

this speeds up the heat transfer rate. Increased air quantities are obtained only at the expense of increased fan power, which increases approximately as the cube of the air quantity. Air velocities through mechanical draft towers vary from 250 to 600 fpm over the gross area of the structure.

Mechanical draft water cooling equipment may be set up inside buildings, where it usually draws its air supply from the general space in which it is installed, and discharges its exhaust air through a duct to the outside. Indoor cooling towers may be either of the wood-filled or the spray-filled type. In many cases where little height but considerable area is available, water is cooled in a spray-filled structure similar to an air washer, with the air passing horizontally through the apparatus and being discharged

TABLE 4. COMPARISON OF VARIOUS TYPES OF ATMOSPHERIC WATER COOLING EQUIPMENT
Figures indicate order of desirability

	COOLING POND	SPRAY POND	SPRAY TOWER	DECK TOWER	MECHANICAL DRAFT	INDOOR TOWER
Cost.....	x	2	1	3	4	5
Area.....	5	4	3	2	1	x
Height.....	1	2	3	4-5	4-5	x
Weight per square foot.....	x	x	1	3	4	2
Independence of wind velocity.....	6	3	4	5	1-2	1-2
Drift nuisance.....	1	6	5	4	2-3	2-3
Make-up water required.....	1	6	5	4	2-3	2-3
Pumping head.....	1	2	3	4-5	4-5	6
Maintenance.....	2	1	3	4	5	6
Suitability for congested districts.....	x	5	4	3	1	2
Water quantity required for definite result.....	6	5	4	1-2	1-2	3

x=Not comparable.

through a duct to the outside. Such apparatus does not have the counter-flow advantage of the vertical mechanical draft water cooling equipment, and therefore requires a much larger excess of air for proper operation. Air velocities and operating powers are considerably above those required by vertical mechanical draft water cooling equipment.

Make-Up Water

Since the atmospheric water cooling equipment performs its functions chiefly by evaporating a portion of the water in order to cool the remainder, there is a continual drain on the quantity of water in the system, and this loss must be replaced. Approximately 1 gal of water is lost for every 1000 gal of water cooled per degree of cooling range; so if 1000 gpm of water are cooled through a 10 F range, 10 gpm of water will be required to replace evaporated water. Replacement supply is usually regulated by a float control valve. Because the evaporation of the water leaves behind the salts which the water contained, high concentration of salts may make chemical treatment of the make-up water necessary to avoid excessive deposits in the condensers. An additional amount of make-up water must be added to replace windage, or *drift loss*. This additional amount of water varies from 0.1 to 3 per cent of the quantity of water being circulated, this percentage depending upon the type of equipment and the wind velocity.

Winter Freezing

If atmospheric water cooling equipment is operated in freezing weather, the water may be cooled below freezing temperature so ice forms and collects until its weight causes damage. To obviate freezing during continued operation, the efficiency of the apparatus may be lowered. This is done on the spray pond and the spray cooling tower by reducing the quantity of water fed to the apparatus, thereby lowering the pressure at the nozzles and increasing the size of the drops produced. On the deck tower the upper system may be shut off and a secondary distribution system put in service midway down the height of the tower. The water will be kept above freezing because it will have shorter contact with the air. The mechanical draft tower can be protected by reducing the air flow through the tower, by stopping or reducing the speed of the fans, or by partially closing dampers.

If the system is operated intermittently in freezing weather, water in the basin may freeze and the expansion of the ice may do harm. Freezing during intermittent operation can be prevented only by draining the water basin when it is out of service. On small roof installations, a tank large enough to hold all the water in the system is often installed inside the building and the basin is drained into this by gravity, the pump suction being taken from this inside tank.

A comparison of various types of water cooling equipment is given in Table 4.

PROBLEMS IN PRACTICE

1 • What performance tests should be given air washers?

a. Capacity, b. Resistance, c. Visible entrainment of free moisture, and d. Humidifying or dehumidifying efficiency.

2 • What are different types of air washers?

a. Spray, b. Wet scrubber, and c. Combination spray and scrubber.

3 • Upon what air velocity are air washers usually rated?

500 fpm through the area above the tank.

4 • What is the difference between direct and indirect humidification?

Direct humidification signifies that the humidifiers are within the space to be humidified with distribution produced by the number of humidifiers. With direct humidification there is relatively little air movement.

Indirect humidification signifies that the air is drawn from the enclosure and passed through the humidifier (air washer) and distributed by means of a duct system.

5 • Where is direct humidification desirable?

Direct humidification is desirable when high humidity is required accompanied with cooling, ventilation, or air motion.

6 • Where is indirect humidification desirable?

Indirect humidification is desirable when high humidity is required with simultaneous removal of heat by ventilation.