Evaporative air conditioning
- the basic principles

To understand how an Evaporative Air Conditioner works, it is necessary to understand something about the properties of heat, air and water vapour.

Evaporative Air Conditioners are often called Evaporative Air Coolers and Desert Coolers. The most common type of Evaporative Air Conditioner is the Direct type in which the hot outside air is cooled within the machine and forced into the building and exhausted to outside again. Other types are Indirect type and Air Washer type.

THIS FACT SHEET ONLY DEALS WITH THE DIRECT TYPE.

What is **heat?**

Before we can discuss the cooling process we must understand a little of the nature of heat — for cold itself is not a property, it is only the absence of heat. Heat exists in two forms: **Sensible** heat and **Latent** heat.

Sensible Heat is the heat you can feel, or "sense". It is a property in Nature that can be detected with a thermometer. A pavement heated by the sun, a stove burner, or a hair dryer, are examples of sensible heat.

Latent Heat is hidden heat that cannot be detected with a thermometer. The heat used to evaporate water into water vapour is called "Latent Heat of Evaporation". For example, it is the heat from the hot pavement that is given up to evaporate the water after a summer rainstorm, or the heat from the stove burner given up to evaporate the water in a boiling kettle. As the liquid water changes its state into vapour, (you can't see water vapour) it absorbs heat from its surroundings; the temperature does not change but the amount of heat or energy it absorbs is contained in the molecular structure of the vapour. Evaporative Air Conditioning is only possible because of this natural phenomenon of Latent Heat.

Where does **Latent Heat** come **from?**

It comes from surrounding air and materials. Whenever a substance changes its state from solid to liquid (ice to water) and from liquid to vapour (water to vapour or water to steam), it absorbs heat from the surroundings. That means that the surrounding air and solid objects and liquids become cooler as they yield up their heat to the melting or evaporating process.

Total Heat is the sum of latent heat and sensible heat. It is the total amount of heat in a room, made up of heat you can feel and heat you can't feel. Total heat is measured in kilojoules (kJ). 1000kJ is approximately 1000 BTU's. The complete evaporation of one litre of water absorbs about 2000kJ of heat energy and that occurs within the process without any external energy input. **THAT IS WHY EVAPORATIVE AIR CONDITIONERS USE A VERY SMALL AMOUNT OF ELECTRICAL POWER TO OPERATE.** The only power that is required is for driving the fan and pump.

The **Evaporative** Air Conditioning **process**

In Direct Evaporative Air Conditioning machines the heat exchanging process is mechanised by means of a water pump that delivers water to heat exchanging media panels (cooling pads) and a motor driven fan that forces hot outside air through those media panels. These components combine to accelerate the natural heat exchange process.

During the process, some of the sensible heat from the air (the heat you can feel) is changed into latent heat (the heat you can't feel) when water in the Evaporative Air Conditioner is changed into water vapour.

This process of sensible heat changing into latent heat causes the hot air to become colder since some of its (sensible) heat has been used up as explained above. So the air temperature falls. The cold air is then pumped into the building and is eventually exhausted from the building. It is NEVER re-circulated.

The amount of evaporation that takes place depends on the amount of water vapour that is already in the outside air, or, we say it depends on the humidity of the outside air. If the humidity is high not much evaporation can occur in the machine and therefore not much cooling will occur. Therefore Evaporative Air Conditioners are most suited to hot and dry climates.

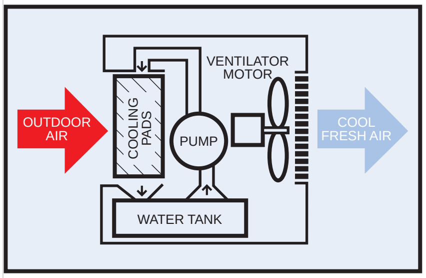
Evaporative Air Conditioning **capacity**

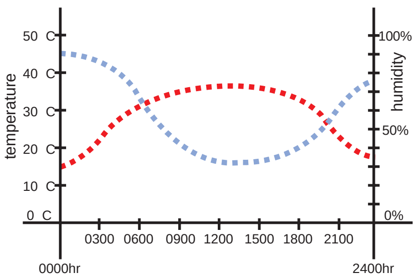
The most important information to know about an Evaporative Air Conditioner is how much can it reduce the temperature. You only need to know three pieces of data to make the calculation — the ambient dry-bulb temperature, the ambient wet-bulb temperature and the saturation efficiency of the machine. The two temperatures can be found by using a special combined thermometer that has one thermometer with a dry bulb and one with a wetted bulb using a water-soaked sock over the bulb. The instrument is called a Psychrometer.

The saturation efficiency of the machine should be available from the manufacturer, but 80% is a good average. The temperature reduction of the air supplied by an Evaporative Air Conditioner is the difference between dry and wet bulb temperatures multiplied by the efficiency. For example, the dry and wet bulb temperatures on a given day were 35 C dry bulb and 22 C wet bulb; machine efficiency was 80%. The temperature reduction is 35 – 22 = 13 C x 80% = 10.4 C, and therefore the air supplied to the building is 35 – 10.4 = 24.6 C.

In the above statement the figure of 80% saturation efficiency was used. The superior design of Breezair Evaporative Air Conditioners yields much higher effiencies. Many Breezair models have up to 94% saturation efficiency and therefore they lead the world in delivering bigger temperature reductions and very high "cooling effects". In the above example, the air supplied to the room would be 22.6 C, by using 94% efficiency.

Breezair **Evaporative** Air Conditioner





Above chart represents a typical summer day showing temperature & relative humidity in non-tropical region

Temperature range through the day
Humidity range through the day

Breezair®
Advanced natural **cooling**

Quality System
Quality Endorsed Company
ISO9001:2000 LIC QEC 0391 SAI Global
CE LV EMC