

DME S-006-2013 – Lecture 04



DME
GERMAN DESALINATION

Zero Liquid Discharge (ZLD)

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DME - Seminar
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SAUDI WATER & POWER FORUM




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Zero Liquid Discharge (ZLD)




**When the well's dry,
We know the worth of water**
Benjamin Franklin

Part 1: Terrawater in general

Part 2: Zero Liquid Discharge with  **saline**
by terrawater


Part 3: Applications for ZLD with TerraSaline

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nature as guide


Terrawater...

- ... is based on the natural principle of **evaporation** (<100°C).
- ... uses **Geo-, Solar thermal and Waste heat**
- ... defies the **roughest ambient conditions**
- ... produces **Distillate**

Terrawater works in the fields of...


- Desalination
- Drinking Water
- Process Water
- Waste Water
- Concentration ZLD

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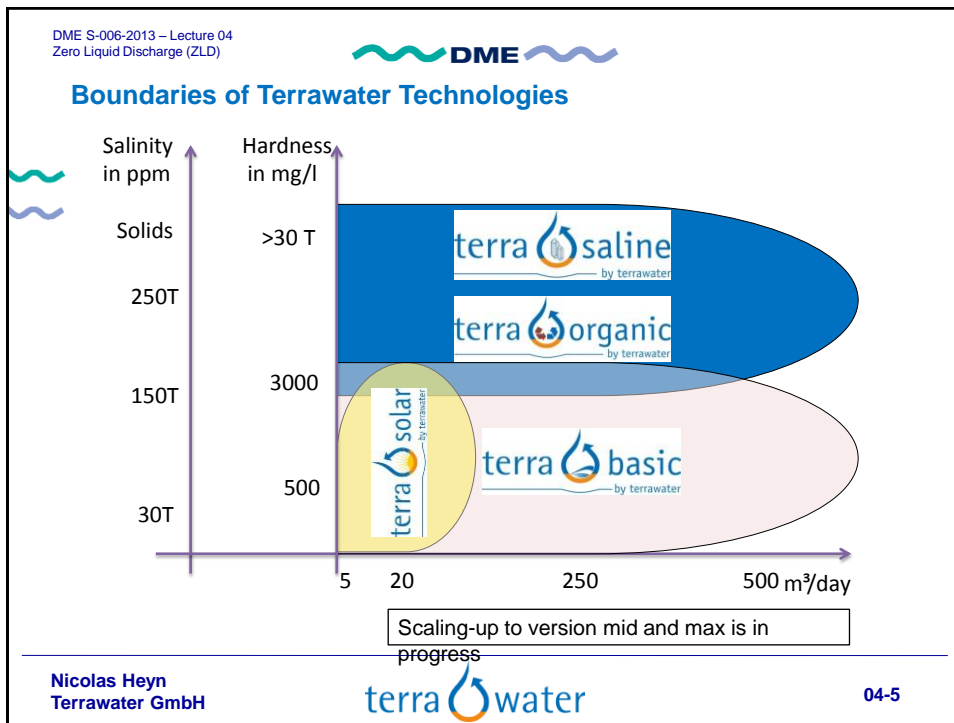
**Principle Terrawater:
Humidification / Dehumidification**

Water production on oil platform with TWBasic

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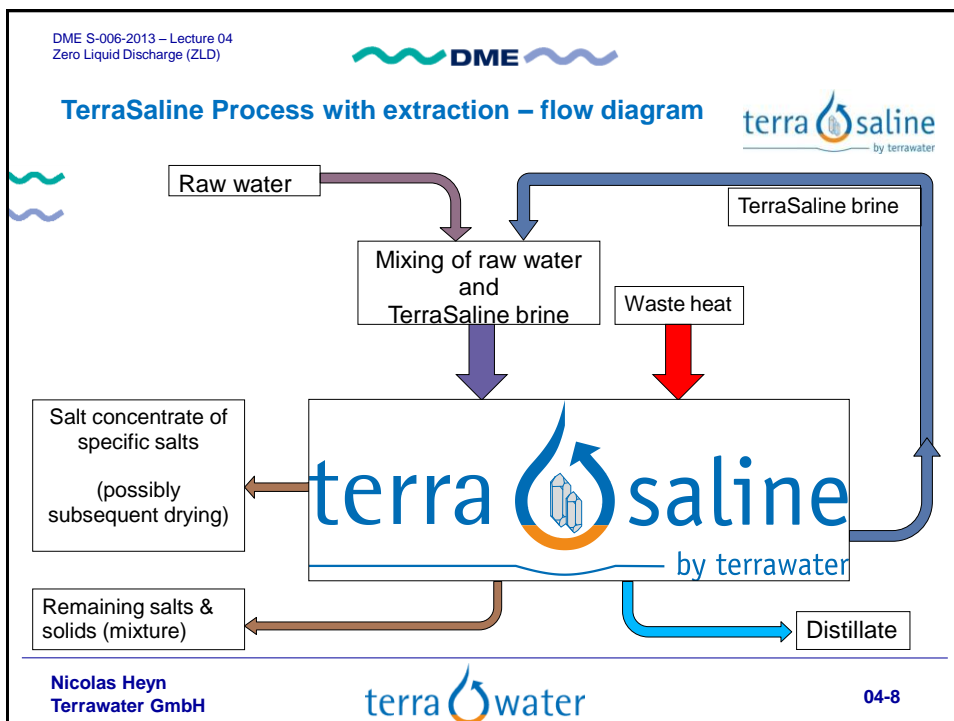
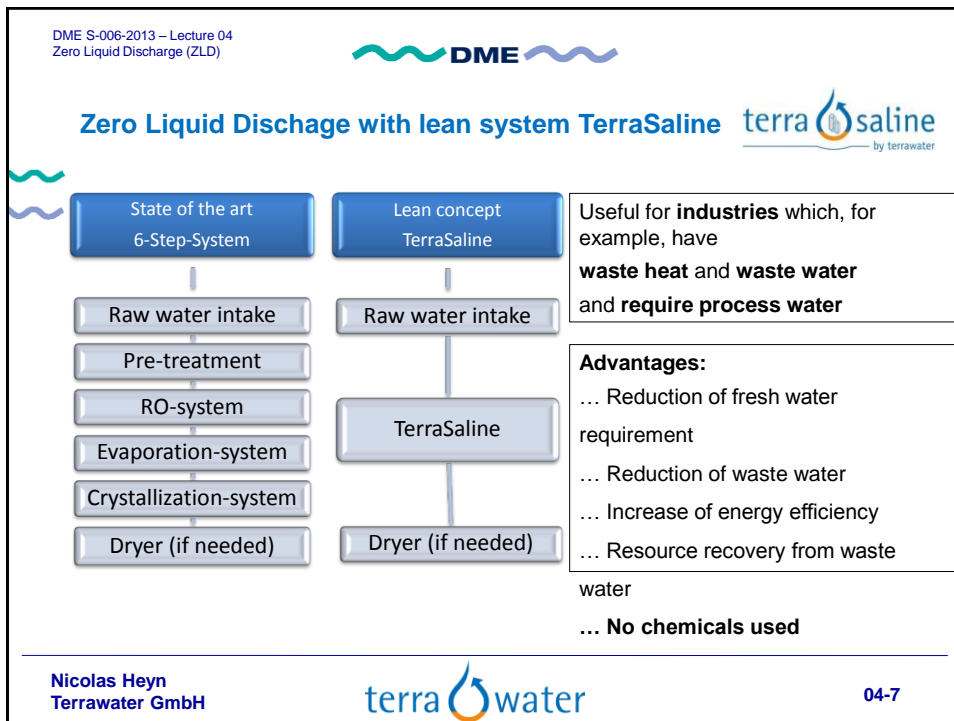
**Water is easy to distribute,
to pick it up again - difficult**
China, unknown

Part 1: Terrawater in general
Part 2: Zero Liquid Discharge with terra saline by terrawater
Part 3: Applications for ZLD with TerraSaline

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terra water

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Extraction of distillate by humidification / dehumidification

Leaned on the nature water cycle, Terrawater works internally with temperatures of max. 95°C.


As high saline waters are very aggressive to metal, Terrawater builds all components from synthetics.



Condenser



Water-water heat exchanger



TerraSaline Modules

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Extraction of solids by sedimentation and crystallization

The TerraCrystallizer inside TerraSaline is designed for the extraction of the solids.

The solids can be evacuated manually or automatically.



Produced salt



TerraCrystallizer

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Control of saturation limits and temperatures




Terrawater ZLD system avoids any use of chemicals.

As a consequence, the fall out places of solids inside the TerraSaline must be controlled so that they could be extracted online.

So, controlling the ZLD-process means controlling the individual saturation limits as a function of temperature.

In addition to that, the different cleaning and solid extraction technologies available along with TerraSaline helps to realize this

**real
Zero Liquid Discharge
system.**



46.3 °C	16.8 °C	50.5 °C
64.8 °C	33 °C	32.8 °C
19.5 °C	18.2 °C	17.7 °C
17.23 kWh	5.43 kWh	16.48 kWh

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**Water is not everything,
but everything is nothing without water**
unknown

Part 1: Terrawater in general
Part 2: Zero Liquid Discharge with terra saline
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ZLD example 1: brine re-use

Task:

- + raising output of existing desalination system
- + reduction of brine
- + reduction of fresh water needs
- + production of process water
- + reducing disposal costs




Step 1: brine water intake

- ✓ regardless of the salinity

Step 2: TerraSaline


- ✓ Concentrating brine to saturation limit
- ✓ Producing distillate
- ✓ extracting wet solids

Step 3: deposit wet solids, reducing brine


Test facilities brine re-use from RO reject of a power plant, Thailand

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ZLD example 2: wells

Task:

- + well has limited yield
- + recovery rates of other desalination - systems are too low for the drinking water demand
- + salinity is too high for other desalination systems



Step 1: Well water intake



- ✓ regardless of the salinity
- + brine injection is forbidden

Step 2: TerraSaline

- ✓ Concentrating well water to the saturation limit
- ✓ Producing distillate
- ✓ Producing solids


Step 3: deposit wet solids, no brine injection

Solar desalination from limited well in Akutsima, Namibia

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**ZLD example 3:
resource recovery**

Task:
+ metals and / or salts shall be recovered
+ waste water shall be concentrated to a further product

Step 1: Feed water intake

Step 2: TerraSaline
✓ Concentrating sea water to the saturation limit
✓ Producing distillate
✓ Producing salt/solids for industry purposes
✓ Producing concentrated liquids like fertilizers

Step 3: drying drum and sieving



Sea salt production from north sea water on the island Sylt, Germany

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Thank you for your attention



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