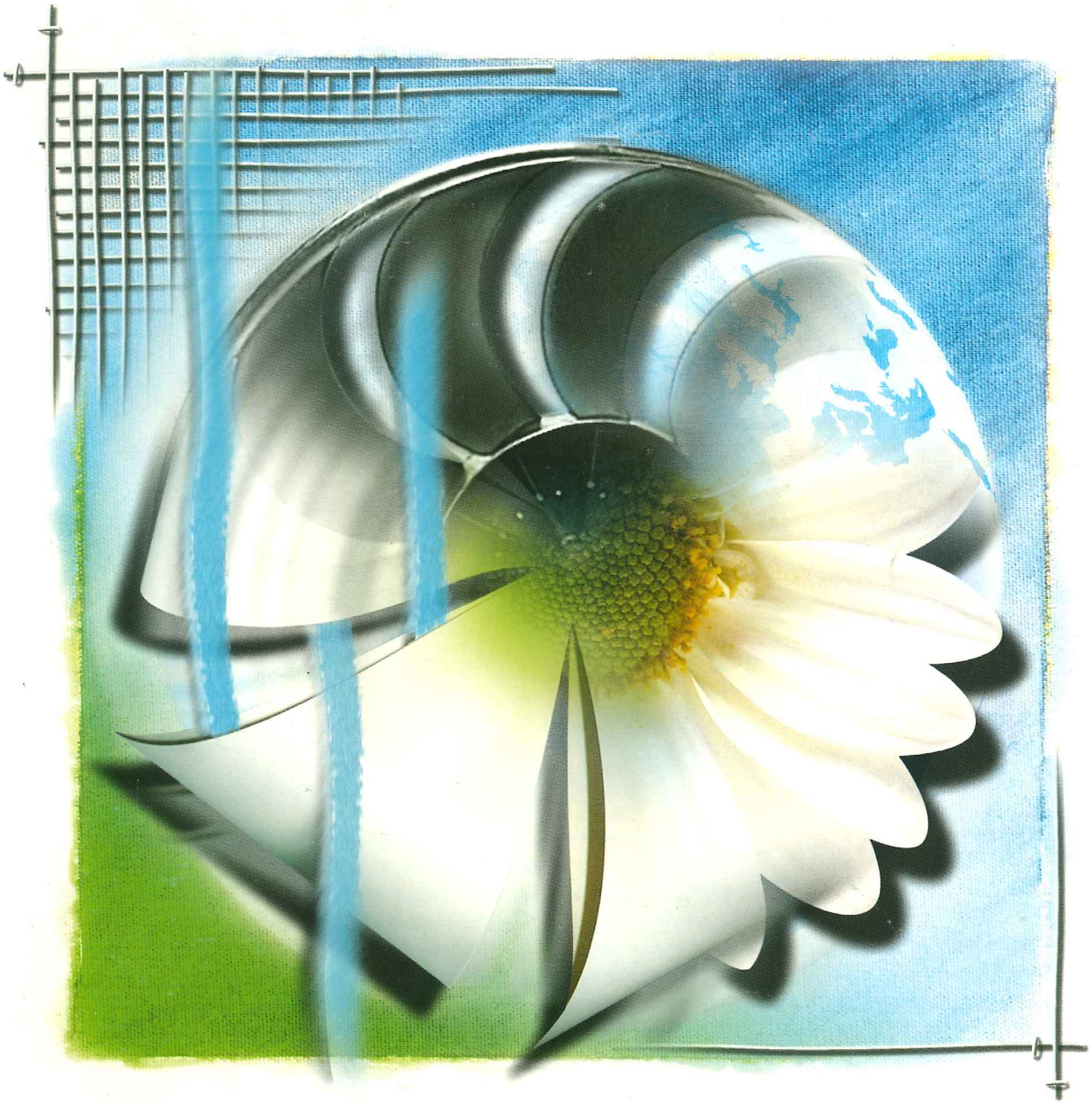


EVAPORATIVE COOLING

How efficient heat transfer technology helps protect the environment

INDUSTRIAL PROGRESS: COMFORT FOR ALL

THE PERFECT

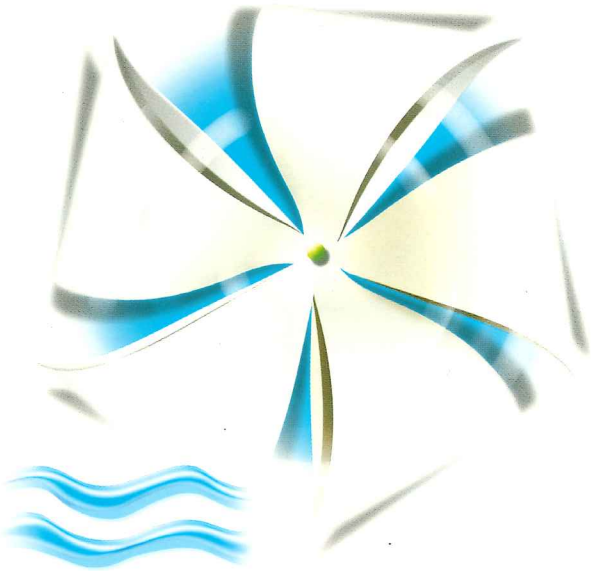
Industrial progress has resulted in many technological developments that enable mankind to enjoy a more comfortable lifestyle. Moreover, the industrial sector itself provides a significant number of jobs and, with this income, those working in industry are themselves able to enjoy the comforts afforded by industrial development. However, manufacture of goods and the utilities needed in the production process use up limited natural resources and can potentially cause pollution of our planet.
The demand for economic growth is continuous, especially in developing countries. As a result, the major challenge facing industrial progress is how more goods and facilities can be made available to more people without wasting natural resources and without damaging the environment. Efficient use of electricity is one of the key factors, since the production of electrical energy is known to be one of the main contributors to global warming.

Therefore, processes using electrical power must respect the environment and utilise the most efficient technologies.

PROCESS EFFICIENCY

To run any process, some form of energy input is needed. Within the process, most of this energy is used in achieving the desired result, for example, production of materials and goods or provision of services such as cooling. Part of the energy input is lost during the process and is usually released in the form of heat. This heat needs to be removed from the process and, whilst some of it can sometimes be recovered for re-use, most of it is waste heat that needs to be dissipated into a heat sink, usually into the atmosphere.
The better the process efficiency, the smaller the amount of waste heat and the easier it is to dispose of the waste heat effectively. Many technological processes are temperature sensitive and require cooling, often at as low a temperature as possible.
In order to ensure optimum process efficiency, it is important to select the best cooling technology for these applications.

BALANCE



SAFETY

Leakage and spillage into the environment of substances used in industrial processes must be avoided, most especially if they are potentially harmful to humans or the environment. Processes in which leakage or spillage causes the substance to escape straight into the environment are known as direct systems. By the nature of their design, direct systems have a lower safety level. Processes where there is no direct release to the environment when a leak occurs are called indirect systems. Clearly, these have a greater safety level and should be the first choice when designing processes that use hazardous substances.
As far as cooling systems are concerned, indirect systems can be created by the use of intermediate heat exchangers or closed loop technology. This will require an extra step of heat transfer but are often used in waste heat removal applications because they prevent leaks of substances used in the process directly into the environment.

OPERATING RESOURCES AND POLLUTANTS

In comparison with the requirements of the process itself, the energy used by the heat removal or cooling equipment is generally low. However, when evaluating the total energy requirements of a process, it is always necessary to study the efficiency of the waste heat removal and to ensure that the energy usage of the heat transfer equipment chosen be minimised. Next to this other environmental factors need to be considered, especially noise which is another pollutant created by industrialisation. Technologies with the smallest acoustical impact on the surroundings are clearly preferred.

EVAPORATIVE

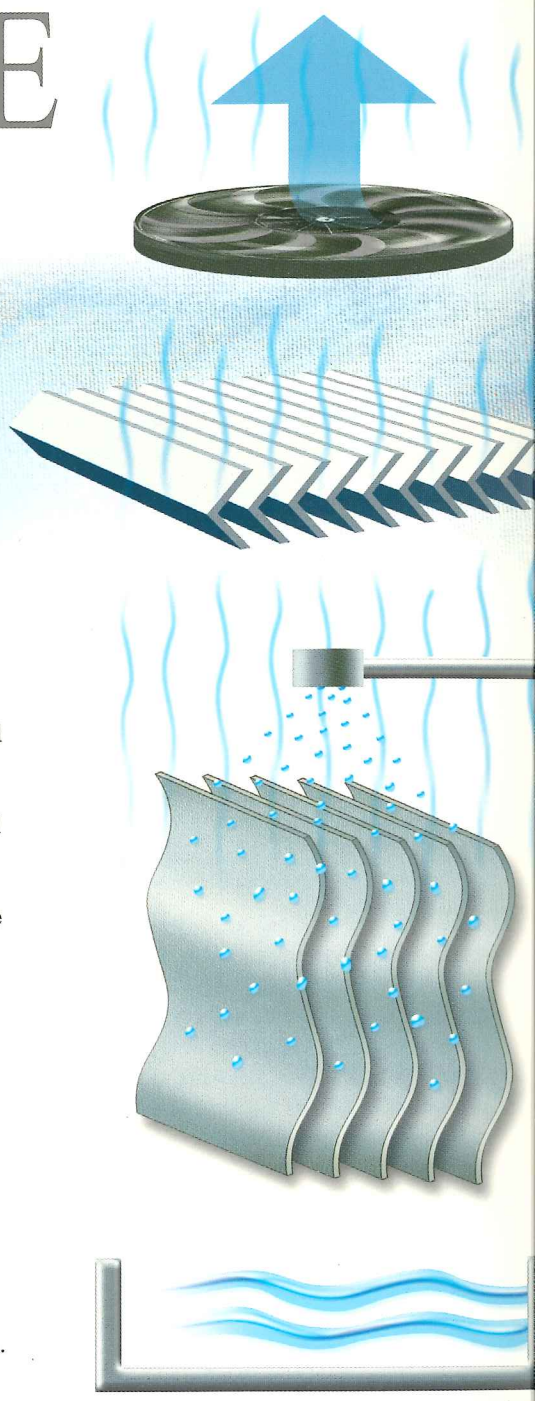
PROVEN EFFICIENCY

Evaporative cooling is a natural process using water as the cooling medium which provides an efficient and proven means of transferring waste heat into the atmosphere. This is the principle of operation used by all cooling towers and evaporative condensers to cool or condense fluids and gases in a wide variety of applications. By evaporation of water when cooling a fluid or condensing a gas the heat is rejected into the atmosphere.

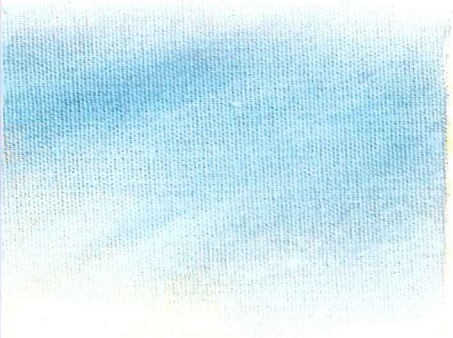
This is achieved by having close contact between the water circuit and an airstream, whereby the major part of the heat is transferred to the air by evaporation of a small amount of the water and the heat is then carried away in the warm, saturated discharge air. The amount of evaporation, and thus heat transfer, is dictated by the wet bulb temperature of the ambient air which, particularly in summertime when cooling requirements are usually at their highest, is considerably lower than the dry bulb temperature of the same state of ambient air. Thus, evaporative cooling equipment always achieves lower cooling water temperatures than air cooled equipment whose performance is dictated by the ambient dry bulb temperature. For example, this means that, even on hot summer days with ambient dry bulb temperatures well above 40°C, evaporative cooling can cool water to temperatures of as low as 25°C. The use of latent heat transfer during the evaporation process has other advantages. Because more heat is removed by evaporation than by standard sensible heat transfer, evaporative cooling requires four times less airflow for a given heat transfer capacity compared to a conventional air cooled process.

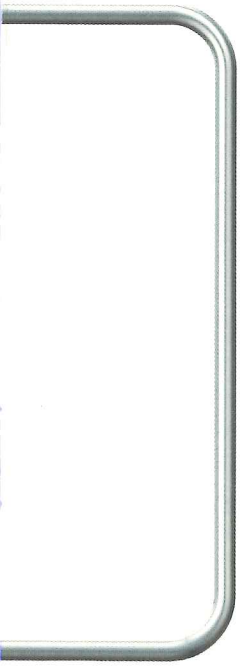
Various types of evaporative cooling products exist. They all comprise a heat exchange section that is constantly wetted by a water spray arrangement, a fan system that either forces or induces ambient air through the heat exchange section and a number of other auxiliary components such as a water collection sump, drift eliminators and controls.

Evaporative cooling equipment is available on the market in a broad range of sizes, from small units which can be transported fully assembled up to very large units which require assembly or construction on site. There are also many options in terms of materials of construction and fan arrangements so the designer can choose the best combination of performance, energy usage and product life for each particular application. Finally, evaporative cooling products are available with a broad array of accessories such as capacity controls, sound attenuation packages and anti-vibration mounts.



COOLING:



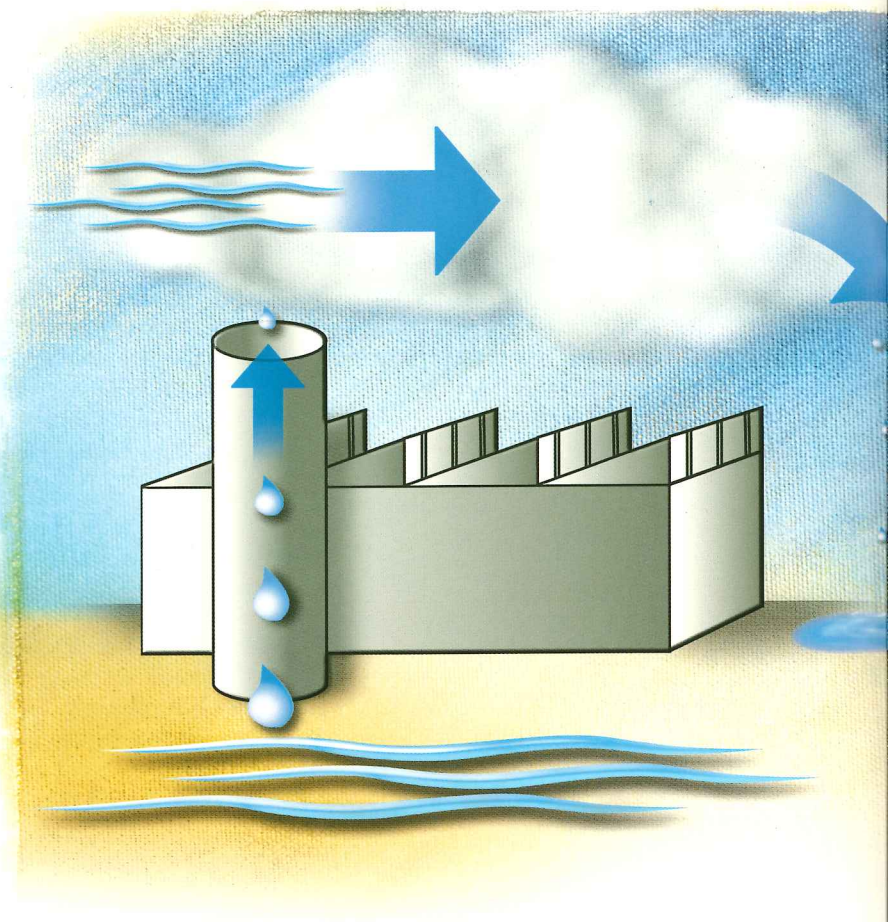


A FRONT-RUNNER IN ENERGY SAVING

Effective heat transfer combined with lower airflow through the unit makes evaporative cooling equipment a front runner when it comes to energy savings. Firstly, the lower cooling water temperatures achieved by evaporative cooling assure optimal operation of the process as very often these lower temperatures increase process efficiency and reduce energy usage. Secondly, the evaporative cooling equipment itself is highly energy efficient due to its use of latent heat transfer. Thus, both by application and design, evaporative cooling equipment saves energy and reduces emissions of greenhouse gases that cause global warming.

MAXIMUM SYSTEM SAFETY

Evaporative cooling equipment is highly suited to indirect systems which reduce the risk of harmful leakage or spillage. The possibility of cooling water temperatures to 25°C or below enables the use of an intermediate heat exchanger which means the process fluid can be cooled in a closed loop to 30°C or less. By comparison, air cooled equipment, which is dependent on the ambient dry bulb temperature, can only achieve process fluid temperatures of around 50°C. For many processes, these temperatures are prohibitively high so that the process cannot operate at all or at very low efficiency. Evaporative cooling avoids this problem and both process efficiency and system safety are assured.



LESS USE OF RESOURCES

In evaporative cooling systems the cooling water is recirculated and there are only minimal water losses. A small portion is evaporated and a further small amount is drained off from the system to prevent uncontrolled concentration of impurities in the water. The water saving compared to a 'once through' cooling system is over 95%.

Electrical energy requirement is also low. Since four times less air is needed than for comparable air cooled equipment, fan motor power consumption is much lower. Use of high efficiency fans and an aerodynamic design for the heat transfer section result in excellent overall energy efficiency for evaporative cooling equipment.

LOW ENVIRONMENTAL IMPACT

SOUND

Evaporative cooling has a low environmental impact as far as noise, drift loss and plume are concerned. The predominant source of sound from both evaporative and air cooled equipment is the air moving system. As evaporative cooling needs less air, the equipment needs fewer fans or fan runs at lower speeds, both of which reduce audible sound levels. These can be reduced further by the use of two speed fan motors, variable frequency drives (VFD) or sound attenuation packages.

DRIFT LOSS

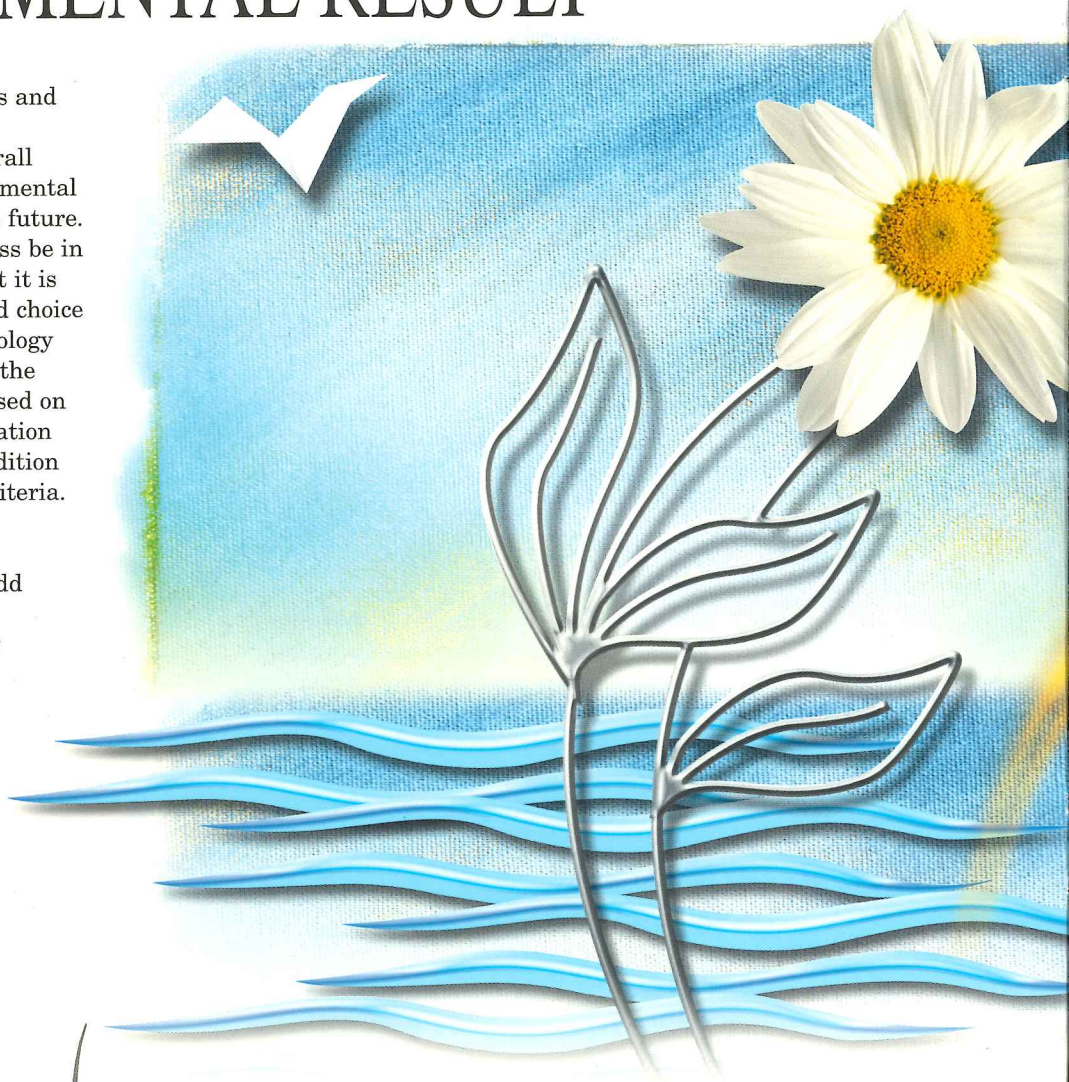
Drift loss is the aerosol or small water droplets that are entrained in the leaving airstream as the air is forced or induced through the evaporative cooling equipment. It is common practice to fit the high efficiency drift eliminators at the discharge of the equipment to minimise the drift and thus limit the water lost to very small quantities. Drift eliminators also play a role in preventing harmful bacteria within the droplets escaping from the unit should the water in the evaporative cooling equipment be contaminated.
An adequate regime of water quality control and maintenance is recommended and more information can be found in Eurovent Publication 9/5 'Recommended Code of Practice to Keep Your Cooling System Efficient and Safe".

PLUME

Under certain weather conditions, a visible plume emanates from the evaporative cooling equipment as the warm, humid discharge air condenses upon mixing with colder ambient air. This plume is pure condensed water vapour only, similar to clouds, and is harmless, it may only generate locally reduced visibility or icing hazards. Several plume abatement methods are available to minimise or even eliminate the visible plume.

CHOOSING A COOLING TECHNOLOGY FOR THE BEST ENVIRONMENTAL RESULT

Heat transfer equipment is an integral part of many processes and its proper choice is of utmost importance in maximising overall efficiency and meeting environmental responsibilities now and in the future. In order that industrial progress be in harmony with the environment it is necessary to make a considered choice of the best heat transfer technology for each application. Choosing the best technology needs to be based on a thorough analysis and evaluation of environmental factors in addition to technical and commercial criteria. An 'environmental' approach to choosing between different technologies may sometimes add cost but must also be seen as an investment in protecting the environment.



EVAPORATIVE COOLING PROVIDES THE

A RESPONSIBLE WORLD

AN INDUSTRY CONTINUOUSLY STRIVING TOWARDS OPTIMAL SOLUTIONS

The principle of evaporative cooling has been applied in industry for more than 100 years during which the surrounding technology has been continually improved. The useful life of evaporative cooling equipment has been greatly extended by the use of corrosion resistant materials; heat transfer efficiency has been increased by the development of improved heat exchanger configuration; sound levels have been reduced by the use of low noise fans with an aerodynamically efficient design as well as other sound reducing accessories and options. In addition, sophisticated performance models have been created that allow the thermal performance of evaporative cooling products to be predicted under a variety of operating conditions. Today, the European manufacturers of evaporative cooling equipment offer a broad range of high quality, reliable products and constantly strive for further improvement.

BEST ENVIRONMENTAL BALANCE

THE SIGNIFICANCE OF THE EVAPORATIVE COOLING INDUSTRY IN EUROPE

A WIDE RANGE OF APPLICATIONS

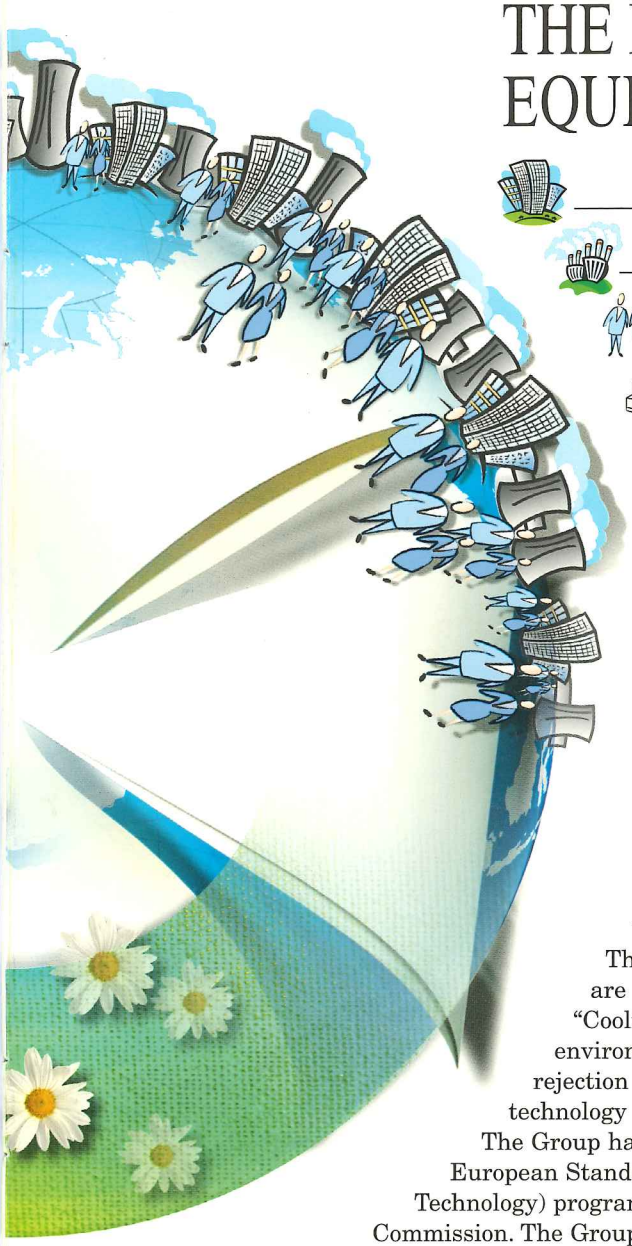
Evaporative cooling equipment is available in many configurations and sizes, from a small factory assembled unit on a building to a large site-erected structure at a power station. Evaporative cooling equipment is used for almost every cooling need:

- air conditioning systems for buildings
- petrochemical and pharmaceutical industries
- automotive industry
- steel making processes
- electronic and semiconductor plants
- power generating stations
- co-generation plants
- industrial refrigeration systems
- machinery cooling such as compressors

and many, many more applications.

In Europe alone, there are more than **500,000** evaporative cooling equipment installations which provide over one million MW of cooling. Without evaporative cooling, most of the processes at these installations could not operate or would only operate at significantly lower efficiencies. Without the energy saving benefits of evaporative cooling equipment there would be substantially greater usage of precious natural resources and more threat to the environment.

THE EVAPORATIVE COOLING EQUIPMENT INDUSTRY IN EUROPE



MORE THAN 30 COMPANIES

MORE THAN 50 FACTORIES

OVER 7,000 EMPLOYEES

500,000 INSTALLATIONS IN OPERATION

The European evaporative cooling equipment industry comprises over **30 manufacturers with more than 50 manufacturing plants** employing over **7,000 employees**. The total annual turnover of the industry **exceeds 500 million Euros**. Thousands of installations are added each year and the number of owners and operators is countless.

The widespread use of evaporative cooling, backed by a substantial manufacturing industry, is evidence that it plays an important role in today's industrial society. In order to perpetuate a more comfortable lifestyle, through responsible industrial progress, evaporative cooling is the preferred technology for nearly all waste heat removal applications.

A RESPONSIBLE INDUSTRY

The major European manufacturers of evaporative cooling equipment are associated in the Eurovent/Cecomaf Working Group 9 "Cooling Towers". The Working Group focuses on the environmental importance of efficient and safe heat rejection systems for which evaporative cooling technology provides effective solutions.

The Group has participated in drawing up European Standards and in the BAT (Best Available Technology) programme launched by the European Commission. The Group has published a number of technical documents including Eurovent 9/5 "Recommended Code of Practice To Keep Your Cooling System Efficient and Safe".

More information about Eurovent/Cecomaf and Working Group 9 "Cooling Towers" can be found on the Eurovent/Cecomaf website www.eurovent-cecomaf.org.

EUROVENT/CECOMAF

80, Boulevard REYERSLAAN
1030 BRUSSELS - BELGIUM
http.www.eurovent-cecomaf.org