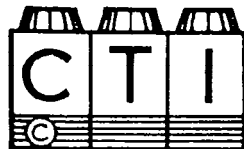


COOLING TOWER MANUAL



Chapter 9

MATERIALS OF CONSTRUCTION FOR COOLING TOWERS

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9.1 SCOPE

The materials of construction for a cooling tower are of primary importance and should be given the most detailed attention. The average process cooling tower is operated to some degree on a year round basis and is, therefore, alternately exposed to hot, warm, or cold air and water. The air is sometimes dirty, polluted with fumes, and most probably contains microbiological organisms. Also, there is always an abundance of oxygen to support life and to accelerate corrosion. Moisture conditions may range from saturation to dryness. Temperatures may range from extremely hot to extremely cold. This chapter describes various materials of construction and the limitations of such materials. The choice of the materials of construction should be made based on their suitability to a particular cooling tower process.

9.2 DEFINITIONS

None

9.3 STRUCTURAL MATERIALS9.3.1 Lumber

Redwood, Douglas Fir, and Southern Yellow Pine are the species of lumber normally used in cooling tower construction. Lumber may be used for structural framing, fill, drift eliminators, casing, fan decks, fan rings, water basins, louvres, partitions, stave pipe, stairways, handrails, and structural connectors.

Of these species of lumber, redwood is most frequently used. The forerunners of mechanical draft cooling towers, spray ponds, and atmospheric deck towers utilized redwood because of ease of handling, natural durability, and its successful use in tanks and piping. The service life of redwood may be lengthened considerably by the application of pressure preservative chemicals, such as chromated copper arsenate, to the wood before cooling tower erection.

Reference is made to Chapter 1 for information relative to microbiological decay and high temperature deterioration (Ref. 1).

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Pressure treated Douglas Fir has been in use in cooling towers for approximately 20 years and has a good service record. Pressure treated Douglas Fir is a good choice for use in cooling tower construction. Exterior-grade treated Douglas Fir may also be used for fan decking, distribution basins, and fan rings.

The standards for California Redwood, Douglas Fir, and Dense Southern Pine listed in Ref. 2; 3, and 4 set forth in detail the grades, specifications, and grading rules for these materials when used in the construction of industrial water-cooling towers.

9.3.2 Preservative Treatment of Lumber

A field research project involving treated lumber was instituted by CTI in 1951 as a parallel program to the CTI study of wood maintenance in industrial water-cooling towers. This study (Ref. 5) included eight pressure preservative treatments of four species of lumber. The results of seven years exposure of these treated wood test panels in operating towers in the Gulf Coast area were analyzed in November, 1958. Consultations with the treating companies, the tower users, the members of American Wood Preservers Association Cooling Tower Committee C-22, and interested individuals in the industry were productive in developing a treating procedure which accommodates the unusual severity of exposure.

The following is a tabulation of the pressure preservative treatments used for the treatment of lumber used in industrial water-cooling towers:

Creosote

Acid Copper Chromate (ACC) - Celcure

Chromated Copper Arsenate (CCA) - Erdalith

Ammonical Copper Arsenite (ACA) - Chemonite

The standards listed in Ref. 5 and 6 govern the treating procedure, the minimum retentions and penetrations to be obtained, and the physical condition of the lumber when pressure treating industrial water-cooling tower lumber.

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9.3.3 Asbestos Cement Board (ACB)

The major use of ACB in cooling tower construction is for inlet air louvres and tower casings. However, some of the large, natural draft, hyperbolic cooling towers have distribution systems, drift eliminators, and fill constructed of ACB. Extreme care must be exercised in this application to avoid freezing during winter operation. ACB retains moisture and its freezing leads to failure. ACB has excellent resistance to normal industrial atmospheres. It is a noncombustible material and is not subject to microbiological decay.

However, as with any material, ACB has disadvantages. Should a cooling tower be involved in a fire, ACB can hamper manual fire fighters as it "explodes" in fragments. It is degraded if exposed to cooling tower water with relatively high chlorides (>1000 ppm). It is also pH sensitive and should not be used where water is maintained as pH 5.5 or lower.

The standard as listed in Ref. 7 established grades and dimensions of incombustible asbestos cement materials for industrial field-assembled and water-cooling towers.

9.3.4 Plastics

Plastics used as materials of construction in cooling towers may be grouped into two classes: (1) Glass reinforced polyesters and epoxies and (2) thermoplastics.

Glass reinforced polyesters and epoxies are used in the construction of fan blades, fan rings, distribution systems, hub covers, casing, fill supports, fill, distribution basins, and framing connectors. These materials are of many types, but are usually reinforced with glass fibers or glass cloth. Polyesters may be general purpose, chemical resistant, fire retardant, styrene additive, or stabilized. Epoxies may be cold cured or thermoset. These materials give good service in cooling towers for over 15 years.

In some instances, the type of resins used and the quality control during fabrication of various components resulted in exposing the glass fibers to the cooling

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tower circulating water. This was due to inadequate "wetting" of the glass fibers with the resins. Exposed fibers or cloth to the circulating water results in a phenomena known as "wicking" whereby the resin is dissolved away from the fibers resulting in loss of strength. New materials and processes have been developed resulting in better quality control.

The nonreinforced thermoplastic resins include polypropylene, polystyrene, and polyvinylchloride. Components such as water distribution orifices, louvre supports, spray nozzles, fill, fill supports, drift eliminators, conduit, and distribution systems may be constructed of the thermoplastics and used successfully.

Both types of plastics, (1) glass reinforced polyesters and epoxies and (2) thermoplastics, when subjected to high circulating water temperatures ($> 150^{\circ}\text{F}$) may be adversely affected. Weight loss and tensile strength loss are common problems resulting in failure at high operating temperatures.

9.3.5 Hardware and Fasteners9.3.5.1 Types of Corrosion

The choice of materials for cooling tower hardware and fasteners involves the factors of cost, strength, and corrosion resistance. A selection of material for this application based on cost alone may not prove to be the best choice. One must become familiar with the various mechanisms of corrosion encountered in the cooling tower atmosphere. Conditions of operation in tower systems are so varied and corrosion mechanisms so complex that there is no simple solution to the problem. The best that can be done is to make a comparison between materials in specific environments similar to those existing in cooling towers.

The choice of materials for hardware and fasteners in cooling towers depends a great deal on the practices or policies of the user or operator. Some operators practice a rigid control of water treatment and preventative maintenance. Sometimes there are numerous

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