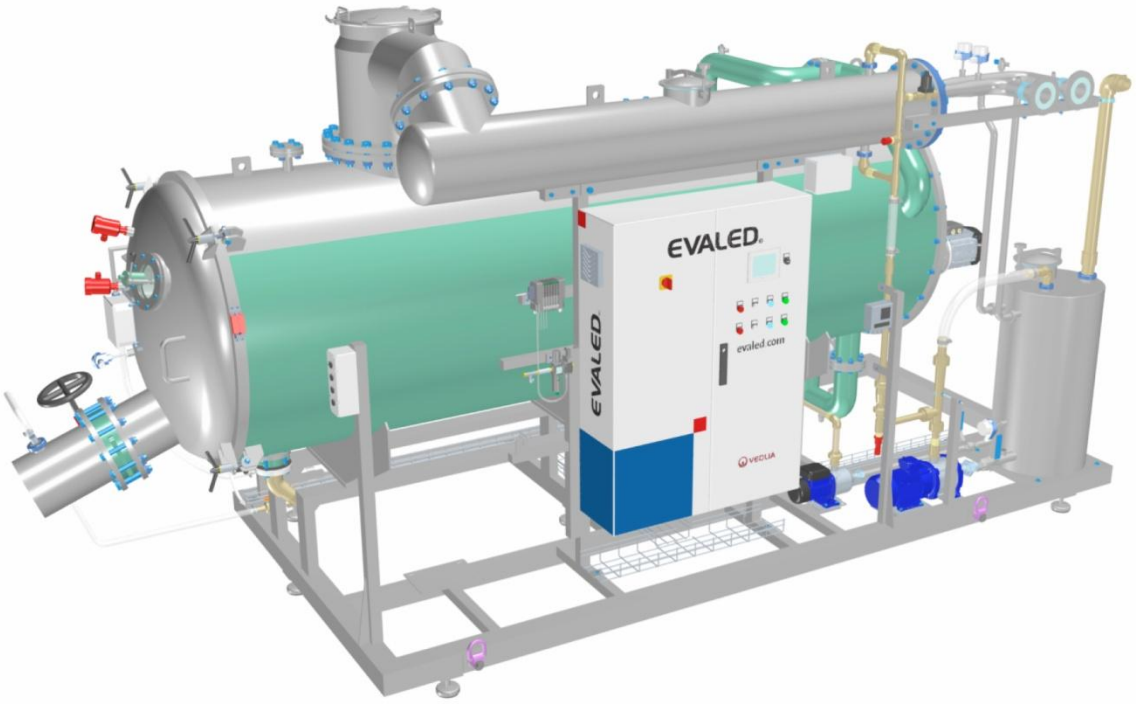
EVALED®

AC technology | R series | 6



More information on this product.

VEOLIA

technical report

Vacuum evaporator
with scraped system
and heating jacket exchanger

CO_2 footprint

1 Technical characteristics

Nominal production capacity of distillate with water:	6000 [l/24h]
Available versions:	**AC R 6 FF#** (superduplex stainless steel)
Electrical equipment:	AC R 6 --3 (400 [V] 50 [Hz] 3P) AC R 6 --4 (460 [V] 60 [Hz] 3P)
Construction:	pre-assembled single module on a stainless steel frame
Condensation heat exchanger:	with U tubes
Heating exchanger:	heating jacket
Evaporation conditions:	absolute pressure 4-30 kPa. Temperature 30-70 [°C]. Working conditions may differ according to the temperatures of the heating and condensing fluids.
Distillate and concentrate temperature:	30-70 [°C]. Working conditions may differ according to the temperatures of the heating and condensing fluids.
Drops separator:	perforated grill demister with packing elements
Heating/cooling technology:	hot water/cold water
Vacuum system:	liquid ejector
Operating control:	automatic, continuous 24/24h 7/7d by PLC Siemens S7-1200; status information and consent to equipment operation remotable through digital signals
Operator panel:	touch screen Proface GP4000 series
International Protection Rating:	IP 54
Noise:	maximum value ~75 [dB(A)] measured at 1 mt from the surface of the machinery and at 1,6 mt from the floor
Main reference legislation: *(CE marking)*	Machinery Directive (2006/42/CE) Electromagnetic compatibility (2014/30/UE) Electrical safety (EN 60204-1)

2 Nominal performance

The data reported in the following table (values tolerance ± 10%) refer to the performances achieved with clean machine fed with tap water, in standard atmospheric conditions and with service fluids respecting the limits mentioned in paragraph 9.

Version	**UM**	**AC R 6**
Maximum production of distillate with water	[l/24h]	6000
Absorbed power	[kW]	6
Electrical specific consumption per litre of distillate	[Wh/l]	24
Thermal specific consumption (heating) per litre of distillate	[kJ/l]	3000
Thermal specific consumption (cooling) per litre of distillate	[kJ/l]	3000
Heat generated by thermal dissipation	[kW]	15
Concentrate volume for each discharge	[l]	2500

3 Functional description

The machine AC R 6 is a scraped evaporator for the treatment of water based liquids. It uses the effect of vacuum to make water based liquids boil at low temperature (30-70°C).
The machine works in batch mode: at the end of the treatment cycle it stops working and discharges the boiler.
Depending on examination of the liquid characteristics, the concentrate may be automatically discharged through the optional pneumatic valve **VP15** or through optional pump **G04** (see par. 3.4).
For component identification refer to figure 1.

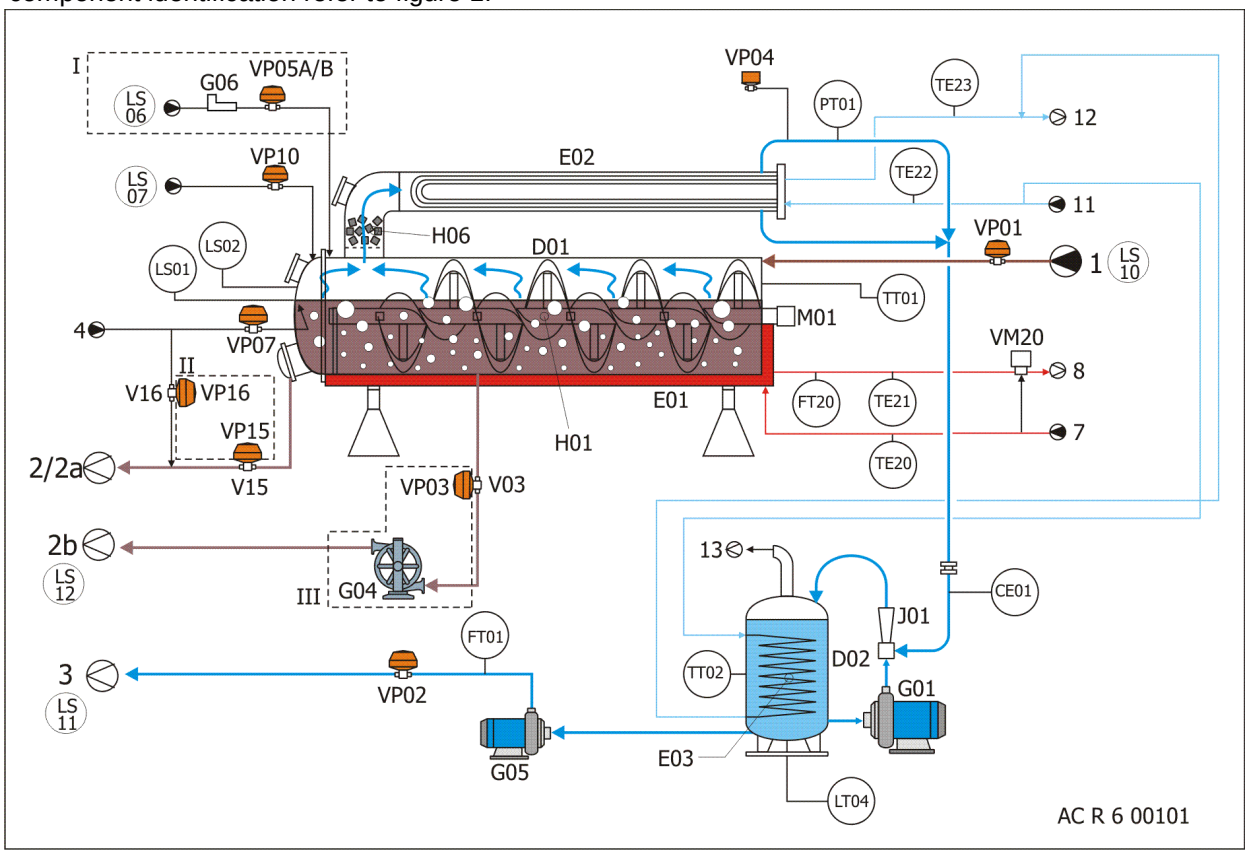


Figure 1

The numbers within a circle are the main sensors of the machine. The Roman numerals and the dashed lines indicate the optional components. The numbers near the inlet and the outlets indicate the connection to the process lines.

3.1 Process liquids circuit

The liquid to be treated is sucked into the boiling chamber **D01** as a result of the vacuum created inside it by the vacuum system. The feed is controlled by the level sensor **LS01** which controls the pneumatic valve **VP01**. The bottom of evaporation chamber consists of a heating jacket heat exchanger **E01**. Inside the boiling chamber there is a scraper **H01**, driven by an electric motor-reducer **M01**. The Archimede screw shape assures a good cleaning of the heat exchanger **E01** walls and an efficient stirring.
Hot water, coming from the user supply, flows into the heat exchanger **E01**. The contact between the process liquid and the walls of the heating jacket leads to the boiling of the liquid itself. The vapor firstly goes through a grate type with packing elements **H06** to damp the drops and secondly goes into the U tubes heat exchanger **E02.** The vapor condenses in the heat exchanger shell, whilst cold water, coming from the user supply, flows through the tubes.
The vacuum system extracts the distillate together with any incondensable gases and sends them to the storage tank **D02**. The distillate is discharged through the pump **G05** according to the measure of the level sensor **LT04.** Incondensable gases come out of the air breather tube located on the top of the distillate storage tank **D02**. The concentrate is discharged according to the functioning mode of the equipment, that is based on the duration of the treatment cycle or when the desired concentration is reached (the discharge procedure is described in par.3.4).

3.2 Vacuum system

The vacuum system consists of a centrifugal pump **G01** coupled to the ejector **J01**. The ejector works on the Venturi principle and uses the distillate produced by evaporator as a motor fluid. The efficiency of the vacuum

system depends on the temperature of the motor fluid; the coiled heat exchanger **E03** cools the distillate in the tank **D02**. The opening of the valve **VP04** breaks the vacuum inside the boiling chamber.

3.3 Heating and cooling circuits

Hot and cold water networks supply energy to bring liquid to boiling point and to let the steam condense. The motor-driven valve **VM20** controls the hot water flow rate into the exchanger **E01** according to the values measured by the temperature sensors **TT20/21** and by the flow rate sensor **FT20**. Sensors **TT22** and **TT23** measure the input and output temperature of cooling water in the condenser **E02**.

Hot water required to boil the liquid and cold water necessary to condense the steam are both at user's care. Utilities supply shall be pre-arranged with suitable characteristics (see par.9). If these service networks are not available, it is possible to install the option for the simultaneous production of hot and cold water OR PC R. Refer to the dedicated technical report for further details.

3.4 Concentrate discharge

The concentrate discharge may be carried out in three alternative modes (that can not work simultaneously):

- Manual mode (output 2) - standard: through the opening of manual butterfly valve **V15** installed on the boiler front door.
- Automatic mode with front valve (output 2a) – option OT PD C: through the opening of pneumatic butterfly valve **VP15** installed on the boiler front door;
- Automatic mode with pump (output 2b) - option OT DP C: using the pneumatic discharge pump **G04** and pneumatic valve **VP03.**

The activation of the scraper, during the discharge, helps the emptying of the boiling chamber.

The concentrate discharge mode must be chosen according to the characteristics of the fluid to be drained (e.g. dry content, set treatment parameters etc.).

3.5 Auxiliary liquids

Antifoam, supplied through the pneumatic valve **VP05A/B** if the optional system **OM AF F** is installed.

Additive (or antifoam) supplied through the pneumatic valve **VP10**.

Tap water for washing of level sensors **LS01/02** inside the boiling chamber **D01,** and for washing of the concentrate discharge valve **V15/VP15**.

Bactericide for the distillate, if the optional system **AM BT D** is installed.

4 Options and Accessories

(*1)	Code	Description	Standard/Opt
[-]	-	Provision for level control on external process liquid tanks	S
[-]	OT CP D	Distillate transfer device (40 l/min – 2 bar)	S
[-]	OC FM D	Distillate flow rate measuring device	S
[-]	OC CN D	Distillate conductivity control device	S
[-]	OW TW	Automatic washing of the level switch in the evaporation chamber	S
[-]	OM AD F	Additive/antifoam dosing device (*4)	S
I	OM AF F	Antifoam dosing device with pump for high dosages	O
II	OT PD C	Device for the automatic concentrate discharge with pneumatic front valve	O
III	OT DP C	Device for the automatic concentrate discharge with pneumatic pump	O
[-]	OC EN	Ethernet interface device *(*2)*	O
[-]	OC PB	Profibus interface device *(*2)*	O
[-]	OI AQ	Interface device for Aquavista digital platform *(*2) (*3)*. Ethernet option "OC EN" required	O
[-]	OR PC R	Device for simultaneous production of hot and cold water	O
[-]	AM BT D	Bactericide dosing device	O
[-]	AR PE S	Device for hot water production with industrial steam	O

**1) See the diagram in figure 1. *2) To be considered when ordering. *3) Can be combined with remote control contract EVA-Link. Refer to the specific Aquavista documentation. *4) It can be used for antifoam product. If the machine treats liquids that produce a lot of foam, use the specific optional OM AF F.*

As regards the interface device for Aquavista digital platform **OI AQ,** the device for simultaneous production of hot and cold water **OR PC R** and accessories **AM BT D** and **AR PE S** refer to the specific technical reports.

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5 Construction materials

The main materials that come into contact with the process liquids are listed in the following tables.

Materials:

SS 304/L	Austenitic stainless steel AISI 304 (EN 1.4301) / AISI 304L (EN 1.4306)
SS 316/L	Austenitic stainless steel AISI 316 (EN 1.4436) / AISI 316L (EN 1.4404)
SDSS	Superduplex stainless steel UNS S32750/UNS S32760 (EN 1.4410/EN 1.4501)
PP	Polypropylene
C22	Nickel alloy UNS N06022
FPM	Fluoropolymer
PTFE	Polytetrafluorethylene
CSP	Painted carbon steel
Ti	Titanium

Component	**ID**	**AC R 6 FF#**
Evaporation chamber	**D01**	SDSS
Distillate storage tank	**D02**	SS 316/L
Jacket heat exchanger	**E01**	SS 304/L
U tubes heat exchanger	**E02**	SS 316/L
Coil heat exchanger	**E03**	SS 316/L
Vacuum pump	**G01**	SS 316/L
Concentrate discharge pump (option)	**G04**	PP
Distillate discharge pump	**G05**	SS 316/L
Antifoam metering pump (option)	**G06**	PP
Liquid type ejector	**J01**	PP
Level switches inside the boiling chamber	**LS01/02**	C22
Structure and frame	**-**	SS 304/L
Piping and line parts	**-**	SS 316/L + PP
Service network piping (hot- cold water)	**-**	SS 304/L
Scraper blades	**-**	PTFE
Scraper screws	**-**	Ti
Gaskets	**-**	FPM+PTFE
Electrical panel	**-**	CSP

6 Dimensions and clearance zones

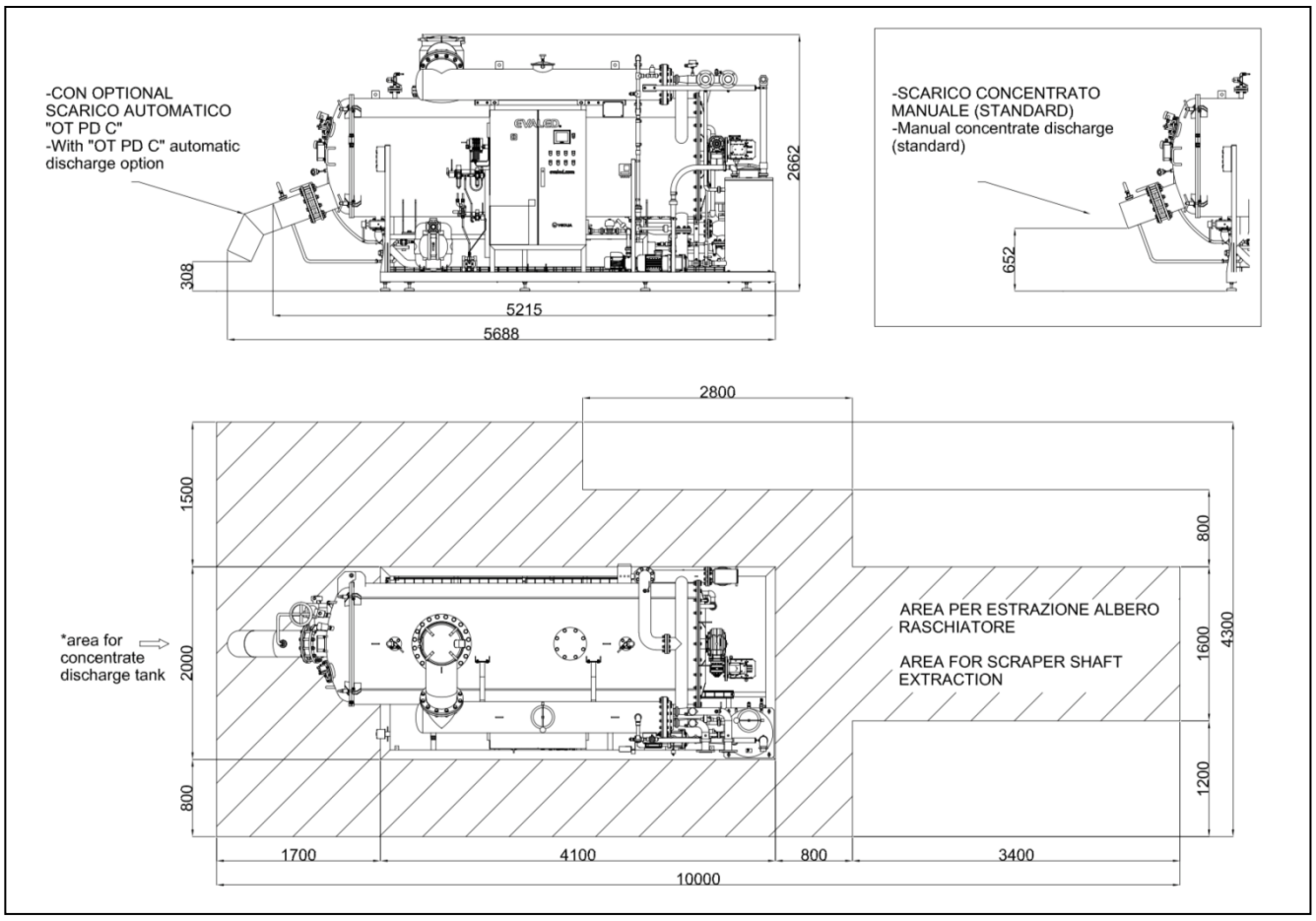

Figure 2

A clearance height of ~2 metres is required above the machine for maintenance operations.

Depending on the concentrate discharge mode and the type of installation it may be necessary to install the machine in a raised position to allow the positioning of a container under the front valve V15 / VP15 to collect the discharged concentrate.
The effective height must in any case be evaluated according to the collection type of the concentrate discharge and the dimensions of the container used. Contact VWT Italia for further details.

7 Dimensions, weight, packaging, storage and handling

Type	Dimensions [mm]	Weight [kg]
Standard packaging (pallet + nylon)	5200 x 2050 x 2700 h	3000
Packaging with wooden crate (also with protection bag)	5500 x 2200 x 2850 h	4000
Empty without packaging/under normal conditions with water	See Figure 2	2950 / 6000

If the equipment has to be stored for a prolonged period before the installation it must be kept in the delivery condition, indoor, in a clean, dry area within a temperature range of **+5** e **+45**°C.
The evaporator can be moved by pallet truck or forklift truck with forks of a suitable length or by a self-propelled crane or gantry crane using a harness and sling to balance the load.

8 Environmental conditions

Temperature	Working conditions
5÷45 [°C]	Normal conditions
0÷5 [°C]	Start up allowed only with precautions
<0 [°C]	provide antifreeze protection
>45 [°C]	Contact VWT Italia

The machine is designed to be installed at a maximum altitude of 1000 metres a.s.l. (for installations at higher altitude contact VWT Italia).
Should the machine have to work in a climate with temperatures lower than 0°C (high risk of freezing), it is advisable to use antifreeze in heating and cooling circuits or tracing the pipes.
With antifreeze, the evaporator performance will be lower than the nominal ones (par.2) and the required head in the service circuits higher than that reported in par.9. Contact VWT for further details

9 Installation requirements

The machine is designed to be installed indoors, in a safe area, in non-aggressive atmosphere, on a horizontal surface that can support the weights listed in section **7**.
Around the machine perimeter it is necessary to set some clearance zones to allow the personnel and the maintenance operators to work with no obstacles and to keep the air transit free (see section **6**). The clearance zone required in front of the main door of the machine depends on the size of the concentrate discharge tank used (shown in Figure 2). The features of the hydraulic connections are listed below:

(*1)	Description	Type	Dext [mm]	Available outlet pressure [barg]	Required inlet pressure [barg]
1	Liquid to be treated inlet	Hose-adapter	42	-	-0,3 <P< 1
2/2a	Concentrate discharge	Pipe	273	gravity	-
2b	Concentrate discharge with pump (option III)	Hose-adapter	52	~3	-
3	Distillate discharge	Hose-adapter	22	~2	-

**1) Ref. Figure 1*

The machine is supplied with a collector for the conveyance of non-condensable gases (in the distillate tank D02) that must be advisably canalized, if necessary, in respect of the local regulations.

The operative conditions inside the heating and cooling circuits strongly rely on global working conditions of the evaporator and on environmental conditions taking place on the installation site. Below are 2 examples of the characteristics of the service fluids to obtain nominal performance from the machine (these values do not consider the use of antifreeze).
The unit can operate in different conditions from those shown in examples A and B with different performances from the nominal ones (the performances could be lower in case of service fluids deriving from OR PC R); contact VWT Italia for more details.

Examples	A	B
Heating water		
Heating thermal power [kW]	210	
Flanged fittings inlet/outlet	DN 80	
Inlet water temperature [°C]	80	90
Outlet water temperature [°C]	65	65
Heating water flow-rate [m^3/h]	12	7
Required head [kPa] *	180	130

Cooling water		
Cooling thermal power [kW]	210	
Flanged fittings inlet/outlet	DN 65	
Inlet water temperature [°C]	10	30
Outlet water temperature [°C]	20	35
Cooling water flow-rate [m^3/h]	18	36
Required head [kPa] *	150	190

* hydraulic circuits external to the machine are not included

Cooling and heating water must be without solvents and/or corrosive substance, to preserve the machine components, and coarse material, inside the water, must have a diameter lower than 100 µm, in order to avoid piping clogging. Maximum pressure must not exceed 600 kPa. End user must check that, in high temperature conditions of the heating water, no depressurization conditions are reached.
The sectioning of the process lines by means of manual valves is at user's charge.

The machine is designed to work with hot and cold water. If industrial steam is available instead of heating water, an intermediate heat exchanger must be installed (see accessory AR PE S); the thermal heating power required remains the same and the steam flow necessary to guarantee it must be calculated.
If hot and cold water are not available at the installation site, the optional device for simultaneous production of hot and cold water OR PC R can be combined with the machine.

The machine requires the following utilities to operate:

	Setup	Required pressure	Flow rate	Connection	Features
Compressed air	AC R 6 –3/4	6 [barg]	1 [Nm^3/h]	PE tube (Dext 10 mm)	Dehydrated and without oils
Compressed air	AC R 6 –3/4 with option III	6 [barg]	20 [Nm^3/h]	PE tube (Dext 10 mm)	Dehydrated and without oils
Tap water	AC R 6 –3/4	1,5-3 [barg]	2 [m^3/h] (intermittent flow)	PP tube (Dext 22 mm)	For washing of components in D01 and of V15/VP15

	Setup	Frequency	Voltage	Nominal current / Installed power	Power supply
Electric energy	AC R 6 –3	50 (±2%) [Hz]	400 (±4%) [V]	12 [A] / 5,5 [kW]	3 PHASE + GROUND
Electric energy	AC R 6 --4	60 (±2%) [Hz]	460 (±4%) [V]	14 [A] / 7,5 [kW]	3 PHASE + GROUND

Electric cabinets are designed for triphase power feed networks type TN-C, TN-S (without neutral) or TT.
Short circuit current rating (Icc) ≤ 10kA.
The power line is responsibility of the customer and must be equipped with an adequately sized main power switch by a qualified technician, in accordance with good practice and in accordance with the protection level of the distribution board.

10 Documentation

The machine is supplied with standard documentation, realized according to standard Veolia formatting, symbols and tagging of components and that includes all options available for the machine. Different requests must be considered when ordering.

Standard documentation package includes:

- Installation, use and maintenance manual;
- Process diagram (P&ID);
- General assembly drawing with tie-points list;
- Wiring diagram;
- Spare parts list;
- FAT test report;
- CE declaration of conformity.
- Manuals of the main components installed on the machine (pumps, frequency inverter, instruments,…).

Physical quantities used in manual and HMI are expressed in SI units (International System) and derived units.
Standard documentation package is provided in hard copy (electronic version on request - pdf file).

11 Environmental Impact Reduction: CO_2 emissions

Below are the results of our Carbon Footprint study and a comparison with an extreme case of pollution:

$kgCO_{2eq}/m^3$ liquid waste treated	58.68
Percentage of emissions avoided with respect to incineration of the liquid waste	-95.2%

The first data value represents an average between the various industrial uses considering a use of the machine 24h/d, 330 d/y, for 10 years, road transport of the machinery to 1000 km from production site of the manufacturer and road transport of the chemical products for a distance of 100 km from the customer's site. The data of the comparison with incineration was weighted on the yield of the machine, i.e., the ratio between the initial liquid waste to be treated and the residual concentrate to be disposed of.

12 Chemical products

Chemical products are required during the normal operation of the machine. In order to obtain the best performances together with minimum consumptions, the manufacturer recommends using "Hydrex" chemical products.

"Hydrex" is the VEOLIA brand that meets the chemical products requirements of the wastewater treatment and process water production.

Notes

- For details concerning the safety and the installation of the machine refer to the use and maintenance manual.

- The data in this document are indicative. VWT Italia reserves the right to change any data without prior notice. The front-page photograph is neither representative of all versions nor models.