mechanical draft towers vary from 250 fpm 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 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.

Data are given in Table 4 for determining the tower area based upon the water cooling range, and the difference between the air wet-bulb temperature and the cooling water temperature leaving the tower, frequently referred to as the *approach to the wet-bulb*. The values given in this table are based on an air velocity of 300 fpm through the tower.

For a specific installation, manufacturers should be consulted, since the data on water cooling equipment included in this chapter are for general application only.

Example 2. Based on the design data given in Example 1, determine the size of mechanical draft cooling tower to cool the same amount of water if an air velocity of 300 fpm is used through the tower and a spray eliminator is located at the top of the unit.

Solution. With an air wet-bulb temperature of 70 F and a leaving water temperature of 80 F, the approach to the wet-bulb is 10 F. The cooling range is equal to the water temperature difference of 100 and 80 F or 20 F. From Table 4 a value of 0.47 sq ft of tower area per gallon of water is selected for an approach of 10 F and a 20 F cooling range. With a 70 F wet-bulb air temperature the correction factor is 1.00.

$$1000 \times 0.47 \times 1.0 = 470 \text{ sq ft of tower area}$$

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.

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

Table 5. 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.

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 5.

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