

# H2O

APPLYING THOUGHT  
TO WATER IN THE  
MIDDLE EAST

## PLUS

MARKETPLACE  
TENDERS &  
CONTRACTS  
CLASSIFIEDS  
EVENTS WATCH

### FEATURES

#### GROUND WATER

**Recharging dry wells**

#### PROCESS WATER

- **Manipulated Osmosis:  
An alternative to RO?**
- **Solid solution**

#### DESALINATION

**Water from waste heat**

#### ON THE RECORD

Alan Hinchman, Global Water  
Industry Manager, GE  
Intelligent Platforms

#### PRODUCT FOCUS

#### MEMBRANES

**Crossflow basics**

#### HEADLINES

Norit is GWI's Water  
Technology Company  
of 2011

WETEX 2011  
concludes on  
a high note

Second desal plant  
for Singapore

#### SHORT TAKE

Garry Pender, Professor of Environmental  
Engineering & Head, School of the Built  
Environment, Heriot-Watt University

Vijay Gopal, Regional Sales  
Manager -GCC, CST Industries

#### FOCUS

#### SLUDGE DIGESTION

Tawfiq Abu Soud, Executive Director,  
Drake & Scull Water and Power (DSWP)

# TOWARDS SMARTER WATER MANAGEMENT

**INTELLIGENT WATER SYSTEMS CAN PLAY A  
SIGNIFICANT ROLE IN MEETING THE WATER  
NEEDS OF A GROWING WORLD POPULATION**



Visit our website  
at [www.h2ome.net](http://www.h2ome.net)

# WATER FROM WASTE HEAT



Can **Low Temperature Desalination** (LTD) change the prevalent discourse that largely revolves around conventional thermal and reverse osmosis technologies?

BY ANOOP K MENON

WETEX 2011 EXCLUSIVE

**T**RADITIONAL THERMAL PROCESSES, like power generation, are inherently inefficient, with bulk of the energy input being wasted. The waste heat, felt the Swiss duo of Mark Lehmann and Mark Braendli, was too good a resource to, well, 'waste'. They put their heads together and the result was Low Temperature Desalination (LTD), which uses waste heat to produce potable water from seawater or Reverse Osmosis (RO) brine.

"Thermal power plants typically transform only 30% of the energy input into electricity; the remaining 70% is wasted as reject heat. We take this 'free' energy and use it to produce fresh water," said Lehmann. The waste heat is harnessed by the LTD process, at temperatures as low as 50 °C to 110 °C, to desalinate sea water or RO brine at low pressure. The water produced can either be recycled into the power plant or sold to the local water distribution network as drinking water of the highest quality.

LTD is suitable for tapping waste heat from gas turbines, concentrating solar power (CSP) plants, diesel power plants, waste incineration plants and also energy-intensive industrial facilities like cement plants and petrochemical plants.

Lehmann said, "In the case of diesel power plants, half of the waste heat is already in the engine cooling and can be tapped directly. With more

complex systems like gas turbines, the waste heat from the exhaust can be extracted with an ordinary boiler to get hot water, which can be used for the running of the LTD plant." Lehmann believes that the process can be used in district cooling plants too.

Watersolutions, the company set up by the duo with some partners to produce and commercialise the LTD concept, has struck a partnership with ABB Power Systems to market the solution worldwide. The partnership's scope of supply includes engineering, installation and commissioning. Solutions are customised to meet specific plant requirements.



(Left to Right)  
Mark Lehmann,  
Tuija Elomaa-  
Maenpaa of ABB  
and Mark Braendli

As a thermal desalination process, how does LTD compare with the dominant thermal desalination technologies in the Gulf region, namely Multi-Stage Flash (MSF) and Multi-Effect Distillation (MED). Also, does it have a role in water/power co-generation model prevalent in the region?

Mark Braendli feels that MSF's biggest drawback is that it burns significant volumes of high quality fuel, which puts a question mark on its future in the Gulf region. He said, "What is burnt cannot be used for electricity production. The thermal energy required for both MSF and MED is very high. Though MED is regarded as 'less costly' than MSF, extra efforts are still required with regard to tube thickness, materials."

The biggest advantage of the LTD system is that it is based on low temperature and low pressure distillation. Braendli continued, "We try to solve the same problem, but our plant is simpler, uses waste heat as low as 50 to 110 degree C. There is no need for vapour or mechanical compression and most important, it transforms 97% of the waste energy into water."

In the LTD process, the waste heat of the heat source is transferred via heat exchangers to the salt water, which evaporates quickly at low pressure conditions, already at about 30°C. The vapour passes from the evaporator through a connection into the condenser, where it condenses. This condensation process is based on an efficient, specially designed spraying system. The fresh water is passed to the consumer, the brine back into the sea or can be used for salt production. A re-cooling system (air, water) ensures that the heat is removed from the system.

The application of cascades allows using the heat several times and leads to an increase in productivity with the same amount of energy available.

"The heat transfer is easily done because there are no tubes inside the vessels. Even less than two degrees difference in the Delta T between evaporation and condensation makes it possible to run the process," said Braendli.

Unlike MSF and MED, LTD does not use internal heat exchangers, which translates into low operating and maintenance costs. Both MED and MSF have costly tube bundle heat exchangers, made of titanium or high-grade stainless steel, inside the condenser. In MSF, they are used to preheat the brine recycle stream, while in MED, they basically function as condensers/evaporators. "Precipitation of gypsum and bicarbonate results in scaling in the tubes," said Lehmann. Chemicals are required to slow down the growth of bio-films and scaling on heat exchanger surfaces, as well as regular plant shutdowns for cleaning and maintenance by trained staff.

In the case of LTD, when problems do pop up, they happen outside the plant, because the LTD concept does not have any heat exchangers inside the plant which makes it much more maintenance-friendly from the operator's perspective.

In June 2010, the first LTD plant became operational in Egypt. EG1, which is co-located with the diesel-powered El Gouna power plant on the Red Sea coast, utilises waste heat from diesel engine's cooling cycles to produce 500 m<sup>3</sup>/day of drinking water.

The plant is designed for a thermal input power of 7MW. "They have 3.5 MW waste heat from the engine coolers and another 3.5 MW from the flue gas out of the stacks," said Lehmann. The LTD system's modular plant design and standard components cut installation time and costs. "In the case of our Egyptian plant, the installation time was mere 11 days, requiring one technician and two to three workers," said Braendli. The containerised plants are of heavy steel construction and incorporate non-corroding plastic tubes.

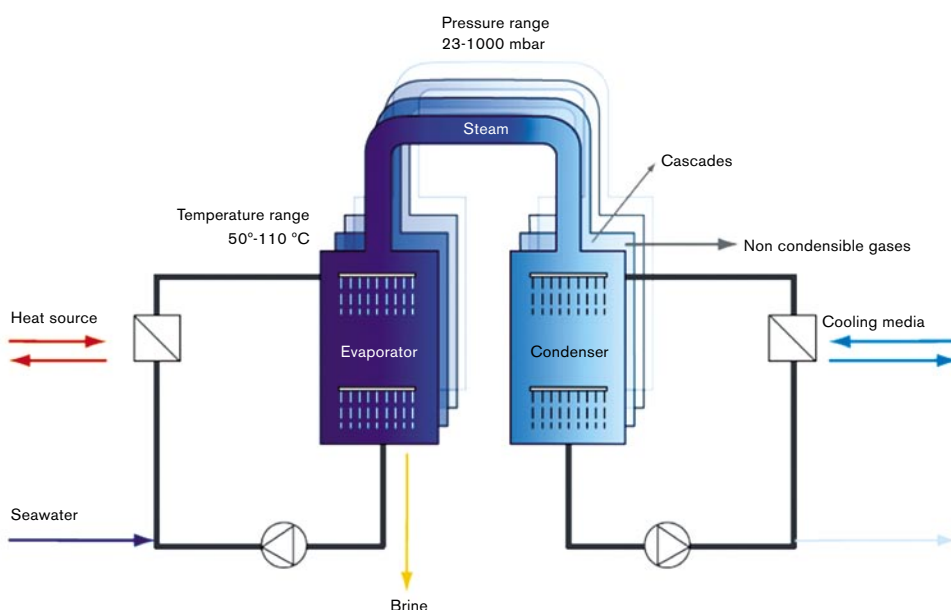
### In comparison with RO

How does LTD compare with Reverse Osmosis (RO), which is being projected as a viable alternative to thermal desalination in the region? "The salinity of the sea water is a limiting

factor when it comes to RO," said Lehmann. He pointed out that the LTD system can process intake water with a very high level of salinity and removes all salts, minerals and impurities, with only a moderate need for pre-treatment. This, the inventors claimed, gives LTD a huge cost, efficiency and quality advantage over RO, which requires extensive pre-treatment and a large input of chemicals to remove organisms and particles. As the LTD system is insensitive to fouling and scaling, the need for maintenance is a fraction of that for RO.

Lehmann said, "You have to periodically clean the membranes in a RO plant; you have to spend considerably on

### The Principle of LTD System



anti-scaling, cleaning consumables. If something goes wrong, the membranes have to be replaced. In our LTD system, you just open the plate heat exchanger and clean that out, which doesn't take more than a day, and is certainly not comparable to cleaning membranes or thousands of fragile heat exchanger tubes."

Braendli observed that both thermal and RO desalination have high energy consumption in the form of fuel or electricity, and in the Gulf region, even electricity has to be produced by a fossil power plant. "Our LTD process uses only waste heat to produce high quality drinking water for man and animal," he said.

The high salt tolerance of the LTD process means it can also process reject brine of RO plants to extract fresh water. "The way we see it, this water is perfect. It is pre-treated, clean, but too salty, may be five to six per cent," said Lehmann. As the LTD process is highly tolerant to the salinity of the feed water, the plant can be installed to retrofit existing RO plants too.

Braendli said, "It seems to me that the 30% -40% recovery rate of RO desalination systems is as bad as taking 100% fuel and getting only 30%-40% out of it. With LTD, we are able to increase overall recovery rate of RO plants, not by per cent but by factors."

Lehmann pointed out that pumping the brine back into the coast increases the salinity levels in coastal areas and adversely impacts marine life. "We can bring the brine close to precipitation, take out the salt as bulk material and sell it to plastic industry, where salt is used daily or deposit in the desert where it is harmless," he proposed.



**The LTD desalination plant at the El Gouna power plant on the Red Sea coast of Egypt**

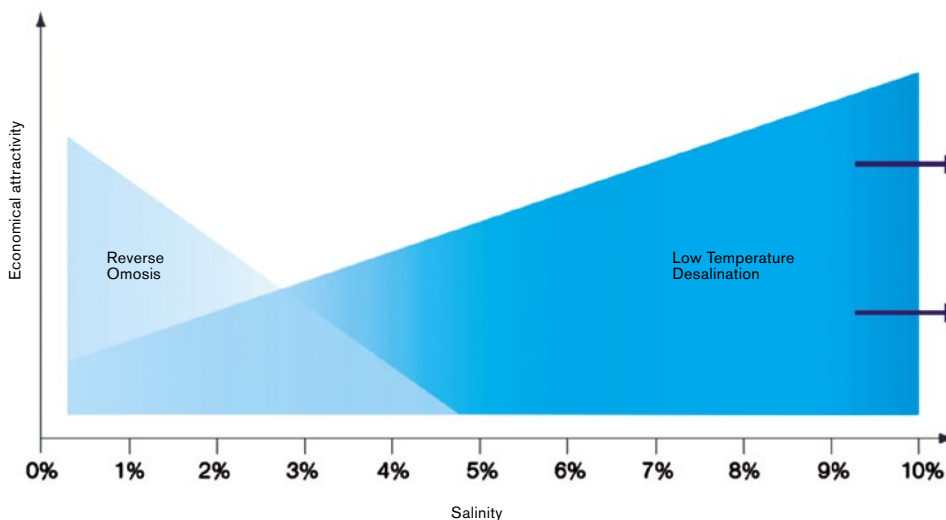
The important features of the LTD process that emerges from this discussion are robust and simple operation, modularity, high salt tolerance towards the feed water and the production of drinking water of high quality. In this perfect world, could something go wrong? The only thing that can go wrong, hastened Braendli, is leakage. A gas-tight container system resistant to excess and/or negative pressure is a vital for the smooth running of the LTD process. The entire LTD-system must be free of non-condensable foreign gas except for a tolerable remainder. Further, the pressure in

the vapour chamber needs to be continuously monitored and controlled in such a manner that distillation is always carried out in a range close to the saturation vapour pressure of the liquid to be distilled. At the start of the process, a vacuum pump removes all non-condensable gases until the pressure range is 23 – 100 mbar. "We have to make a box, make it tight and makes sure it runs on the parameters. A minor change in pressure or higher percentage of non-condensable gases can spoil the process," cautioned Lehmann.

To conclude, today, nearly 20,000 seawater desalination

plants with a total capacity of 60 million m<sup>3</sup>/day are in operation worldwide. Forecasts predict quadrupling of this capacity in the next 15 years. For our region, which is completely dependent on desalination for its water needs, the opportunity of using waste heat and solar energy for desalination through LTD technology, promises a new era of clean, efficient and sustainable water supply.

**LTD is more efficient and economical than RO**



**Coupled with solar**

Due to its efficient usage of energy at low temperature levels, LTD is also suitable for the production of drinking water using solar energy. Braendli said, "In solar plants, the super heated thermal oil goes over steam turbines, and after the turbines, the condenser delivers waste heat, which can be used in LTD plant."