



INTRODUCTORY GUIDE

## **EVAPORATIVE COOLERS**

NATURAL COOLING SOLUTIONS









## EVAPORATIVE COOLERS

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# 1 INTRODUCTION

Evaporative cooling is a natural cooling principle that is gaining in popularity due to the numerous advantages it offers.

Increasing environmental concerns and rising energy costs are increasing the focus on evaporative cooling (also called biocooling or adiabatic cooling).

Being a low-cost alternative that uses very little energy, evaporative coolers are maintenance friendly and require no installation (portable versions). Simply connecting a water supply or refilling the water tank is enough for users to instantly enjoy efficient cooling.

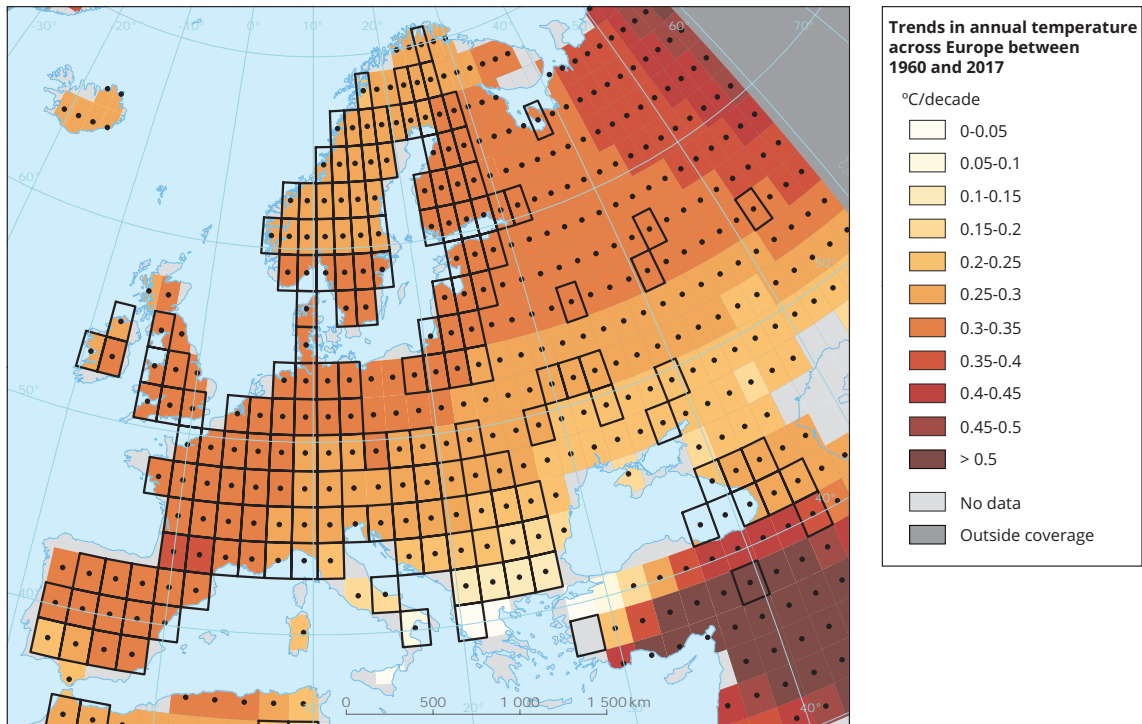
Year after year, temperatures are rising, leaving many companies concerned about safety

and productivity. The past decade saw a stunning five record-setting years (2010, 2014, 2015, 2017, 2018 and 2019). The number of warm days has doubled between 1960 and 2019 across Europe. Adding to that, laws to avoid heat stress in the workplace are getting tougher year by year.

As a result, many are looking for efficient cooling solutions for their large industrial warehouses, hangars or car workshops.



## ANNUAL TEMPERATURE TRENDS ACROSS EUROPE BETWEEN 1960 AND 2017



Source: <https://www.eea.europa.eu/data-and-maps/indicators/global-and-european-temperature-9/assessment>

### ALTHOUGH GAINING POPULARITY, EVAPORATIVE COOLING HAS BEEN FAIRLY UNKNOWN IN EUROPE UNTIL NOW.

Master Climate Solutions offers a full range of portable and fixed evaporative cooling solutions that are economical and efficient and that help users improve their working conditions, comfort and productivity.

This guide is meant to help you understand what evaporative cooling is and how it works, what it can do for you, where it is ideally applied and much more.

Being a relatively unknown but highly economical and efficient alternative to other types of air climatisation, evaporative cooling has the potential to help many businesses around the world reduce their costs while increasing indoor comfort for their employees.

Our experienced cooling experts stand ready to assist with any requirements or doubts you might have in that connection.

Enjoy the read!

## 2 INTRODUCTION INTO EVAPORATIVE COOLING

### HISTORY OF EVAPORATIVE COOLING

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The ancient Egyptians, Greeks and Romans used wet mats (what we call "cooling pads" today) to cool indoor air. They hung the mats in front of tent openings and windows. The wind blowing through these mats causes evaporation of water, thereby cooling the air temperature inside.

During the 15th century, the first mechanical fans were built to provide ventilation. In the 18th century, textile manufacturers in New England began using water evaporative systems to condition the air in their mills. The system consisted of large "cooling towers" with fans that transported the water-cooled air inside their buildings.



### WHAT IS EVAPORATIVE COOLING?

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Remember how getting out of the water after swimming on a hot, dry day feels chilly when the wind hits your wet skin? Or how dipping your finger in a glass of water and then blowing air across your finger leaves a cool sensation as the water evaporates. That is evaporative cooling.

Try the same thing when there is no wind or no air moving. The surrounding air is quickly saturated with moisture, there is no evaporation and the cooling effect is gone.

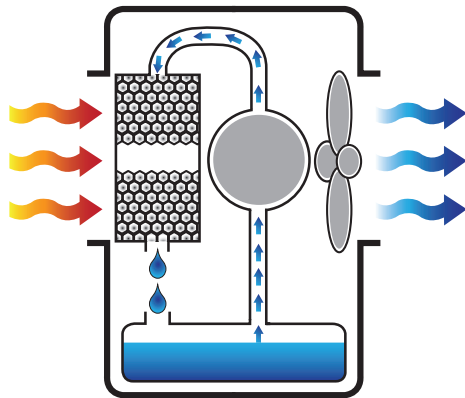
Evaporative cooling units create this naturally occurring process and provides a constant flow of cool, refreshing air into a hot, uncomfortable environment.



## HOW DOES IT WORK?

The heart of the evaporative cooling system is the cooling pad where the water evaporates and the air passing through the pads is cooled.

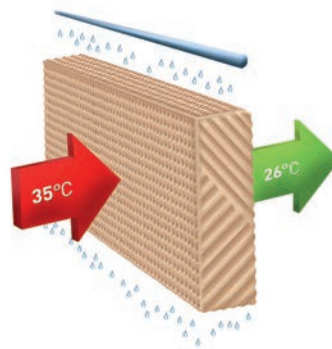
Evaporative cooling pads are manufactured from fluted cellulose sheets that are glued together. The material is chemically impregnated with special compounds to prevent rot and ensure a long service life and easy maintenance.



*Evaporation results from contact between air and water.*

The integrated water distribution system spreads water evenly over the cooling pads to make sure the entire surface is kept wet. This maximises the cooling effect.

Fans create a negative pressure, causing air to be drawn through the pads.



*A control system operates the water pump and the fan distributes the cool air in the area.*

## EVAPORATIVE COOLING AND HUMIDITY

A given volume of air at a certain temperature and pressure is capable of absorbing and holding a certain amount of water vapour. If that volume of air contains 50% of the moisture it is capable of holding, we say it is at 50% relative humidity.

The hotter the day, the drier the air, the more cooling can be done by means of evaporation. In other words, the cooling effect is best when you need it most.

Our evaporative coolers are developed to work well in high-humidity environments too, however, and will remain much more efficient than a simple fan that just circulates warm air.

Our coolers will increase humidity by 2 to 5%, depending on temperature and humidity in the environment you want to cool. The slight increase is not noticeable in ventilated areas where the air produced by the unit is exhausted.

		RELATIVE HUMIDITY																
		2%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%
INCOMING AIR TEMPERATURE	24°C	12°C	13°C	14°C	14°C	15°C	16°C	17°C	17°C	18°C	18°C	19°C	19°C	20°C	21°C	21°C	22°C	22°C
	27°C	14°C	14°C	16°C	17°C	17°C	18°C	19°C	19°C	20°C	21°C	22°C	22°C	23°C	23°C	24°C	24°C	25°C
	29°C	16°C	17°C	17°C	18°C	19°C	20°C	21°C	21°C	22°C	23°C	23°C	24°C	24°C	25°C	26°C	27°C	
	32°C	18°C	18°C	19°C	21°C	21°C	22°C	23°C	24°C	25°C	26°C	26°C	27°C	28°C	28°C	29°C	30°C	
	35°C	19°C	20°C	21°C	22°C	23°C	24°C	26°C	26°C	27°C	28°C	29°C	29°C	30°C				
	38°C	21°C	22°C	23°C	24°C	26°C	27°C	28°C	28°C	29°C	31°C	31°C						
	41°C	22°C	23°C	25°C	26°C	27°C	29°C	30°C	31°C	32°C								
	43°C	24°C	25°C	27°C	28°C	29°C	31°C	32°C	33°C									
	46°C	26°C	27°C	28°C	30°C	32°C	33°C	34°C										
	49°C	27°C	28°C	30°C	32°C	34°C	35°C											
	52°C	28°C	30°C	32°C	34°C	36°C												

This table shows the theoretical **OUTGOING AIR TEMPERATURE** of a cooler.

The theoretical **OUTGOING AIR TEMPERATURE** depends on the **INCOMING AIR TEMPERATURE** and on the **RELATIVE HUMIDITY**.

Simply find your **INCOMING AIR TEMPERATURE** and **RELATIVE HUMIDITY**, then locate the value where the two intersect and that is your theoretical **OUTGOING AIR TEMPERATURE**.

### Example:

*Incoming air temperature = 35°C*

*Relative humidity = 30%*

*Outgoing air temperature = 26°C*



## EVAPORATIVE COOLING VS AIR-CONDITIONING

In general, the operating cost of an evaporative cooler is much lower than that of a central air-conditioner. The initial equipment cost is also lower than for comparable air-conditioner equipment.

Most often, air-conditioners are impractical and operationally uneconomical for spacious industrial environments because of their size and because doors are often open. Evaporative cooling uses no gasses or compressors.

In addition to low operating costs and simple installation, evaporative cooling is an ecofriendly alternative to traditional air-conditioners because it uses no refrigerants and just a fraction of the electricity required by other comparable cooling options.

On average, the cost of usage is just 10% of a traditional air-conditioning system. That means hundreds or thousands of euros in savings every year.

For large, open areas like hangars or workshops with open doors there are no good alternatives. An air-conditioner is expensive and can cause health issues like dry throats. A fan does not really cool – it simply circulates hot air.

In terms of air-conditioning, many people tend to use it too often. That increases energy costs because it requires you to create and maintain a high temperature difference between indoor and outdoor environments.

Master's evaporative coolers use a highly efficient cooling media, enabling them to efficiently cool the air even in very high relative humidity conditions. Combined with their sturdy portable design, which makes them easy to move around in factories, hangars and workshops, the coolers are ideally suited for spot cooling, delivering cooling where it is most required.



### EVAPORATIVE MASTER COOLERS



LOW OPERATION COSTS



EASY INSTALLATION



SAFE FOR YOUR HEALTH



ECO-FRIENDLY,  
NO REFRIGERANT



WORK WITH OPEN  
DOOR AND WINDOWS



PORTABLE

## VENTILATION

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Fresh, clean air is necessary to provide a comfortable and healthy environment that also promotes the work efficiency of employees.

To ensure healthy air, it is fundamental to clean it by eliminating or reducing the

concentration of dirt it contains. Ventilating work environments using cool and filtered air improves the air quality.

Much like in nature, the fresh air creates a sea breeze effect on the people working.



## HEAT STRESS

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Climate conditions on the work floor directly influence the comfort and the efficiency of workers. According to a report released by REHVA in 2011, the ideal climate conditions are 23-25°C at 45-60% humidity. In industrial applications, this can be up to 27°C.

Often, temperatures in unconditioned environments exceed that level, for example in heat process industries that use ovens and foundries. This creates a risk of heat stress among workers, increasing the risk of accidents while also reducing productivity.

The effects and costs of heat stress are not well documented by most companies. When an employee faints due to heat, it may well just be reported as a fainting incident without any apparent cause.

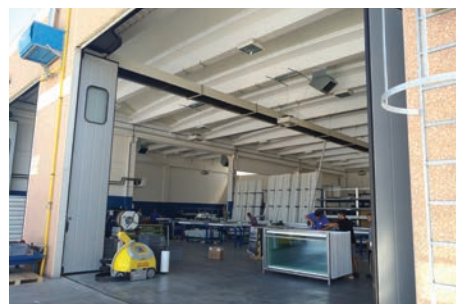
Workers exposed to excessive temperatures (temperature, air velocity, humidity, sun and other elements that can cause heat) for too long will have trouble concentrating and may for instance dehydrate, go into cramps, feel dizzy or faint.

Traditional air-conditioning systems do not perform well in large, open areas, such as

industrial factories or storages. In addition, to be effective in such environments, they will become very expensive to install and operate.

We recommend evaporative coolers because they generate a comfortable and fresh working environment for workers at a reasonable investment cost.

With our range the level of productivity can be maintained in safe working environments. Our evaporative coolers offer a balance between humidity and cooling and avoids dramatic temperature differences, benefiting the health of the people.







We are not only offering solutions for people and animals, but also for machinery. Overheating machines may fail, so lowering the temperature using evaporative cooling can potentially save a lot of money for you.

In factories, there are often certain zones that have higher temperatures than the rest of the factory, for instance because of the heat emitted from machinery or certain production processes. This is easily resolved with a portable, evaporative spot cooling solution.

## 3 APPLICATIONS

Evaporative coolers can be used in a variety of applications. They are generally the preferred choice for extreme working conditions and for large areas where using air-conditioners is too expensive or impractical.

### THE INDUSTRY IN GENERAL

Applying ovens or other heat-generating equipment as part of their manufacturing processes, many industrial operations offer working environments that are hot throughout the year. Examples include the glass, steel and plastic industries.

In production facilities that have several floors, the heat problems increase as you move up inside the building.

Moreover, many factories are relatively old and were not designed to deal with excessive heat to modern standards. Sunshine quickly warms them up, making employees feel like they are working in an oven. Not only does that affect productivity, it may also be a legal issue.

The laws and regulations in Europe are getting stricter, and in certain locations extra breaks are required when the temperature exceeds a certain level. In addition, heat can affect machinery too, increasing the risk of breakdowns or failure.

Depending on requirements, portable evaporative spot coolers or stationary air coolers can deliver the necessary cooling capacity.

In factories, some zones are often hotter than the rest of the factory. These may arise as a result of heat emitted from machinery or production processes, or because many employees work in that specific area. Using portable coolers, you can spot cool any such hot areas.





## AGRICULTURE

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High temperatures can negatively influence animals (less eggs and milk for example).

Chickens, for example, do not sweat so when it gets extremely warm, they may become sick or even perish. Also, they grow less because they do not eat as much because of the heat stress they are facing.

With our evaporative cooling solutions, temperatures can easily and efficiently be reduced, creating a comfortable climate inside the stables, chicken houses and similarly.

Due to the ventilation of our fans, the emissions in cow stables are also reduced.



## MILITARY

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In the military, many applications benefit from the use of evaporative cooling solutions. Due to the durability and practical use we are a preferred supplier of many international armies when it comes to cooling workshops, tents, hangars, etc.

A great deal of military missions take place in extremely warm weather in Africa, the Middle East and similar environments that require the use of cooling solutions. Here, portable units that are easy to transport and apply come in handy.



## AUTOMOTIVE

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The automotive industry and many of their suppliers (tyre factories, car glass and gear box manufacturers etc.) generate a lot of heat during the day.

A typical car repair shop or tyre centre often has the doors open and uses simple fans to try and circulate the air a bit. However, fans only move hot air around.

Evaporative coolers do a better job and they can be scaled to fit both small and big shops.

In the racing industry, evaporative cooling is a popular tool that helps reduce the temperatures in and around the pit boxes.

Due to the portability of our evaporative coolers, they are easy to move around and bring from race to race, even across continents.



## AVIATION

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Cooling solutions for the aviation sector are always in high demand. A hangar is very difficult to cool due to high ceilings and frequently open doors. Here, using portable cooling solutions to spot cool only working areas is ideal. Cooling the entire indoor space would be a waste of money. For full flexibility, portable coolers should be chosen so cooling can be moved to where it is required.

With the option of ducting cool air, it is also possible to cool the inside of airplanes. Our evaporative coolers are ideal for large, well-ventilated areas, but they can also be used outdoors – ideal for some armies who use evaporative coolers for outdoor maintenance of their helicopters and airplanes because they do not have access to a hangar.







## TENTS AND EVENTS

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During events with a lot of people and during hot summer days it can be extremely warm.

Utilising equipment such as our biggest evaporative coolers, you can cool more than

300m<sup>2</sup>, creating an ideal temperature inside and around tents.

Once connected to a water hose, this solution delivers instant and fully mobile cooling without requiring a lot of energy.



## HOTELS, RESTAURANTS, CATERING (HORECA)

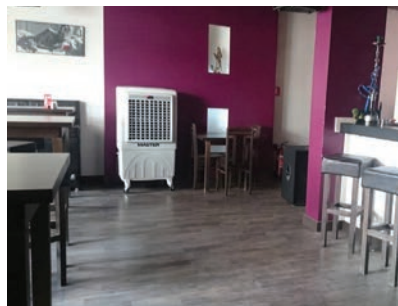
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Applying small and quiet evaporative coolers at a hotel terrace creates a very comfortable dining and relaxation area for customers on hot summer days.

In addition to enticing customers to stay longer, the nature of evaporative cooling also reduces the presence of insects since they do not like air-conditioning.

The coolers can be used indoors (with doors and windows open to guarantee maximum level of ventilation and highest cooling effect) or outdoors.

Using the louvers, the air flow can be directed to where cooling is required.





## LOGISTICS

Evaporative coolers cannot create a guaranteed specific temperature such as, for instance, a 23 degrees Celcius maximum. Instead, they will cool down your air by 3 to 10 degrees Celcius, depending on the temperature, humidity and ventilation of the surrounding air.

Therefore, logistics centers wanting to cool a warehouse should be careful to choose the right solution for it.

For example, portable spot cooling is ideal for cooling of loading/unloading areas. To cool

an entire storage, a more powerful and fixed installation is required.

Trucks can also become very hot when exposed to direct sunlight. Sometimes, even to the point where it is nearly impossible to unload them.

Our small portable solutions will help reduce the temperature enough for staff to load or unload trucks, containers and more.



## OTHER APPLICATIONS

In general, evaporative cooling is a great choice for most big and partially or fully open spaces. Examples include greenhouses, sport halls, churches, or fitness centers.

Oftentimes, for such applications, there are no realistic alternatives that will deliver the right amount of cooling in a financially feasible manner.



## 4 FREQUENTLY ASKED QUESTIONS

Does the concept of evaporative cooling trigger more questions than answers? This section offers our response to some of the most frequently asked questions and concerns about evaporative cooling. Feel free to reach out if yours is not on the list!

### NOISE LEVEL

*Can the level of noise from evaporative coolers be reduced?* Sound is subjective, and the same sound will be interpreted differently from person to person. In our main markets, the importance of cooling effect by far exceeds that of sound reduction. Our coolers come with speed adjustment capabilities so you can reduce speed and thereby sound, if so required. The smaller the cooler, the lower the sound level. The sound level from our units is between 60 and 66 DB.

### INFECTION RISKS

*Do evaporative coolers increase the risk of infections and other health problems?* No, on the contrary! This question is usually based on the mistaken assumption that because evaporative coolers can result in a slight humidity increase, they also increase the risk of virus and bacterial and fungal growth. All of Master's evaporative coolers pre-filter the air, thereby eliminating particles that can act as vehicles for bacteria and viruses. The positive effects of using evaporation are actually well established.

### VIRUS DISINFECTION

*Can evaporative coolers disinfect from viruses?* Since the COVID-19 outbreak in 2020, Master evaporative coolers have been equipped with UV light. The UV light kills any bacteria and viruses in the water that the evaporative cooler uses. As UV light is very concentrated, the power consumption is insignificant.

### LEGIONELLA RISKS

*Does evaporative cooling increase the risk of legionella because it uses water?* No. The water used by our coolers is constantly moving and kept at a very low temperature. This creates an environment hostile to legionella.

**MASTER EVAPORATIVE COOLERS ARE INEXPENSIVE AND ECO-FRIENDLY COMPARED TO ALL ALTERNATIVES AVAILABLE ON THE MARKET**



## COOLING CAPACITY

*How much can evaporative coolers reduce the temperature?* Typically between 3 and 10°C, but it depends on external factors, such as temperature, humidity and available ventilation. The higher the temperatures, the more they can cool. The lower the humidity, the more water our coolers can evaporate and the more ventilation the better they work.

## AIR FLOW PROBLEMS

*What can I do to adapt the air flow to my requirements?* Most of our coolers have louvers, so you can control the air pattern/direction. Moreover, our coolers come with speed adjustment capabilities so you can reduce air velocity. Other solutions are to lift the cooler to a higher place to ensure the air is not directed at people (cool air always moves downwards, so cooling is guaranteed with this solution too).

## ENERGY CONSUMPTION

*How much energy do the coolers use?* Master evaporative coolers are very energy-friendly. Fitted with variable speed features, our coolers use between 250W and 750W. This translates into around 1 euro per day.





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