EVAPORATIVE COOLING

EVAPORATIVE COOLING: WHEN IT IS USED AND HOW IT WORKS

A process called adiabatic cooling better known as evaporative cooling, is often used in climates where high dry bulb temperatures are associated over time with relatively low wet bulb temperatures. The cooling process involves cooling an air-water-vapor mixture (i.e. dry bulb temperatures is lowered) without any gain or loss of heat through the BMA unit. During this process the wet bulb temperature stays the same therefore the relative humidity increases. Evaporative cooling generally uses fresh air only.

INEXPENSIVE WAY OF COOLING

The initial capital cost of an evaporative cooling system may be less than one-fourth that of a refrigerated system for the same structure. The power to operate the evaporative cooling system would be considerably less than that of a refrigeration system.

SELECTION GUIDE FOR THE INDUSTRIAL EVAPORATIVE COOLERS (CELdek AND GLASdek TYPE)

- Determine the outdoor design dry-bulb (Db) and wet-bulb (Wb) temperatures.
- Determine the specified indoor Db temperature.
- Determine the amount of fresh air required for the room.
- Based on the specified indoor and outdoor design conditions determine the required evaporative media efficiency.

$$\text{Efficiency of evaporative cooler media required} = \frac{\textit{Outdoor Db°F – Indoor Db°F}}{\textit{Outdoor Db°F – Outdoor Wb°F}} \times 100$$

- Once this is calculated refer to the Media Efficiency Chart on page 25 to determine the unit that provides the evaporative efficiency required.
- The corresponding Break Horse Power (BHP) can then be taken from the BMA Performance Specification Chart, given the external static pressure (ESP" W.C.). Note: Add for accessory static pressure drops when applicable and 0.4" W.C. for the Evaporative Cooling/Filter section (does not include flat filters, see page 26). Given the blower HP and line voltage, the Full Load Amps (FLA), starting amps and total amperage can be determined.
- The industrial cooling units are available mounted horizontally with horizontal discharge, up discharge, or down discharge.
- For the heating operation selection guide refer to page 1 in the Main BMA Brochure.

NOTE: The following can be found in the Main BMA Brochure (BMA0105BR2):

1. The heating capacities (MBH) pages 4 and 5.
2. The accessory static pressure drops page 6.
3. The Brake Horse Power required (BHP) pages 4 and 5.

INDUSTRIAL EVAPORATIVE COOLER EXAMPLE

A conference room is to be cooled using an evaporative cooling process. The outdoor air conditions are as follows:

1. 90° F Db temperature
2. 60° F Wb temperature

The design air flow for the room is 19,500 CFM, with an external static pressure of 1/2 inch W.C. The supply air Db temperature desired is approximately 65° F.

Determine:

1. The required evaporative Media Efficiency given the outdoor design conditions and desired supply air temperature.
2. The Industrial Evaporative Cooling Unit that can provide the design air flow given.
3. The media thickness that can provide the evaporative Media Efficiency to cool the entering air temperature to 65° F Db.
4. The Break Horse Power required.

Answer :

1. Evaporative Cooler Media Efficiency Required $= \frac{\textit{Outdoor Db°F – Indoor Db°F}}{\textit{Outdoor Db°F – Outdoor Wb°F}} \times 100$

   Efficiency % $= \frac{\textit{90°F – 65°F}}{\textit{90°F – 60°F}} \times 100$

   $= 83\%$

2. Referring to page 2 (Media Efficiency Chart) the unit that can provide the design air flow of 19,500 CFM is a BMA125.
3. The BMA 125 Industrial Evaporative Cooler can, with a 12 inch media thickness provide a 90% effective media at 19,500 CFM.
4. In order to determine the BHP first the accessory, evaporative/filter section, and external static pressure drops must be added together to get the total static pressure of the system.
   - Accessory Pressure drop(s) = N/A
   - Evaporative /filter section = 0.4 inches W.C.
   - External static pressure = 0.25 inches W.C.
   - Flat filters (clean) = 0.25

   Total Static = 0.9 ≅ 1 inch W.C.

Referring to page 4 (BMA Brochure BMA0105BR2) the BHP corresponding to a BMA 125 at 19,500 CFM with 1 inch total static pressure is approximately 11 BHP.

Industrial Evaporative Cooling Section Specifications

Standard

The evaporative cooling sump tank is constructed of 304 stainless steel. The sump tank is continuously welded. The media is either 8″ or 12″ thick Munters "CELdek" cellulose fluted evaporative pads, impregnated with insoluble anti-rot salt and rigidifying saturants. A 2″ thick matched Munters distribution pad is to direct the water to the media. A heavy-duty "Little Giant" pump is to be provided complete with a level switch and balancing valve. The sump tank shall be equipped with a brass float valve. A continuous bleed valve shall minimize build-up of undesirable contaminants.

All units are available with a 2-position by-pass damper for winter operation (cold air will by-pass the evaporative media when inoperative and then enter the burner section for heating). The filters must be taken out prior to this operation.

Optional

- Complete evaporative cooling section to be constructed of 304 stainless steel
- 12" thick Munters "GLASdek" media UL900 rated (meets all universal fire codes).
- 8" thick Munters "GLASdek" media UL900 rated (meets all universal fire codes).
- Automatic drain and fill
- 2" thick flat filters

MEDIA EFFICIENCY CHART

MODEL NUMBER	DESIGN AIR FLOW MIN	MAX	MEDIA THICKNESS 12 INCH	MEDIA THICKNESS 8 INCH
	CFM		MAX. EFF.% - MIN. EFF.%	MAX. EFF.% - MIN. EFF.%
BMA 109	1 600	2 500	90 - 88	81 - 77
BMA 112	2 500	4 000	92 - 89	83 - 79
BMA 115	3 000	7 000	93 - 89	86 - 78
BMA 118	4 500	10 000	92 - 89	85 - 78
BMA 120	6 000	14 000	93 - 88	86 - 77
BMA 122	12 000	19 000	91 - 88	82 - 77
BMA 125	14 000	25 000	92 - 88	83 - 77
BMA 127	20 000	28 000	91 - 89	82 - 79
BMA 130	25 000	35 000	89 - 88	80 - 77
BMA 133	28 000	40 000	90 - 88	81 - 77
BMA 136	30 000	50 000	91 - 88	82 - 77
BMA 215	8 000	14 000	92 - 90	85 - 80
BMA 218	10 000	20 000	94 - 90	87 - 80
BMA 220	20 000	22 000	89 - 88	81 - 80
BMA 222	22 000	28 000	89 - 88	83 - 80
BMA 225	30 000	40 000	89 - 88	80 - 77
BMA 227	30 000	55 000	91 - 88	82 - 77
BMA 230	45 000	70 000	92 - 89	83 - 78
BMA 233	60 000	80 000	89 - 88	80 - 77
BMA 236	70 000	90 000	89 - 87	76 - 78
BMA 330	65 000	105 000	91 - 88	85 - 81
BMA 336	80 000	140 000	91 - 88	85 - 80

NOTES:

EFFICIENCY OF EVAPORATIVE COOLER MEDIA REQUIRED = $\frac{\textit{Outdoor Db°F – Indoor Db°F}}{\textit{Outdoor Db°F – Outdoor Wb°F}}$ *X 100*

- *INDUSTRIAL EVAPORATIVE COOLING/FILTER SECTION STATIC PRESSURE DROP IS APPROXIMATELY 0.4 INCHES W.C. (DOES NOT INCLUDE FILTERS).*
- *THE EVAPORATIVE COOLING UNITS ARE AVAILABLE MOUNTED HORIZONTALLY WITH HORIZONTAL SUPPLY DISCHARGE, UP DISCHARGE OR DOWN DISCHARGE. REFER TO PAGE 1 FOR SELECTION EXAMPLE.*
- *REFER TO THE MAIN BMA BROCHURE FOR OTHER PERFORMANCE SPECIFICATIONS ON THE BASIC UNIT.*

SELECTION GUIDE FOR THE COMMERCIAL EVAPORATIVE COOLERS (ASPEN MEDIA TYPE PADS)

- Determine the amount of fresh air required for the room.
- Based on the fresh air requirements for the room, the corresponding model can be selected from page 35 (Commercial Evaporative Cooling Specifications).
- Determine the outdoor design dry bulb (Db) ° F and wet bulb (Wb) ° F temperatures.

The Aspen Media pad on average can cool the outdoor Db temperature by 70% of the wet bulb depression. Therefore, the following formula can be used to calculate what the Db supply temperature.

Leaving Db Temperature = Outdoor Db° F - (0.7 X (Outdoor Db° F - Outdoor Wb° F))

The corresponding Brake Horse Power (BHP) can be taken from the BMA Performance Specification Chart, given the external static pressure (ESP"W.C.).

Note: Add for accessory static pressure drops when applicable and 0.3 inches W.C. for the Commercial Evaporative Cooler. Given the blower HP and line voltage, than the Full Load Amp (FLA), starting amp and total amperage can be determined. The Commercial Evaporative Cooling units are available mounted horizontally with, horizontal discharge, up discharge or down discharge.

For heating operation, refer to page 1 in the Main BMA Brochure Selection Guide.

NOTE: The following can be found in the Main BMA Brochure (BMA0105BR2):
1. The heating capacities (MBH) pages 4 and 5.
2. The accessory static pressure drops page 6.
3. The Brake Horse Power required (BHP) pages 4 and 5.

COMMERCIAL/EVAPORATIVE COOLER EXAMPLE #1

A classroom is to be cooled using an evaporative cooling process. The outdoor air conditions are as follows:
1. 90° F Db temperature
2. 60° F Wb temperature

The design air flow for the room is 14,000 CFM with an external static pressure of 1/2 inch W.C.

Determine:
1. The leaving air temperature given the outdoor conditions.
2. The Commercial Evaporative cooling unit that can provide the airflow specified.
3. The Brake Horse Power required.

Answer:
1. LDb° F = ODb° F - (0.7 X (ODb° F - OWb° F))
   LDb° F = 90° F - (0.7 X (90° F - 60° F))
   Leaving Temperature = 69° F
2. Referring to following page (Performance Chart), the unit that can provide the design air flow specified is a BMA120.
3. To determine the BHP necessary, the Commercial Evaporative cooler and External Static pressure drops must be added together to get a total static pressure for the system.

Accessory Pressure drop(s)	= N/A
Evaporative Cooler	= 0.3 inches W.C.
External Static Pressure	= 0.5 inches W.C.
V-Bank Filter Section	= 0.6 inches W.C.
Total Static	= 1.4 ≅ 1.5 inches W.C.

Referring to page 4 (BMA Brochure BMA0105BR2) the BHP corresponding to a BMA120 at 14,000 CFM with a 1.5 inch total static pressure is approximately 11.45 BHP.

COMMERCIAL EVAPORATIVE COOLER SECTION SPECIFICATIONS

The entire cooler cabinet, blower housing, and blower wheel are constructed of heavy gauge, rust and corrosion inhibiting G90 galvanized steel.

- The cooler cabinet is protected both inside and outside by electrostatically applied paint. This gives excellent protection from the weather and resists chalking and discoloring associated with other finishes.
- All pad louver assemblies have visible water troughs, which make it easy to adjust water levels from outside without removing the louver assembly. This feature helps ensure even wetting of the evaporative media for greater cooling efficiency.
- The Commercial Evaporative cooler design permits the louver assemblies and filter pad holders to be easily removed without the use of tools. All louver assemblies are complete with a pad support preventing the pad from sagging.

PERFORMANCE CHART

MODEL NUMBER	DESIGN AIR FLOW MIN.	MAX.
	CFM	
BMA 109	1,600	2,500
BMA 112	2,500	4,000
BMA 115	3,000	7,000
BMA 118	4,500	10,000
BMA 120	6,000	14,000

NOTES:

- *To calculate the leaving dry bulb temperature use the following formula:*
  LDb Temp = Outdoor Db°F - (0.7 x (Outdoor Db°F - Outdoor Wb°F))
    - *Commercial Evaporative cooler static pressure drop is approximately 0.3 inches W.C.*

Refer to the Main BMA Brochure for other performance specifications on the basic unit.