

WHITEPAPER

# Increase the reliability and sustainability of your air-cooled chiller

A higher Energy Efficiency Ratio with adiabatic pre-cooling



# Introduction

The calculated cooling capacity of previously manufactured commercial and industrial air-cooled chillers is insufficient for the ever-increasing outdoor temperatures of recent years. As a result, cooling systems are often unable to provide the intended cooling capacity and use unnecessarily large amounts of energy in practice. In some cases, chillers cannot achieve the required cooling capacity and the machines malfunction. Consequently, servers overheat, freezers defrost, and staff suffer from a hot indoor climate.

This whitepaper outlines the challenges associated with an inefficient cooling system and discusses ways to make existing cooling machines run as efficiently as possible. Learn how to save huge costs & increase the reliability of your cooling system.





# 1. A failing cooling system in warm outdoor temperatures

In recent years, temperatures have been increasing steadily. At the time, consultants did not consider this increase when determining the required cooling capacity of a building, supermarket or server parks. As a result, chillers are not equipped for the hot outside temperatures. In warmer periods, this can lead to a variety of problems:

- The energy efficiency (EER) of the chiller goes down, and energy consumption increases significantly.
- The chiller's fans run at full load and can cause noise pollution in the process.
- The compressor has to work harder. This causes the head pressure to increase enormously, and theoretically, the risk of refrigerant leakage increases.
- The extra load on the components in the machine causes excess wear and tear on the chiller, resulting in shorter service life.
- The cooling capacity that is required cannot be delivered, which can cause the chiller to malfunction (also called 'tripping').
- In the worst case, the cooling machine will fail completely.

The latter must be avoided, of course. But the risk of pollution and unnecessarily high energy consumption must also be prevented. Fortunately, there are several ways to ensure that a refrigeration system functions optimally and efficiently despite high outside temperatures. The following chapter explains this further.



## 2. How to increase the efficiency of your cooling system

### 2.1: An efficient cooling system: the basics

Before we dive deeper into the different solutions to optimize a cooling system, we first like to explain what is meant by 'increasing a chiller' efficiency. Because it is not just about **boosting the EER** of a chiller, but also about **increasing the cooling capacity** while **lowering the peak current**. In addition, you want to ensure that the chiller is no longer running continuously at full load when more cooling power is required. This, in particular, **contributes to the lifespan of the machine**. Last but not least, you want to make sure that the **reliability of the chiller is increased**, in other words, that it does not malfunction under any circumstances.

### 2.2. An efficient cooling system: the how-to

There are several ways to increase the efficiency of a chiller. These are outlined below from least to most effective.

#### **Adding to the refrigerant**

In the case of a water-cooled cooling system or chiller, energy consumption can be reduced by adding an agent to the refrigerant that improves heat transfer and increases the cooling system's efficiency.

#### **Update operating system & software**

Often a lot can be gained in the efficiency of a chiller by optimizing the controls. This ensures a more effective and energy-efficient control of the cooling system.

## Replacing the fans

Older cooling machines often have fans that are less efficient at full and part load. Also, with increasing outdoor temperatures, these fans have to run at full load more often, which can cause noise pollution in addition to high energy consumption. By replacing these fans with energy-efficient EC fans, energy consumption and noise pollution reduce significantly. The efficiency of these EC fans is further increased when used in combination with adiabatic cooling.

## Pre-cooling with adiabatic cooling/air humidification

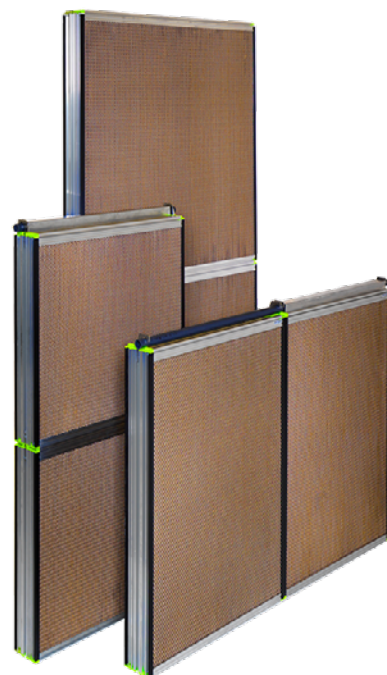
A highly effective way to increase a chiller's efficiency is to cool the air passing through the system with adiabatic cooling (evaporative cooling). There are several solutions to do so:

### ➤ **Adiabatic pre-cooling by contact humidification**

Adiabatic pre-cooling by contact humidification uses a direct evaporation media - a pad. Because warm (dry) outside air flows through the evaporation media, the water in the air stream evaporates, and the temperature decreases. Adiabatic pre-cooling by contact humidification is a very effective way to increase the efficiency of a chiller. This form of adiabatic pre-cooling is not affected in its effectiveness by environmental factors such as wind. In addition, the use of a contact humidifier eliminates the spread of Legionella as it does not create droplets (aerosols), and the system can be safely located near an air handling system and public areas.

For more information,  
see the page PreCooll:

**Adiabatic pre-cooling** →



De OxyVap® - Oxycom's PreCooll direct evaporation media

### ➤ **Adiabatic pre-cooling using a misting system**

Adiabatic pre-cooling by atomization, also called misting, works differently. This system ensures that the warm outside air is, as it were, sprayed with tiny water droplets, cooling down the air. However, there are a few drawbacks to this system. Suppose small portions of stagnant water remain in the pipes, tubes, or pumps in a warm environment when the system is OFF. Legionella can quickly develop and be released into the air in the form of aerosols when the system is reactivated. Therefore, manufacturers recommend that misting systems be placed in public areas only when combined with Reverse Osmosis filter systems. In addition, an adiabatic misting system is only effective when there is very little to no wind. The cooling mist can be blown away by a gust of air, and optimal pre-cooling cannot occur. This also leads to unnecessary water consumption.

For more information, read the blog '[Adiabatic pre-cooling for industrial cooling machines - the advantages and disadvantages](#)' →



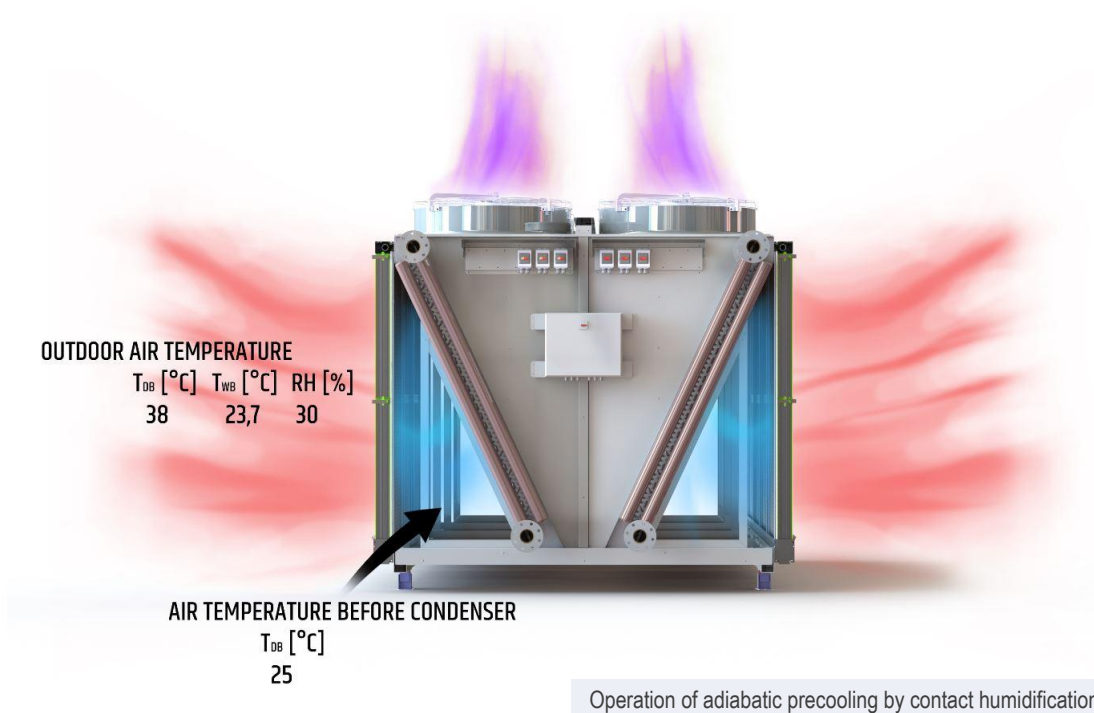
Example of adiabatic precooling by misting



## 3. Adiabatic pre-cooling

### 3.1 Operation of adiabatic pre-cooling

Energy is required to evaporate water. When water evaporates, energy, in the form of heat, is extracted from the airflow. The air temperature thus decreases while the humidity increases. Placing an adiabatic pre-cooler in front of a chiller ensures the outside air is pre-cooled by direct evaporative cooling before it passes through the condenser. A chiller runs more efficiently at lower suction temperatures. Pre-cooling reduces the energy consumption of the cooling system.



## 3.2 Advantages of adiabatic pre-cooling

The use of adiabatic pre-cooling, using evaporative media, comes with many advantages:

- Lower energy consumption and therefore lower CO2 emissions from the chiller
- More cooling capacity, also on hot days
- Increased reliability of the cooling machine. Failure of the machine can thus be prevented
- Less chance of high-pressure failures of the chiller
- Reduction of the peak current
- Lower noise production as the fan speed can be reduced
- Less mechanical cooling hours and more free cooling hours
- More running hours in partial load and therefore less wear on the chiller
- Often the investment in an energy-saving measure, such as adiabatic pre-cooling, is eligible for a subsidy, such as the EIA subsidy (Energie Investerings Aftrek) in the Netherlands
- When adiabatic cooling is applied in combination with a new cooling machine, it can be laid out at lower temperatures, and therefore a smaller cooling machine is sufficient



# PreCool

## Adiabatic pre-cooling Oxycom



Up to 40% energy savings



Up to 20% more cooling capacity



Up to 30% peak power reduction

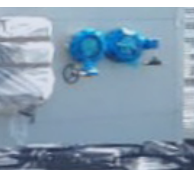


Up to 25 °C pre-cooling

## 4. adiabatic pre-cooling in different scenarios

### 4.1 Adiabatic pre-cooling for data centers

For data centers, an inefficiently operating cooling system can cause several problems. The up-time of the servers is most important in this regard. Data centers must guarantee an uptime of 99.8% to their customers. Therefore, the reliability of the chiller that keeps the servers running is also priority #1. The hot (pre/post) summers of recent years have proven to many data centers that their chillers cannot cope with the outside temperatures. They cannot deliver the required cooling capacity and are in danger of shutting down. In addition, residents in the neighborhood often complain about the noise nuisance caused by fans running at full speed. With the installation of an adiabatic pre-cooler, data centers are assured that their cooling system can deliver the total requested cooling capacity. Thus they can also guarantee 100% working servers to their customers. Combined with energy-efficient EC fans, noise nuisance is also drastically reduced. An additional advantage of using adiabatic pre-cooling is that the chiller consumes much less energy, thus reducing the peak current and increasing the server capacity.





## 4.2 Adiabatic pre-cooling for supermarkets

Supermarkets also suffer the consequences of cooling machines that cannot deliver the required cooling capacity with high outdoor temperatures. As a result, refrigeration and freezer cells cannot reach the legally required storage temperature following the discarding of food products. At a fraction of these costs, supermarkets can invest in adiabatic pre-cooling. The adiabatic pre-cooling system guarantees the optimal functioning of the cooling machine, which also ensures that the cooling and freezing cells always reach the legally required temperature.

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"Since the purchase of an adiabatic pre-cooling system, we no longer need to spray water to keep our cooling machine cool and running on hot summer days. In addition to improving reliability, the PreCool system increases the efficiency of the cooling systems and reduces our energy bill."

**DHR. BOER**  
JUMBO Raalte

## 4.3 Adiabatic pre-cooling general (offices, hotels, etc.)

Even in hotels and offices, it can happen that a cooling machine, under the influence of warm outside temperatures, becomes inefficient or can no longer deliver the desired indoor temperature. In such a case, adiabatic pre-cooling can guarantee a pleasant working/living climate in the building at all times. Not in the least: an energy-efficient climate.







## 5. Conclusion

An inefficiently operating chiller poses several risks. In addition to skyrocketing energy costs and noise pollution, there is also a high probability of reduced cooling capacity or even failure. Fortunately, there are several ways to increase the efficiency of a chiller. The most effective way to do so is by using adiabatic pre-cooling. Adiabatic pre-cooling not only increases the EER of the chiller, reduces the peak current, and expands the cooling capacity, it also dramatically increases the reliability of the chiller.

## Case study Equinix

In cooperation with Trane, Oxycom supplied and assembled the PreCooll. By installing the PreCooll systems, the overload and energy consumption of the condensers are drastically reduced. Read more about this case study here:

[Read case study →](#)



## 6. About Oxycom

At Oxycom, we are pioneers. We design our highly innovative natural cooling systems with one goal: to reduce the global carbon footprint required to cool, ventilate, and heat buildings. Since 2002, we have been developing innovative adiabatic climate solutions. Oxycom has years of experience with numerous applications worldwide. Our broad expertise enables us to complete any project together with our partners/installers successfully.

Are you interested in making your current cooling equipment more sustainable and improving it? We would be happy to assist you in doing so. Schedule a free, no-obligation consultation with one of our specialists.

[Schedule a consultation →](#)