirement of Mixing Water

- **Almost any water that is drinkable may be Used to make concrete. Drinking water with a noticeable taste or odor should not be used until it is tested for organic impurities.**
- **Impurities in mixing water may cause any one or all of the following:**
 - 1. Abnormal setting time.**
 - 2. Decreased strength.**
 - 3. Volume changes.**
 - 4. Efflorescence.**
 - 5. Corrosion of reinforcement.**



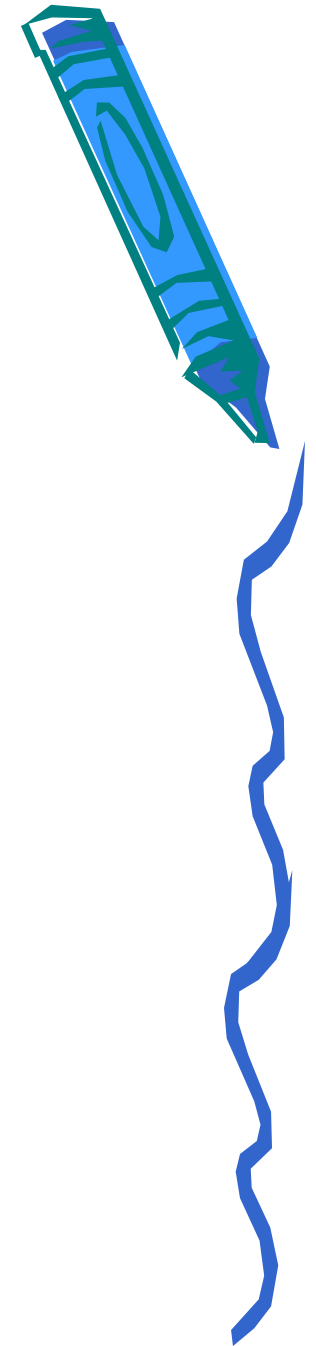
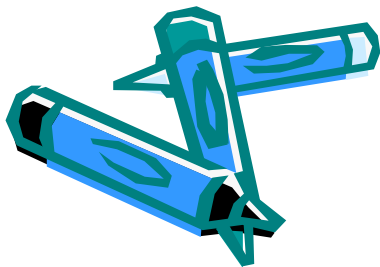


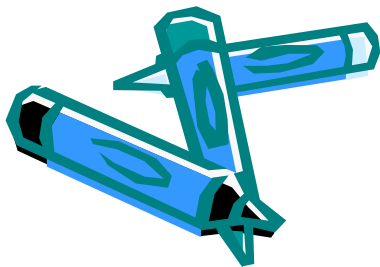
Table 5-1. Performance Requirements for Questionable Water Sources (ASTM C1602)

| | Limits | Test method |
|---|---------------------------------|---------------|
| Compressive strength, minimum percentage of control at 7 days | 90 | ASTM C31, C39 |
| Time of set, deviation from control, hr:min. | from 1:00 earlier to 1:30 later | ASTM C403 |

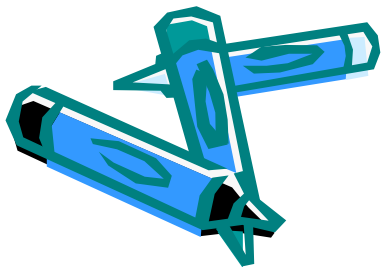
*Comparisons must be based on fixed proportions of a concrete mix design representative of questionable water supply and a control mix using 100% potable water.



- **Some of the impurities in mixing water that cause these undesirable effects in the final concrete are:**
 - 1. Dissolved chemicals.**
 - 2. Seawater.**
 - 3. Sugar.**
 - 4. Algae.**
- **Dissolved chemicals may either accelerate or retard the set and can substantially reduce the concrete strength. Further, such dissolved chemicals can actively attack the cement-sand bond, leading to early disintegration of the concrete.**



- **Seawater containing less than 3 percent salt is generally acceptable for plain concrete but not for reinforced or prestressed concrete. The presence of salt can lead to corrosion of the reinforcing bars and prestressing tendons.**
- **If sugar is present in even small amounts, it can delay setting and reduce concrete strength.**
- **Algae can cause a reduction in the strength of concrete by increasing the amount of air captured in the paste and reducing the bond strength between the paste and the aggregate.**



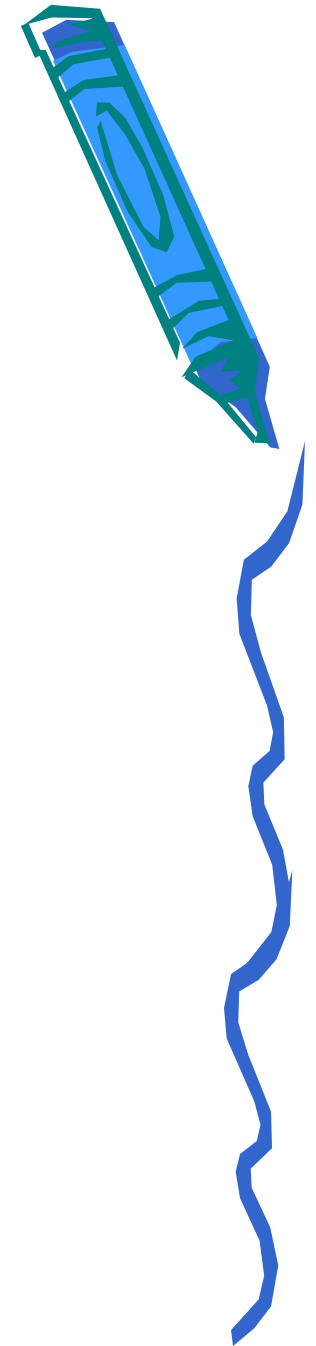
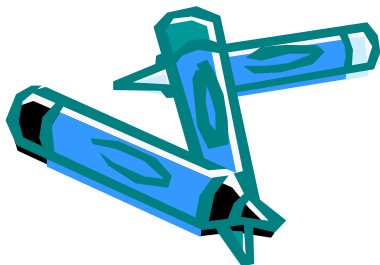


Table 5-2. Optional Chemical Limits for Combined Mixing Water (ASTM C1602)

| Chemical or type of construction | Maximum concentration, ppm* | Test method |
|---|-----------------------------|-------------|
| Chloride, as Cl | | |
| Prestressed concrete or concrete in bridge decks | 500** | |
| Other reinforced concrete in moist environments or containing aluminum embedments or dissimilar metals or with stay-in-place galvanized metal forms | 1000** | ASTM C114 |
| Sulfate, as SO ₄ | 3000 | ASTM C114 |
| Alkalies, as (Na ₂ O + 0.658 K ₂ O) | 600 | ASTM C114 |
| Total solids by mass | 50,000 | ASTM C1603 |

* ppm is the abbreviation for parts per million.

** The requirements for concrete in ACI 318 shall govern when the manufacturer can demonstrate that these limits for mixing water can be exceeded. For conditions allowing the use of calcium chloride (CaCl₂) accelerator as an admixture, the chloride limitation is permitted to be waived by the purchaser.



- **Water containing less than 2000 parts per million, ppm, of total solids can generally be used satisfactorily for making concrete.**
- **The ACI 318 building code limits water soluble chloride ion content in reinforced concrete to the following percentages by mass of cement:**
 - **Prestressed concrete: 0.06%**
 - **Reinforced concrete exposed to chloride in service: 0.15%**
 - **Reinforced concrete protected from moisture in service 1%**
 - **Other reinforced concrete sections: 0.3%**

