

EUROVENT INDUSTRY MONOGRAPH 9/1 - 2019

THE EUROPEAN EVAPORATIVE COOLING INDUSTRY IN A NUTSHELL

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1. INTRODUCTION

The demand for energy efficient buildings and more stringent environmental sustainability requirements in the process industry have increased in recent years. As a consequence, the comfort and industrial cooling industry needed to be considerably dynamic in replying to the changing market demand.

Evaporative cooling combines high thermal efficiency and cost effectiveness by achieving low cooling temperatures with minimum energy and water usage. Low cooling temperatures are essential for many processes to achieve high system efficiency. These processes consume less energy, and, in this way, evaporative cooling contributes to preserving natural resources and the environment.



1.1 GENERAL OBJECTIVE

Evaporative cooling products are used to remove waste heat from processes and reject it to the atmosphere. Unlike with other heat rejection equipment, the thermal performance of evaporative cooling products largely depends on the evaporation of water caused by effective mixing of water and air. The latent heat transfer, caused by evaporation, is not governed by aerodynamic principles only. In fact, aerodynamic efficiency plays only a minor role in the total heat transfer

With evaporative technologies it is possible to decrease the process temperature up to about the wet bulb temperature (lower than dry temperature). Compared to cooling with dry air (sensible heat transfer), evaporative cooling is more efficient; with 1 kilogram of water the heat removed is about 2.200 kilojoule (heat of evaporation) per degree °C, while with 1 kilogram of air the heat removed is about 1 kilojoule per degree °C.

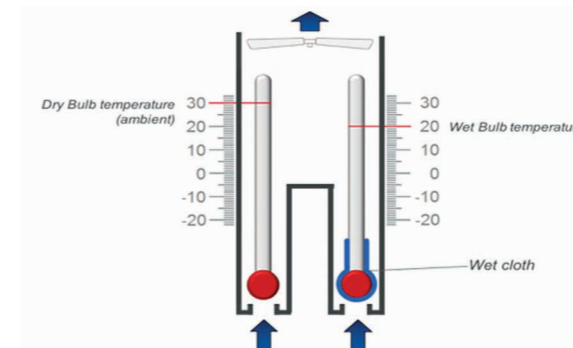


Fig. 1: Wet bulb and dry bulb air temperature

1.2 DIFFERENT TYPES OF THE EQUIPMENT

1.2.1 OPEN CIRCUIT COOLING TOWER

Water from the heat source enters an inlet connection and is distributed over the fill pack through a spray distribution arrangement. Simultaneously, ambient air is induced or forced through the tower, causing a small portion of the water to evaporate. This evaporation removes heat from the remaining water. The cooled water falls into the tower sump from where it is returned to the heat source. It is 'open circuit' as the water to be cooled is in contact with the atmosphere.

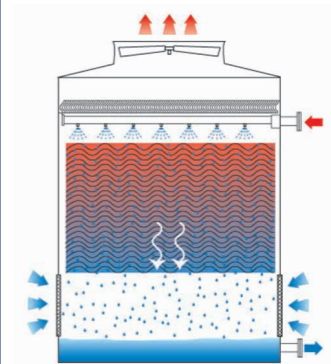
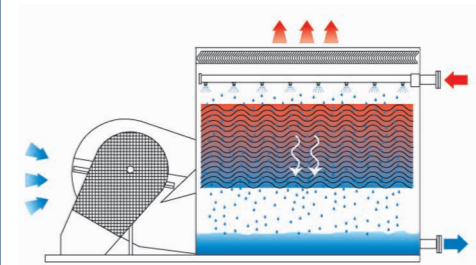


Fig. 2: Open circuit cooling towers

1.2.2 CLOSED CIRCUIT COOLING TOWER/CONDENSER

The fluid to be cooled is circulated inside the tubes of the heat exchange coil. A secondary system distributes water over the tubes of the coil. Simultaneously, air is forced or drawn through the coil causing a portion of the secondary water to evaporate. This evaporation removes heat from the fluid or refrigerant inside the coil. The secondary water falls to the sump from where it is again pumped over the coil. This is called 'closed circuit' as the fluid to be cooled is in a sealed loop and does not come into contact with the atmosphere

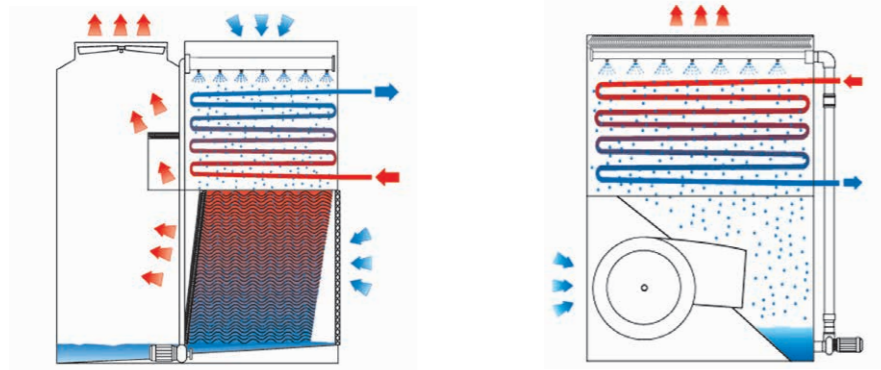


Fig. 3: Closed circuit cooling towers / condenser

1.3 THE MAJOR APPLICATION AREAS

Evaporative cooling equipment finds its field of application in all those processes which have better efficiency due to water evaporation (benefit of lower cooling temperature). These are the so-called "temperature sensitive" processes.

Examples of these processes include:

- HVAC applications
- Industrial applications
- Industrial refrigeration applications

1.4 THERMAL PERFORMANCE CERTIFICATION: ECC & CTI

The most fundamental aspect of quality for any machine is the ability to fulfill its design function. For evaporative cooling equipment this mission is proper heat rejection.

Accurately quantifying the temperature level at which heat is rejected is a challenge that requires expertise and know-how. National and International Standards for thermal performance testing of cooling towers have been prepared in cooperation with engineering societies, associations and institutes. These Standards focus on performance testing as a part of the commissioning process of a specific installation. However, manufacturers have a need for thermal performance testing programmes that certify the performance for an entire product line and guarantee to third parties the correct performance in accordance with published data. Depending on the manufacturing locations, a manufacturer also might wish to guarantee consistent and identical reproduction of the base design with a consequential transferrable performance guarantee to the alternate production locations.

The thermal performance certification has remained a recurring item on the agenda of the European evaporative cooling industry. In this respect, a joint Eurovent Certita Certification (ECC) and CTI (Cooling Technology Institute) certification programme is in place. This programme assesses and certifies the Thermal Performance and Efficiency of a cooling tower.



1.5 THERMAL PERFORMANCE AND EFFICIENCY

The cooling tower shall be capable of cooling a certain amount of water from a defined temperature to another defined temperature at the design wet-bulb air entering temperature.

The thermal performances are ECP certified in accordance with the most recent ECC and CTI certification standards.



2. MANUFACTURERS AND PRODUCTS

2.1 ESTIMATED NUMBER OF MANUFACTURERS IN EUROPE

The European evaporative cooling industry is almost entirely made up of SMEs (Small and Medium Enterprises). By considering manufacturers coming from EU28, Russia, and Turkey, it is possible to estimate a final number of about **45 manufacturers active in Europe¹**.

2.2 PRODUCTION SITES ALL OVER EUROPE

According to the above estimated number of manufacturers active in Europe, it is possible to estimate that in EU28, Russia, and Turkey there about **50 production sites for evaporative cooling equipment¹**.

2.3 ESTIMATED COMBINED ANNUAL TURNOVER

Based on declared and reassessed data, the EU evaporative cooling industry (not including the field erected equipment) has a **direct yearly combined turnover of about 265M EUR¹**.

2.4 EMPLOYMENT FIGURES

Based on declared and reassessed data, the EU evaporative cooling industry (not including the field erected equipment) has an **aggregated direct number of employees of about 1.420 people¹**.

2.5 PRODUCTS INSTALLED IN EUROPE PER YEAR

Based on declared and reassessed data, the total aggregated number of installed evaporative cooling equipment (not including the field erected equipment) in EU28, Russia, and Turkey in 2017 is about **4.000 sold units¹**.

¹ Source: Eurovent Market Intelligence



3. ENERGY CONSUMPTION AND CO₂ SAVING

3.1 INSTALLED HEAT REJECTION CAPACITY

Based on declared and reassessed data, **the installed heat rejection capacity** (not including the field erected equipment) **in EU28, Russia, and Turkey in 2017 is about 3.600.000 kW¹.**

3.2 ELECTRICAL POWER ABSORBED BY AUXILIARIES' COMPONENTS (FANS)

Based on declared and reassessed data, **the electrical power absorbed by auxiliaries' components (fans) in EU28, Russia, and Turkey in 2017 is about 66.000 kW¹.**

3.3 ACHIEVABLE CO₂ SAVING DUE TO EVAPORATIVE TECHNOLOGIES AND RELATED FIGURES

The average installed base of air-cooled chillers (cooling capacity > 1.000 kW) in EU28 is about 530 units per year².

Eurovent has conducted an extensive study, which has simulated, on a year-round base, the typical behaviour of a refrigeration system using an air-cooled condenser and a water-cooled condenser using wet cooling towers.

This study has resulted in average CO₂ emission saving of about 15,5% for industrial applications and 16% for HVAC applications.

By converting the above estimated installed base of air-cooled chillers (530 units per year in EU28), it is possible to conclude that by using evaporative cooling equipment **CO₂ emission saving of about 56.000 tons of CO₂/ per year is fully achievable.**

The above estimated possible CO₂ savings can be translated in¹:

- Greenhouse gas emissions from 10.800* passenger vehicles driven for one year
- CO₂ emissions from electricity use of 8.800* for one year
- CO₂ emissions from 118.000* consumed barrels of oil
- Carbon sequestered by 24.000* hectares of forest

² Source: Eurovent Market Intelligence



4. LEGISLATION AND STANDARDISATION

4.1 APPLICABLE EU LEGISLATION

- [1] Machinery Directive: 2006/42/EC
- [2] Waste Electrical & Electronic Equipment Directive: 2012/19/EU
- [3] Pressure Equipment Directive: 2014/68/EU
- [4] Ecodesign Directive: 2009/125/EC
- [5] ENER Lot 11 - Fans - Ecodesign Regulation (EU) 327 2011
- [6] ENER Lot 21 - Ecodesign Regulation (EU) 2016 2281

4.2 APPLICABLE NATIONAL LEGISLATION

- [1] Austria: Verordnung biologische Arbeitsstoffe (VbA BGBl. II Nr. 237/1998)
- [2] Belgium: Decree Flemish Government of February 9, 2007 n.133
- [3] Belgium: Conseil Supérieur d'Hygiène, section V (C.S.H.: 4870) – Avis du 14/06/2000, approuvé le 29/09/2000, relatif aux dangers de et aux mesures préventives contre une contamination par Legionella en Belgique
- [4] Bulgaria: Regulation No 21/2005 for notification, registration and reporting of communicable diseases (in Bulgarian). Ministry of Health, Official Bulletin 15, 2005
- [5] Czech Republic: Ministry of Health - Decree of No. 473/2008 on surveillance system of selected infectious diseases
- [6] Finland: 229/1998 Sosiaalija terveystieteiden päätös biologisten tekijöiden luokituksesta. Retrieved 30 June 2009
- [7] Finland: Turvallisuustiedote 43 Biologisten tekijöiden luokitus. Retrieved 30 June 2009
- [8] France: Decree N. 2001-97, 1 February 2001
- [9] France: Decree N. 2001-532, 20 June 2001
- [10] Germany: Gesetz zur Neuordnung seuchenrechtlicher Vorschriften – (Seuchenrechtsneuordnungsgesetz - SeuchRNeuG), Act on the Reform of the Communicable Diseases Law (Communicable Diseases Law Reform Act)

- [11] Hungary: 61/1999. (XII. 1.) EüM rendelet a biológiai tényezők hatásának kitett munkavállalók egészségének védelméről. Retrieved 26 June 2009
- [12] Italy: Linea Guida del Ministero della Sanità: Linee guida per la prevenzione ed il controllo della legionellosi – 2015
- [13] Luxembourg: Code du Travail, Livre III – Protection, Sécurité et Santé des Travailleurs. Retrieved 26 June 2009
- [14] Luxembourg: Règlement grand-ducal du 8 juin 1999 portant modification et première adaptation au progrès technique du règlement grand-ducal du 4 novembre 1994 concernant la protection des travailleurs contre les risques liés à l'exposition à des agents biologiques au travail. Retrieved 26 June 2009
- [15] Malta: L.N. 5 of 2006
- [16] Netherlands: De registratie van natte koeltorens
- [17] Norway: FOR 2003-04-25 nr 486: Forskrift om miljørettet helsevern. Retrieved 29 June 2009
- [18] Spain: Royal Decree 865/2003
- [19] United Kingdom: Notification of cooling towers and evaporative condenser regulations 1992 http://www.opsi.gov.uk/SI/si1992/Uksi_19922225_en_1.htm
- [20] United Kingdom: Code of Practice (L8) on The Control of Legionella in Water Systems [4]. This ACoP gives practical advice on the requirements of HSWA 1974 and COSHH, and compliance with the relevant parts of MHSWR regarding the risk from exposure to Legionella bacteria

4.3 ISO STANDARDS

- [1] ISO 16345 - Water-cooling towers — Testing and rating of thermal performance
- [2] ISO 3744: Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane
- [3] ISO 19458: 2006: Water quality, sampling for microbiological analysis

4.4 EN STANDARDS

- [1] EN 14705 – Method of measurement and evaluation of thermal performances of wet cooling towers
- [2] EN 13741 – Thermal performance acceptance testing of mechanical draught series wet cooling towers

4.5 CTI STANDARDS

- [1] CTI ATC-105: Acceptance Test Code for mechanical draft and natural draft cooling towers
- [2] CTI ATC-106: Acceptance Test Code for Mechanical Draft Evaporative Vapour Condensers
- [3] CTI ATC-128: Test code for measurement of sound from water-cooling towers
- [4] CTI STD-201: Standard for Thermal Performance Certification of Evaporative Heat Rejection Equipment
- [5] CTI STD-203: Standard covers the design, fabrication and inspection of crossflow and counterflow mechanical draft cooling towers

4.6 ASHRAE STANDARDS

- [1] ASHRAE 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings
- [2] ASHRAE 188-2015: Legionellosis: Risk Management for Building Water System
- [3] ASHRAE 189.1: Standard for the design of high-performance Green Building

4.7 NATIONAL STANDARDS, SPECIFICATIONS AND RECOMMENDATIONS

- [1] VDMA Specification 24649:2015-07: Operational recommendations for evaporative cooling equipment
- [2] VDMA 24659:2015-07: Economic analysis and partial carbon footprint of evaporative cooling equipment - Guideline for calculation

4.8 EUROVENT RECOMMENDATIONS

- [1] Eurovent 9/1 - 1992: Mechanical draught cooling towers: Selection, installation and maintenance
- [2] Eurovent 9/2 - 1992: Thermal performance acceptance testing of mechanical draught standardized water-cooling towers
- [3] Eurovent 9/3 - 1999: Mechanical draught cooling tower acoustics practical guide
- [4] Eurovent 9/4 - 1999: Minimisation of environmental impacts of waste heat removal systems in Europe
- [5] Eurovent 9/5 - 2002: Recommended code of practice to keep your cooling system efficient and safe
- [6] Eurovent 9/6 - 2002: Eurovent guidelines on how to keep your evaporative cooling system safe
- [7] Eurovent 9/7 - 2011: Recommendation to keep your cooling system efficient and safe
- [8] Eurovent 9/11 - 1999: Application of the Machinery Safety Directive to Standard Mechanical Draught Series Cooling Towers – First edition
- [9] Eurovent 9/11 - 2017: Application of the machinery safety directive – Second edition
- [10] Eurovent 9/12 - 2016: Performance Efficiency Standard for Evaporative Cooling Equipment

4.9 VDI COOLING TOWER CODE OF PRACTICE

- [1] VDI 2047-2: Securing hygienically sound operation of evaporative cooling systems

ABOUT EUROVENT

Eurovent is Europe's Industry Association for Indoor Climate (HVAC), Process Cooling, and Food Cold Chain Technologies. Its members from throughout Europe, the Middle East and Africa represent more than 1.000 organisations, the majority small and medium-sized manufacturers. Based on objective and verifiable data, these account for a combined annual turnover of more than 30bn Euros, employing around 150.000 people within the association's geographic area. This makes Eurovent one of the largest cross-regional industry committees of its kind. The organisation's activities are based on highly valued democratic decision-making principles, ensuring a level-playing field for the entire industry independent from organisation sizes or membership fees.

OUR MEMBERS

Our 'Members' are national associations from Europe, the Middle East and Africa that are representing manufacturers in the area of Indoor Climate (HVAC), Process Cooling, Food Cold Chain, and Industrial Ventilation technologies.

The more than 1.000 manufacturers within our network (Eurovent 'Affiliated Manufacturers' and 'Corresponding Members') are represented in Eurovent activities in a democratic and transparent manner.

For in-depth information and a list of all our members, visit www.eurovent.eu





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