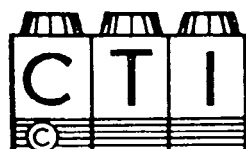


COOLING TOWER MANUAL



CHAPTER 13

INSPECTION OF COOLING TOWERS

COOLING TOWER INSTITUTE
P.O. Box #73383, Houston, TX 77273
616 FM 1960 West, Suite #204
Houston, TX 77090-9990

COOLING TOWER INSTITUTE, INC.
P.O. Box 73383
Houston, Texas 77273
19627 IH-45 North, Suite 230
Spring, Texas 77388
(713) 350-1995

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Chapter 13
INSPECTION OF COOLING TOWERS

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13.1 SCOPE

The equipment and materials in a cooling tower are subjected to a harsh environment and usually a less than ideal inspection program. This chapter deals with the cooling tower inspection format, associated equipment and material problems, and suggested inspection and maintenance procedures.

The "Cooling Tower Inspection Format" has been developed as an operational maintenance tool and record of general tower conditions. The inspection format is meant to be used in conjunction with Tower Manufacturer's operation and maintenance manuals. It utilizes CTI Publications such as Bulletin WMS-104 "Wood Maintenance", for the analysis of types of deterioration found in cooling towers, as well as a standardized rating system for the degree of deterioration.

The frequency at which the inspections should be performed are of course dependent on the users individual preference based on operational or general maintenance criteria.

Normally each manufacturer will recommend inspection intervals based on past experience records. The inspection procedures used will vary from user to user. CTI Bulletin WMS-104 records four basic procedures and observation techniques for wood consisting of visual, strength, touch and probe. These methods of course can be augmented by additional technical sampling for water analysis, timber and component part cross section sampling, Emodulus testing, etc.

13.2 DEFINITIONS

For definitions of terms used in this chapter see Chapter 1 of the Cooling Tower Manual, "Cooling Tower Operations".

13.3 INSPECTION OF WOOD MEMBERS IN COOLING TOWERS

Cells should be checked at regular intervals so that each cell in the complex is inspected at least once a year.

What to look for --

- A. Chemical Surface Attack can be caused by a number of different chemicals. Excessive chlorination is usually the chief offender; however, excessive concentrations of carbonate alkalinity in the tower circulating water for prolonged periods will also cause this attack. Chemical attack is observed as wood delignification due to the selective removal of lignin, which is the cellulose fiber binding agent. It follows, then, that this attack is most prevalent in the flooded tower fill and areas frequently wetted with water, such as the framing timbers. Chemical attack is a thin-layer surface attack and can be detected and checked before serious damage occurs, provided periodic inspections are given the tower and corrective measures are taken when this type of

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attack is discovered. Chemical surface attack is virtually non-existent when the pH is controlled within the range of 6.0 to 8.0.

- B. Biological Surface Attack (or soft rot) is caused by fungi which selectively attack cellulose of very damp wood, leaving primarily lignin. This attack is characterized by a dark appearance and a brash condition of the wood surface. The wood surface becomes "punky" or checked. The active growth of the wood-destroying fungi is confined to the surface layers and remains superficial unless the wood is allowed to dry out frequently.
- C. Biological Internal Attack occurs below the surface of the wood, and often goes undetected until the infection has spread widely, resulting in serious structural damage. The decay can be white rot, attacking both cellulose and lignin and leaving a spongy or stringy mass, or a brown rot, attacking primarily cellulose and leaving a brown cubelike pattern. This type of attack is more apt to occur in the warm, moist, but non-flooded portions of the tower.
- D. Iron Rot is a chemical attack caused by the formation of iron salts around corroding ferrous parts in contact with wood. The wood in the adjacent zone has a charred appearance and may also be more susceptible to fungal attack. Since connections are affected in many cases, extensive repairs may be required.
- E. Structural - Besides inspecting the wood elements for chemical and biological attack, inspection for bowing columns, sagging braces, and loss of any pieces in the structure should be noted. It is very important to look for loose bolts in braces and column connectors. Any loose bolts should be tightened immediately.

(Pictures as shown in WMS 104 in the Cooling Tower Institute Standard should be reviewed.)

Inspections should include the following observations:

- A. Visual - The appearance of the lumber and the depth to which loose or punky material could be scraped off with a dull instrument.
- B. Strength- The breaking strength of drift eliminator boards and splash bars can be tested by hand to determine brashness. Also the softening of the surface and the depth of penetration of a probe should be noted as an indication of strength.
- C. Touch - Feel on the surface of the lumber to see if the surface is fibrous or crumbly.

- D. Probe - The ease with which a probe penetrates heavier members and the depth of this penetration. Also the type fracture made on breaking out is used as an indication of the type of deterioration or its absence in the interior.

In inspecting for internal decay, a probe such as a blunted icepick or a screwdriver is useful. A firm pressure will cause the point of such an instrument to penetrate about 1/4 inch into sound wood. If internal decay is present, the probe will break through the sound wood and penetrate into the softer decayed area.

- E. Hammer - Striking a wood member with a hammer usually results in a good resonance if the member is sound, or a dull thud if there is significant internal decay.

RATING METHOD

Seven sections should be graded for the existence or severity of chemical surface attack, biological surface attack, biological internal attack, algae, iron rot, scale, and structural damage; drift eliminators, louvers, inside casing, outside casing, filling, frame and "other" (usually the fan deck in induced draft towers and the distribution basin in crossflow towers).

The grading system for these conditions consists of two numbers. The first number, from 0 to 10, estimates in 10 percent increments the percentage strength or amount of material destroyed by the particular type of attack. That is, a "1" represents the beginning of discernible attack, and a "10" represents complete destruction of the wood. Although 10 represented complete destruction a grading of 6 to 7 indicates that the useful life of the piece is substantially ended and that the material is approaching a condition in which filling and drift eliminator sections can no longer support themselves or frame members can no longer support imposed loads. The second number, from 1 to 100, represents the percentage of the area covered by the particular type of attack.

If the second number is "10" it signifies 10 percent of a particular portion of the tower was affected, whereas "100" indicates that the entire portion is covered.

For example, a grade of "biological surface 3-100" on the drift eliminators would indicate that 30 percent of the cross-sectional area of the eliminator boards had been destroyed by biological surface attack over 100 percent of the drift eliminator area.

Chart, Figure 13.1 can be used in preparing a Cooling Tower Wood Inspection Report.

Chart Figure 13.2 can be used in determining when to conduct an inspection.

COOLING TOWER INSPECTION REPORT

COMPANY _____
 DATE _____
 TOWER _____

CONDITION OF WOOD

LOCATION	CHEMICAL SURFACE	BIOL. SURFACE	BIOL. INTERNAL	ALGAE	SCALE	REMARKS
MIST ELIMINATORS						
LOUVERS						
INSIDE CASING, UPPER						
INSIDE CASING, LOWER						
OUTSIDE CASING						
FILL, UPPER						
FILL, LOWER						
FRAME, UPPER						
FRAME, LOWER						
DISTRIBUTION SYSTEM						

FIGURE 13.1

CTI INSPECTION SCHEDULE

COMPONENT	Tip Clearance	Tip Travel	Noise	Vibration	Erosion	Corrosion	Vent	Hardware	Rep. Int	Seals	Oil Level	Moisture in Oil	Change Oil	Guard	Plugging	Gear Backlash	Gear Tooth Pattern	Covers in Place	Amp Load	End Bell	Levels	Nozzles	Deterioration	Sag	Hardware Analysis	Relamp	Coupling	Grease	Pitch
Mechanical																													
Fan Blades Cast (C), Plastic (P), Hollow (H)	S	A	D	D	A	A	(H)	S	R																				
Fan Hub						A	A	S																					
Hub Cover						A	A	S	R																				
Gearducer						A	A	S	R																				
Driveshaft						A	M		P	A	D	M	S			A	A												
Unitized Support			D	D	A	A	A	A	R					S															
Electrical						A	A	A	R																				
Motor						A																							
Receptacles				D		A			R										S	A									
Lights						A																							
Push Button Sta.						A			R																				
Conduit						A			R																				
Structure*						(M)																							
Structure Members						(M)																							
Fan Deck						(M)																							
Eliminators					(P)	(M)									M														
Fill					(P)	(M)									M														
Girts					A	(M)																							
Partitions						(M)																							
Siding					(P)	(M)																							
Louvers					(P)	(M)																							
Stairways					A	(M)																							
Access Ladders						(M)																							
Fan Ring						(M)																							
Water					(P)	(M)																							
Cold Basin					A	A																							
Hot Dist.																													

*W - Wood
 *M - Metal
 *P-Plastic, CAB, etc.
 R-As required

D-Daily
 M-Monthly
 S-Semi-annual
 A-Annual
 R-As required

13.4 INSPECTION OF MECHANICAL EQUIPMENT

Mechanical Equipment

I. Fan Assembly

A. Operating Condition

1. Vibration or pulsation
2. Blade tracking
3. Tip Clearance

B. Component Check List

1. Blades
 - a) Blade stem or shank condition
 - b) Leading edge condition
 - c) Tip condition
 - d) Foil surface, top & bottom
 - e) Pitch setting
2. Hub
 - a) Hub-shaft connection hardware condition
 - b) Blade clamp and hardware condition, including torque value.
 - c) Hub cover/center disc condition

II. Speed Reducer/Gear Assembly

A. Operational Condition

1. Unusual noise or vibration
2. Oil leakage & condition

B. External Component Check List

1. Oil fill & vent line condition
2. Input shaft bearings (backlash, etc.)
3. Output shaft bearings (backlash, etc.)