“ If we could ever competitively at a cheap rate, get fresh water from salt water that would outshine any other scientific accomplishments.”

- John F. Kennedy, April 1961

WME GmbH

Gesellschaft für windkraftbetriebene Meerwasserentsalzung mbH

Dorfstr. 38b (OT Starrvitz)

D-18556 Dranske/Rügen

Phone +49 3 83 91-83 21

www.wmea.de – info@wmea.de

Dr. Ulrich Plantikow

The WME MVC desalination plant has been carefully designed and tested by the team of WME headed by a reputed scientist Dr. Ulrich Plantikow with impeachable credentials as detailed below.

Dr. Ulrich Plantikow has been in the field of electro-physics for decades. His experience and knowledge in the field are proved by his numerous valuable contributions. He has approximately 14 publications addressing desalination to his credit along with over 10 patents.

He has been a member of the Technical-Scientific Council of the Nuclear Research Centre, Germany and has also been a delegate for the efficient use of energy for the project management energy research as a part of the project sponsorship of the nuclear research facility Jülich for the Federal Ministry for Research and Technology. In his early years, he assisted the renowned Prof. Dr. Heinz Maecker at the electro-physical institute of Munich, who is famous for producing the high-temperature plasma of 50,000 K.

Following his studies of nuclear physics he did his doctorate at the electro-physical institute of Munich. He worked on space technology at MBB and researched on the sector of fusion reactor development. Further on he committed himself to research and technology regarding energy conservation and wind energy.

In addition, Dr. Plantikow has been associated with various well-established companies like Thyssen AG and Messerschmitt-Bölkow-Blohm Gmbh. He became project manager of process managing for the production of oversized steel elements at the Thyssen AG.

WME seawater desalination plant on the Island of Rügen, Germany

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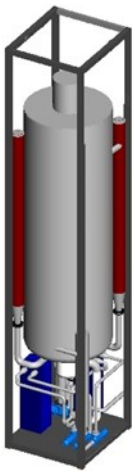


2013-2016 : Solution

Eco-friendly
Non-polluting cleaning system convinces in the Rügen desalination plant. Herald of a new era in chemical-free - MVC desalination.

Marketing : 2013

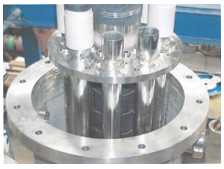
Distribution network
Preparation and statements about marketing agreements with trade representatives worldwide.

2012 : Patents

Exclusive rights
Registration and issuing of patents in the field of desalination processes. In 2006 already two patents were granted for the evaporator tubes.

Progress : 2008-2012

Co-operation
WME GmbH sets assembly cooperation with sub-suppliers industries in Germany. The evaporator construction in Saxonia, Germany, for example, ensures delivery reliability and superior quality.



2008 : Partnership

Wilhelm Banzhaf GmbH
Mr. Dipl-Ing.Werner Haase, CEO of Wilhelm Banhaf GmbH is extending the management.

Realization : 2006-2007

Executed R&D: Enhancing the heat transitions. Research on chemical-free cleaning systems. Scientific cooperation with universities and companies like ThyssenKrupp, GEA, University of Kempten.
Tube tests: Thermodynamic tests at the University of Hannover. Transforming lab-scale into an industrial process.

1999-2006 : Feasibility

Wind-driven desalination
Design and construction of a test desalination facility driven by wind energy on the Island of Rügen/ Germany.

Foundation : 1998

The founders of WME GmbH around Dr. Plantikow transfer a decade of know-how from a former company, consisting of feasibility studies and a small scale wind-driven desalination plant on the Island of Borkum/Germany into the newly established WME GmbH.

Company profile

The WME is a privately owned and managed company with limited liability. It was founded in June 1997 and is based in Dranske on the Island of Rügen, Germany. WME, in German, stands for “Windkraftgetriebene Meerwasser Entsalzung” which translates to wind-driven seawater desalination.

WME GmbH carries out the following activities:

1. R + D activities in the field of desalination, especially by use of regenerative energies, like wind and solar.

2. The operation of the existing wind driven desalination plant.

3. The operation of the mechanical vapor compression to concentrate e.g. waste water and whey.

4. The marketing of the wind driven desalination plant.

5. The sale of this plant

- by direct selling,
- by licensing and
- by entering joint venture agreements.

The WME GmbH is the owner of the patents and of the wind-driven desalination plant on the Island of Rügen in the Baltic Sea, consisting of a 300 kW wind energy converter, the connecting transformer to the public grid and the desalination plant of the mechanical vapor compression type with vertical evaporation-condensation tubes (type MVC-VT).

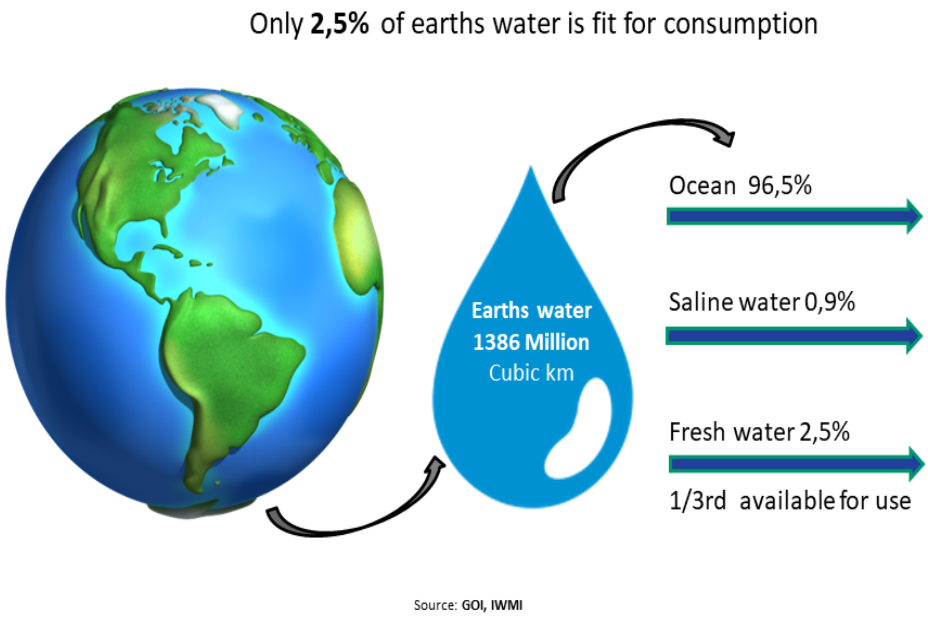
WME has contracted several agreements for the marketing and selling of its products.

The staff of WME consists of

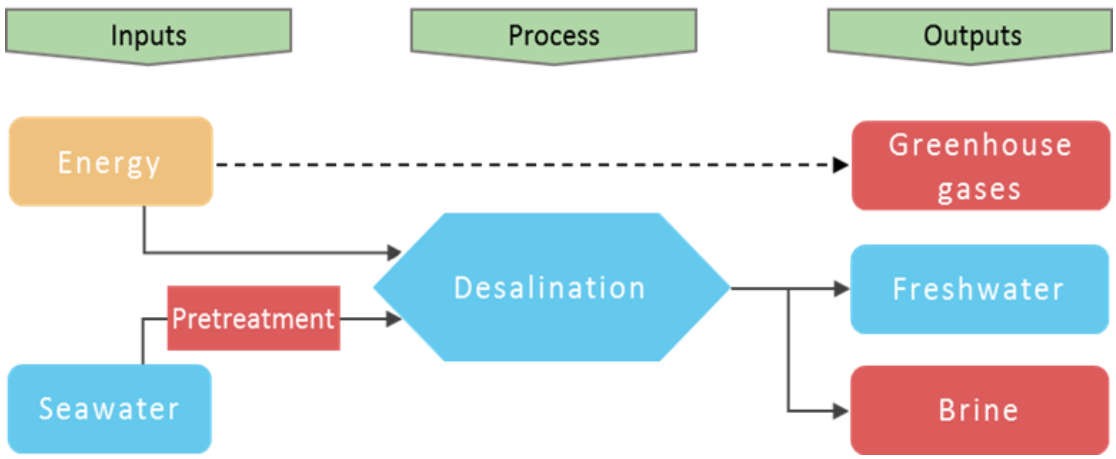
- Engineers
- Chemists
- Physicists
- Economists
- Marketing specialists

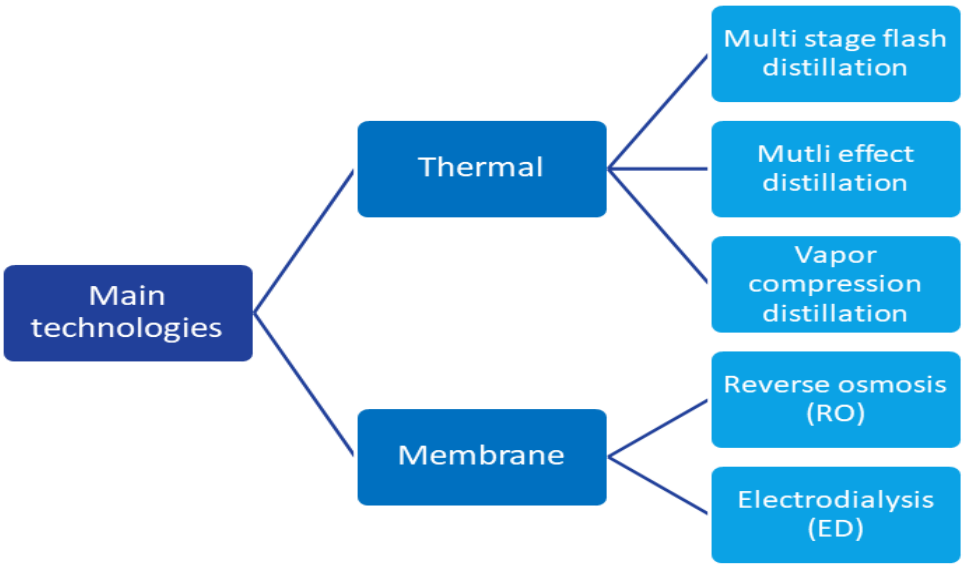
Introduction

Safe and potable water is a basic necessity that is difficult to access nowadays. Sources of good quality water are depleting in tandem with the rise of sea levels. Due to rising temperatures as a result of climate change, water scarcity and drought are increasingly frequent across the globe. Facing the climate change, seawater desalination will become more and more important and probably the only source to provide the future generation with good quality water. Today's desalination plants discharge together with the brine millions of tons of harmful chemicals per year into the marine environment. Hence becoming infamous amongst the environmentalists, farmers etc. They are highly protested against due to its adverse effects on the environment and marine life.



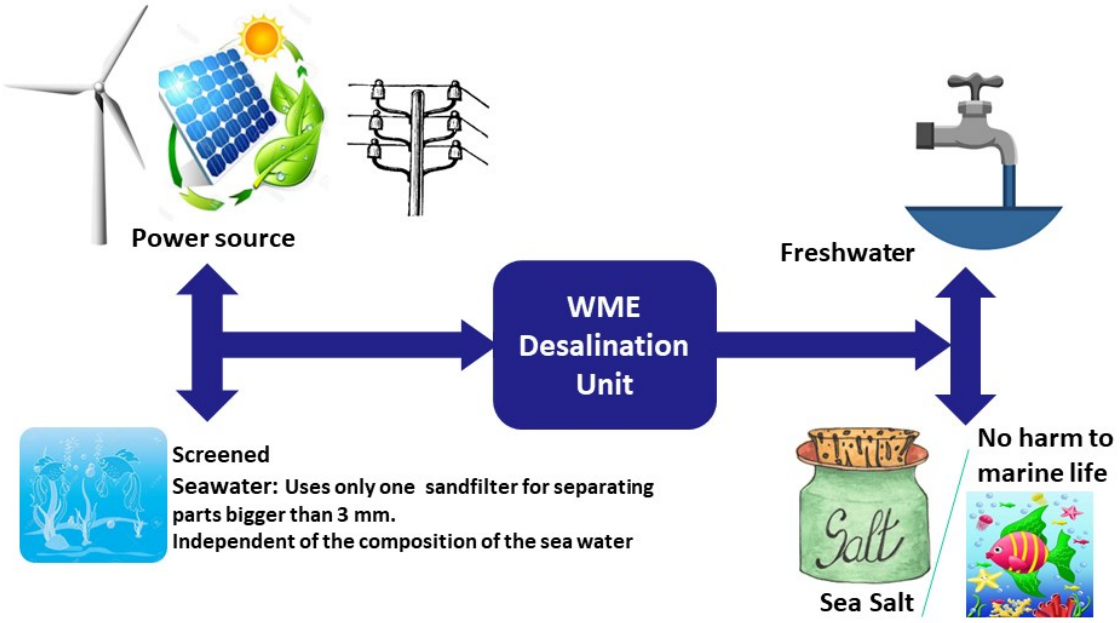
Thus, if the increasing need for seawater desalination in the world will be satisfied through conventional technologies, major environmental damages are unavoidable. On a global level, a **truly eco-friendly desalination technology** can help reach several of the 17 goals in the United Nations' "2030 Agenda for sustainable development", namely "Take urgent action to combat climate change and its impacts", "Clean water and sanitation", "Sustainable cities and communities", and "Conserve and sustainably use the oceans".



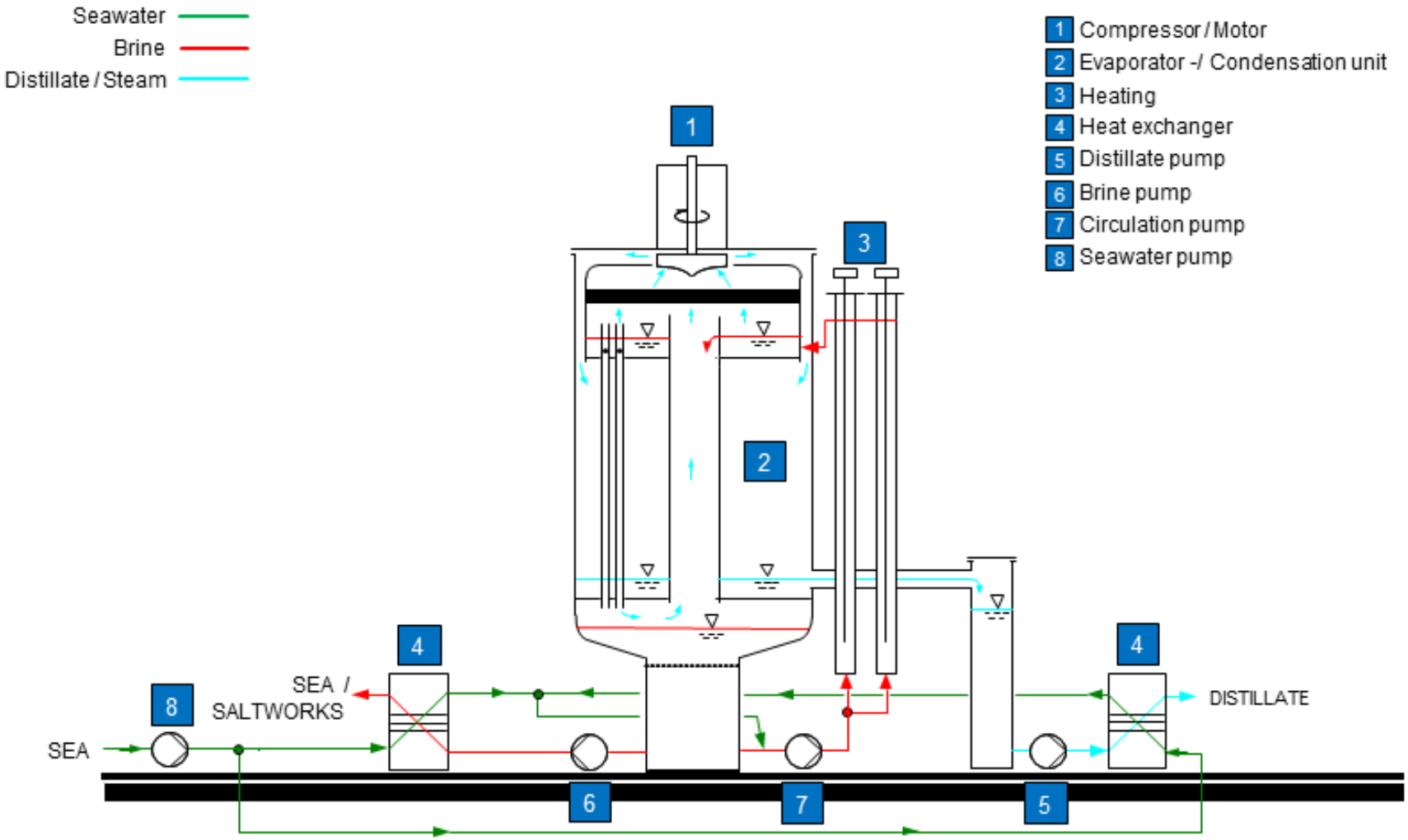


Mechanical vapor compression has turned out to be one of the most sophisticated processes concerning capacities up to 2000 m³ per day. The simple but effective structure concept provides a high technical availability almost without maintenance. WME GmbH brings an **environmentally** compatible, **energy self-sufficient** and **economically viable solution**. It can be powered by any **renewable energy source without the need for energy buffer systems**. Due to a particular feed water conditioning, no chemicals are added to the desalination process.

The water produced has an **outstanding quality**, and the brine output is considerably lower than with other desalination technologies. As the brine is **free of added chemicals,** it can be exploited for salt recovery or ejected back to the sea without harming the environment.



WME Desalination Unit



Plant scheme and description

The WME desalination plant operates by the process of MVC with a combined unit of evaporator/condenser consisting of common vertical tubes (MVC - VT).

1. The seawater (8) is naturally filtered and pumped into a reservoir (4000 liters).
2. Seawater passing through two plate heat exchangers (4).
3. Heat is transferred from the outgoing distillate (5) and brine (6) to the incoming seawater.
4. WME chemical-free conditioning system inhibits the seawater from scaling the plant.
5. A vacuum pump reduces the pressure to the evaporation pressure of the preheated seawater.
6. A vacuum pump removes the gases dissolved in the seawater out of the plant.
7. The degassed seawater reaches the combined evaporator/condenser unit (2).
8. Circulation pump (7) distributes the water uniformly at the entry of the vertical tubes. This leads to a homogenous falling film at the inner surface of the tubes.
9. The seawater evaporates at the wetted inner surface of the tubes.
10. The resulting vapor is compressed above the tubes by the compressor (1).
11. Compressed and heated vapor condensates at the outer surface of the tubes.
12. The condensation heat and energy from the heated vapor transfers through the wall of the tubes in order to evaporate an equivalent amount of preheated seawater.
13. Thus the heat of condensation is recovered completely.

MVC is one of the most energy saving desalination processes as the heat is recovered.

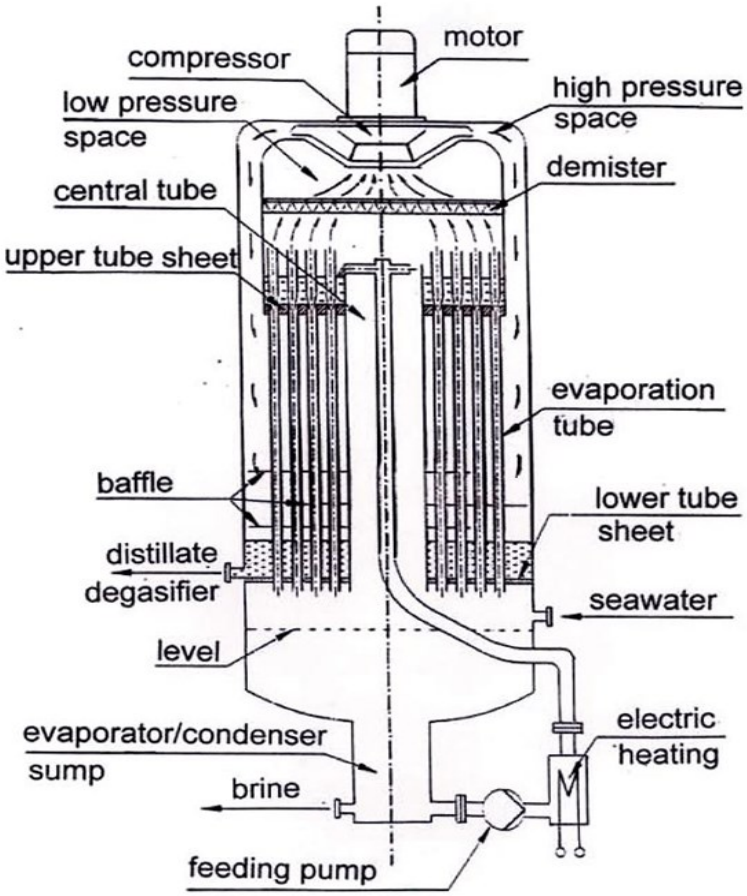
Due to the low evaporation temperatures (< 85 °C), an increase of the vapor pressure (<100 mbar) is enough to realize a temperature difference of 3 - 5 K for the total heat transfer. Hence, an effective heat transfer is taking place through the walls of the tubes.

In contrast to the direct evaporation of seawater, the MVC process requires only 2-3 % of the energy.

The more water evaporates, the higher is the salt concentration of the remaining sea-water. Under normal conditions, the salt concentration should not be higher than 10 %. Therefore concentrated brine is continuously discharged back into the sea.

Energy input is directly proportional to the water output: distillate production depends on the compressor speed respectively the power required by the compressor and the evaporation temperature.

This value can be adjusted by the control panel. The remineralization of the distillate can be achieved by dosing of the adequate minerals as desired.



WME seawater desalination plant at a glance

1. Plant concept and design of the plant

- No control and vacuum check valve needed → no wear of regulated devices and no leakages in long-term operation.
- All components are designed for long life time with thorough testing (incl. electrical components).
- Materials with maximum resistance to corrosion and temperature stability are used.
- No sensitive electronics are used in the entire process engineering.
- The plant's control technology is simple to ensure an excellent security to run the plant.
- No occurance of disturbing factors (fouling, scaling etc) which could bring production to irreversible breakdown.
- The plant is installed in standard sea containers.

2. Service conditions and plant operation/maintenance

- Off-grid operation in remote areas, with diesel / wind generator / solar power is possible.
- Completely uncritical operation even at strongly varying electrical supply including any turn on/turn off operation.
- Once shut down for long time, the plant can be switched on immediately without any preparation.
- The plant can be supervised and controlled remotely.
- The plant does not need continuous on-site employees.
- Maintenance is very simple and essentially refers to standard wearing parts such as pump bearing.
- Plant operation and maintenance can be carried out by semiskilled personnel.
- Runs independent of composition of raw/feed water.

3. Water requirements and product quality

- The raw water may contain a high content of suspended matter → only a coarse filter is necessary.
- Organic contamination (incl. mud) in the raw water even in high concentration does not interfere with the plant.
- It removes all dissolved and non-dissolved contaminants such as salt, fluoride, arsenic, organic and inorganic impurities etc. from raw water. No auxiliary chemicals are needed for the raw water conditioning.
- Any raw waters up to maximum salt concentrations of 50 g/l (if necessary also substantially higher) are applicable.
- It has the ability to treat all type of sea/ river/ sludgy/ contaminated water.
- The produced water is highly pure:

  - Conductivity < 10 µS/cm in continuous operation.
  - Sterile concerning all bacteriological contaminations.
  - The production of table water of highest quality is possible.
  - Applicable as high-purity water for industrial and bottled water purposes.
  - Application of product water for the permanent irrigation of all types of soil without danger of salting.
- The residual water (concentrate) is processed as follows:

  - Up to 10 % salt concentration with standard plant.
  - The concentrate is pasteurized.
  - Volatile organice substances (e.g. odoriphores) can be completely stripped from the concentrate.
  - The concentrate does not contain any chemical additives and plant corrosion products such as copper and nickel.
  - After very simple treatment the concentrate can be used for recreational areas (e.g. swimming pool).
  - The concentrate can be used for the production of pure salt.

4. Environment and emissions

- No heavy metals (corrosion products) are emitted at all.
- No chemical additives/auxiliary chemicals (such as polyphosphates, polymalein acid, polyelectrolytes, chlorine or anti-chlorine) are emitted at any time.
- No exhaust emissions, odoriphores etc. are emitted at any time.
- The brine concentration can be changed if necessary from the usual value of approx. 70 g/l to higher values.

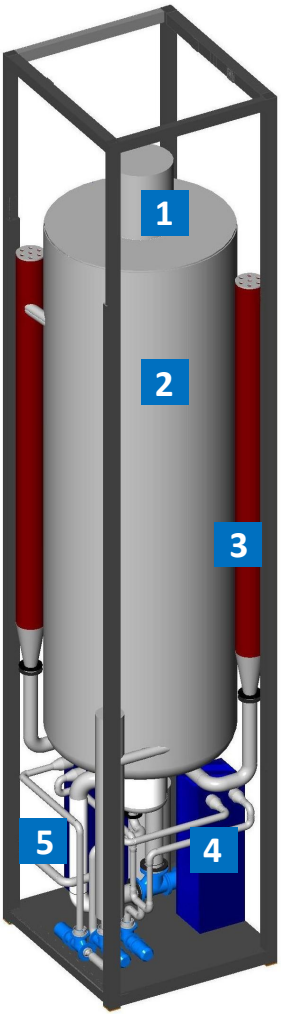
5. Economy

- The plant can produce 480,000 liters per day of purest water suitable for drinking, industrial purposes and agricultural purposes.
- Maintenance of the parts is low and have long lifecycle of more than 25 years.
- All components are delivered pre-installed and the plant can be operated within a minimum time frame.

6. Pre-Treatment and Post-Treatment

- No pretreatment required. Only natural sand filters at surface well necessary (no need of expensive onshore deep well).
- No backwash or interference-prone, energy and maintenance intensive pretreatment technique, such as membranes and high-pressure pumps etc. necessary.
- This reduces the operating and maintenance cost and makes the WME desalination plant the most environmentally friendly plant available till date.
- The plant produces pure distilled water which requires no post treatment and is suitable for direct consumption for various purposes.

WME containerized desalination plant



Evaporation system

1 Compressor

2 Evaporator / condenser unit

3 Heater

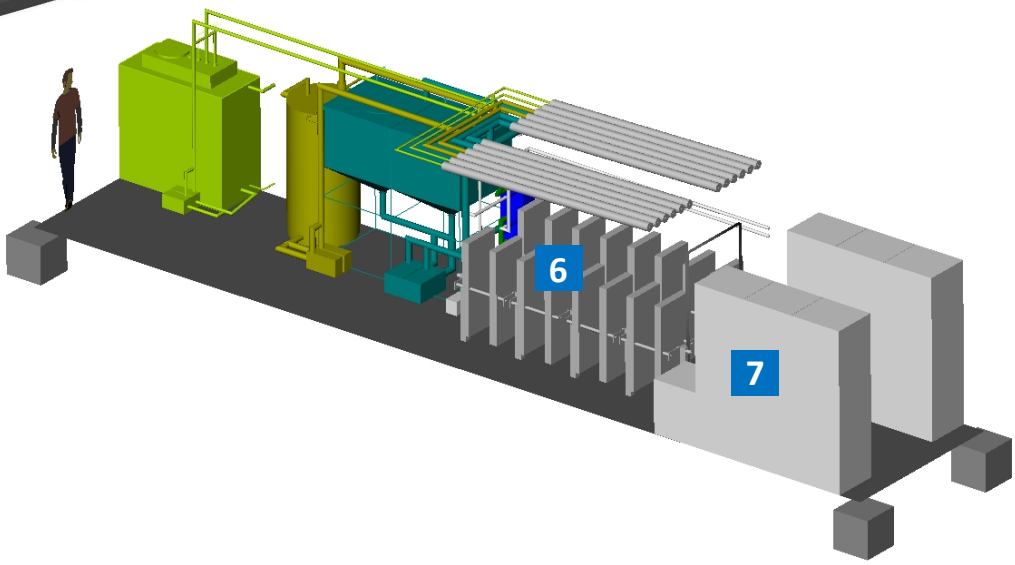
4 Heat exchanger

5 Distillate (drinking water)

Control unit and seawater conditioning

6 Seawater conditioning / anti-scaling system

7 Control unit (PLC and inverters)

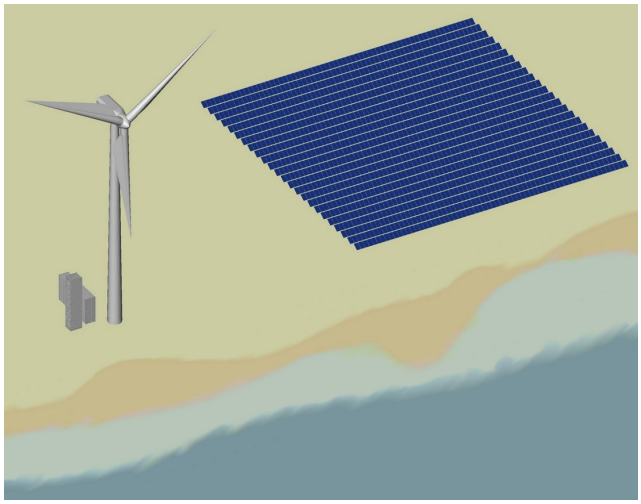


Technical data of seawater desalination plant

Dimension	Desalination tower (l/w/h) 2,900 x 2,440 x 12,200 mm container, 2 pieces (l/w/h) 12,200 x 2,440 x 2,900mm
Area	50 m^2
Weight	about 25,000 kg
Electrical Supply	3 x 400V three phase current, 50Hz
Distillate produced	23m^3/h (max. depending on salt concentration)
Potable water	salt content < 10 ppm (WHO standard < 480 ppm, appropriate as potable water)
Sea water (feed water) flow (inlet)	34,5m^3/h (max. depending on salt concentration)
Brine flow (outlet)	11,5 m^3/h (max. depending on salt concentration)
Brine	10% salt concentration
Electrical conductivity	< 10 µS/cm
Total dissolved solids	≤ 1 mg/l
Material of construction (MC)	Titanium and patented stainless steel (1.4565 S) and other stainless steel
Operation	completely automatic
Monitoring	with modem
Electrical and machining components	Corresponding to German regulations - VDE and VDI

WME plants: Technical data

A. Desalination plant with wind energy plant and solar energy plant for Senegal (Example and size comparison)



seawater flow	30 m³/h
concentrate flow	10 m³/h
distillate flow	20 m³/h
conductivity of distillate	< 10 µS/cm
salinity of concentrate	10,5 %
nominal power of wind or solar energy plant	350 kW
hub height of wind energy plant	40 m
space for solar energy plant	5.000 m²
size of desalination plant	40´ standard sea container (2 pieces)

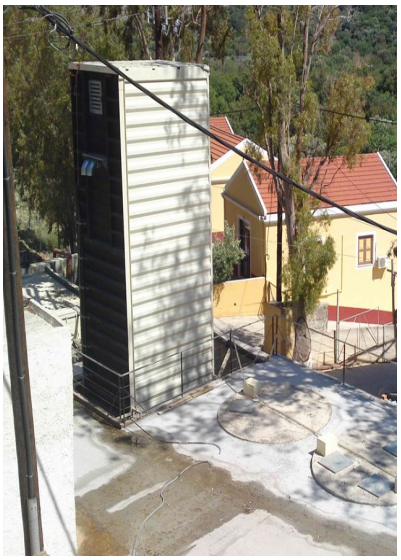
B. Desalination plant on the Island of Borkum, Germany

seawater flow	4 m³/h
concentrate flow	2 m³/h
distillate flow	2 m³/h
conductivity of distillate	< 10 µS/cm
salinity of concentrate	7 %
nominal power of wind energy plant	45 kW
hub height of wind energy plant	24 m
rotor diameter	12,5 m
size of desalination plant	2 x 3 x 9,25 m

C. Desalination plant on the Island of Rügen, Germany

seawater flow	21 m^3/h
concentrate flow	14 m^3/h
distillate flow	7 m^3/h
conductivity of distillate	< 10 µS/cm
salinity of concentrate	7 %
nominal power of wind energy plant	300 kW
hub height of wind energy plant	40 m
rotor diameter	33 m
size of desalination plant	3 x 4 x 13,5 m

D. Desalination plant on the Island of Symi, Greece



seawater flow	40 m^3/h
concentrate flow	20 m^3/h
distillate flow	20 m^3/h
conductivity of distillate	< 10 µS/cm
salinity of concentrate	7 %
nominal power of wind energy plant	350 kW
hub height of wind energy plant	60 m
rotor diameter	45 m
size of desalination plant	40´ standard sea container (2 pieces)

Publications (excerpt)

1. P. Gaiser, U. Plantikow: Seawater Desalination by Windpowered Mechanical Vapour Compression Plants; IDA World Congress "Desalination and Water Sciences", Abu Dhabi, November 1995.

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4. "What Goes Around, Comes Around"; Technology News International East-West Report; March/April 1996

5. W. Damm, Dr. P. Gaiser, D. Kowalczyk, Dr. U. Plantikow: "Windkraftgetriebene meerwasserentsalzung - Betriebserfahrungen und ökonomische Aspekte -", Kongreß renergie `96, 13.06.-15.06.1996, Hamm

6. Dr. U. Plantikow: "The use of wind and solar energy as a source for desalination plant", Workshop on "Promotion of renewable energy technologies for water desalination" 11.04.-12.04.1997, Santa Cruz de Tenerife, Canary Islands

7. U. Plantikow: Potable Water by a Wind-driven Seawater Desalination Plant; International Workshop "Desalination Plant on Desalination in Mediterranean Countries", Rom, 03./04.12.1998

8. U. Plantikow: "Potable Water - The Prerequisite for Life"; Editorial for "World development and Joint Venture finance 1998/1999", Kensington Publication 1998 and World Business council for sustainable development

9. U. Plantikow: Production of Potable Water by Wind-driven Seawater Desalination Plant-results of 4 Years Field Tests; 1999 European Windenergy Conference 01 - 05 March 1999, Nice, France; S. 979

10. U. Plantikow: "Wind-powered MVC Seawater Desalination - Operational Results", Desalination 122 (1999), S. 291

11. R. Huß, U. Plantikow: "New Materials in the Wind Powered Seawater Desalination Plant"; 4 th European Stainless Steel Science and Market Congress, June 2002, Paris, S. 133

12. U. Plantikow, R. Huß: "Production of potable water by a wind-driven seawater desalination plant - experience with the operation"; WWEC 2003, Cape Town, South Africa, 23.11.2003 - 26.11.2003, World wind energy conference and renewable energy exhibiton.

13. U. Plantikow: "Windpowered seawater desalination plant"; ENVIRO MAROC 2004, Seminare, 12.05.2004 - 14.05.2004, Casablanca, Maroc.

14. U. Plantikow: "Application de l´énergie éolienne dans l´industrie et le dessalement de l´eau de mer"; 2ème Rencontre Maroco - Allemagne sur les energies renouvables, 07.04.2005 - 08.04.2005, Hotel Royal Mansour, Casablanca.

15. U. Plantikow Windenergiebetriebene Meerwasserentsalzung der WME, Clean energy power 2007. 4. Innovationskongress 24. – 25.1.2007. Berlin 1. Fachtagung Regenerative Meerwasserentsalzung.

Patents

International patents

WME owns the following patents:

Desalination:

Downpipe Evaporator and Inlet Device therefore:

Europe Patent No.:	1497007	(granted)

Evaporator Tube for a Seawater Desalination System:

Europe Patent No.:	1492731	(granted)
China Patent No.:	CN1303001C	(granted)
USA Patent No.:	7,494,573	(granted)

Electrodialysis system:

Method for Treating Untreated Salt Water for Producing Treated Water:

Europe Patent No.:	2582632	(granted)
China Patent No.:	ZL201080068700.4	(granted)
Japan Patent No.:	5689954	(granted)

Method for Producing Hydrogen Chloride or an Aqueous Solution therefore using Untreated Salt Water and Electrodialysis System:

Europe Patent No.:	10782532.5-1354	(pending)
China Patent No.:	ZL201080068674.5	(granted)
USA Patent No.:	9,108,844B2	(granted)
Japan Patent No.:	5763185	(granted)

References

Links: Book - Wind-powered MVC seawater desalination — operational results, Dr.U.Plantikow:

https://books.google.de/books?id=mGl_AgAAQBAJ&pg=PA979&lpg=PA979&dq=%22Potable+Water+by+a+Winddriven+Seawater+Desalination+Plant%22&source=bl&ots=UkkU0bQSBR&sig=VFt9tc8GDnS2CpoVgxn_IOgh1IE&hl=de&sa=X&ved=0ahUKEwjy0aqf99XSAhXC1ywKHTgkCn0Q6AEIMjAB#v=onepage&q=%22Potable%20Water%20by%20a%20Wind-driven%20Seawater%20Desalination%20Plant%22&f=false

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Newspaper article – Frankfurter Allgemeine Zeitung FAZ

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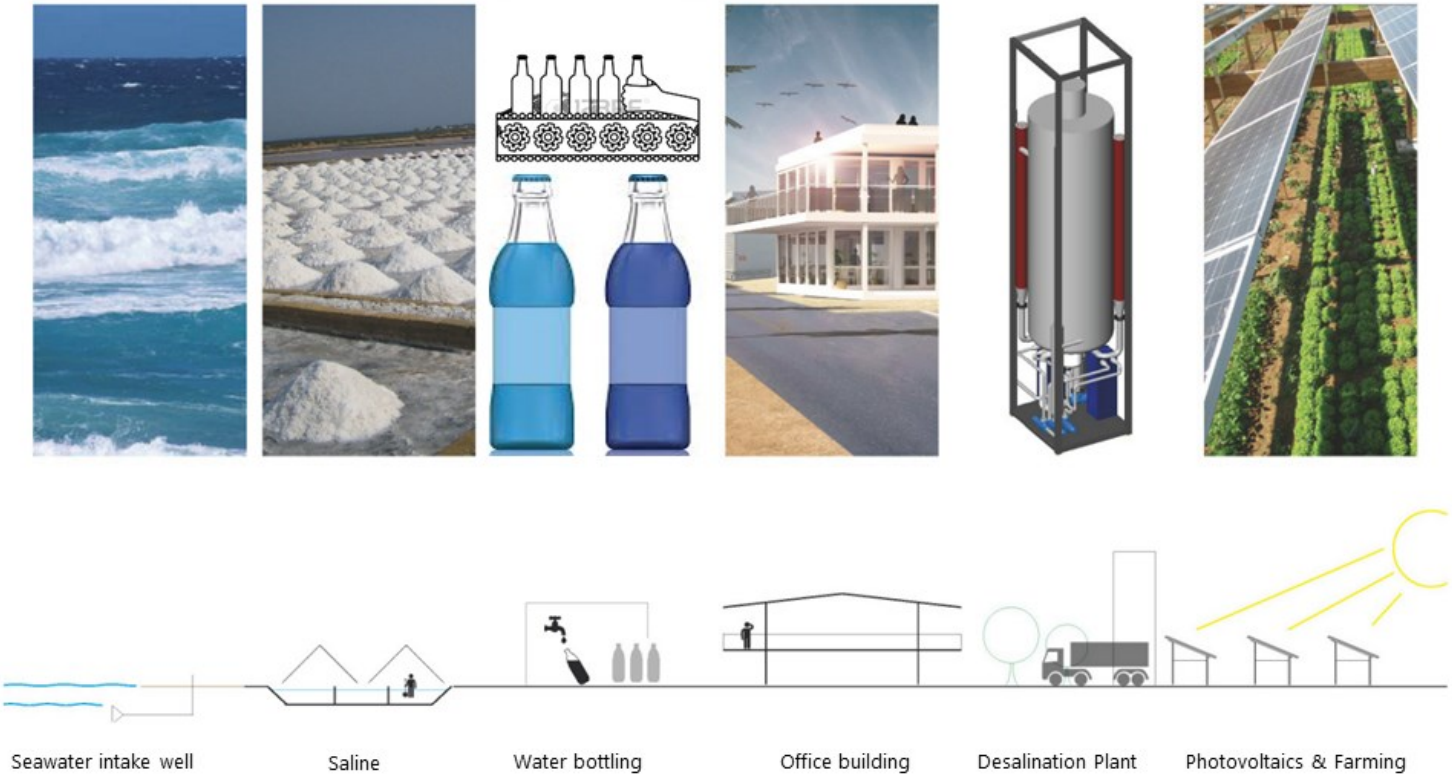
Value-added chain

The WME technology produces water, which can be used for both drinking and industrial purposes. WME customers will benefit from opportunities to create **added value** in downstream businesses such as **salt works, agriculture, food processing, beverage industry** and **tourism**. They will not only provide drinking water but also initiate local development and create jobs. This makes the WME desalination plant a means to prevent poverty migration caused by extreme water scarcity and drought.



Salient features of the plant

- ⇒ Long-time tested standard components
- ⇒ With a life cycle of more than 25 years
- ⇒ No copper or other heavy metal discharge in sea
- ⇒ Pollution free and environmentally safe
- ⇒ No greenhouse gas production issues
- ⇒ No use of chemicals
- ⇒ Excellent water quality
- ⇒ No cleaning required for scaling etc.
- ⇒ Running/operating cost almost nil
- ⇒ Minimal maintenance
- ⇒ Remote controlled, easy to operate and monitor
- ⇒ Once shut down, plant can be started immediately without any preparation
- ⇒ Proven technology and standalone unit
- ⇒ Runs on all types of renewable energies as well as on power grid
- ⇒ Works independent of the feed water composition
- ⇒ No occurrence of disturbing factors such as fouling, scaling and corrosion
- ⇒ High quality salt as value-added share
- ⇒ No post or pre-treatment