Minimum Liquid Discharge – The Best Bang for Your Buck

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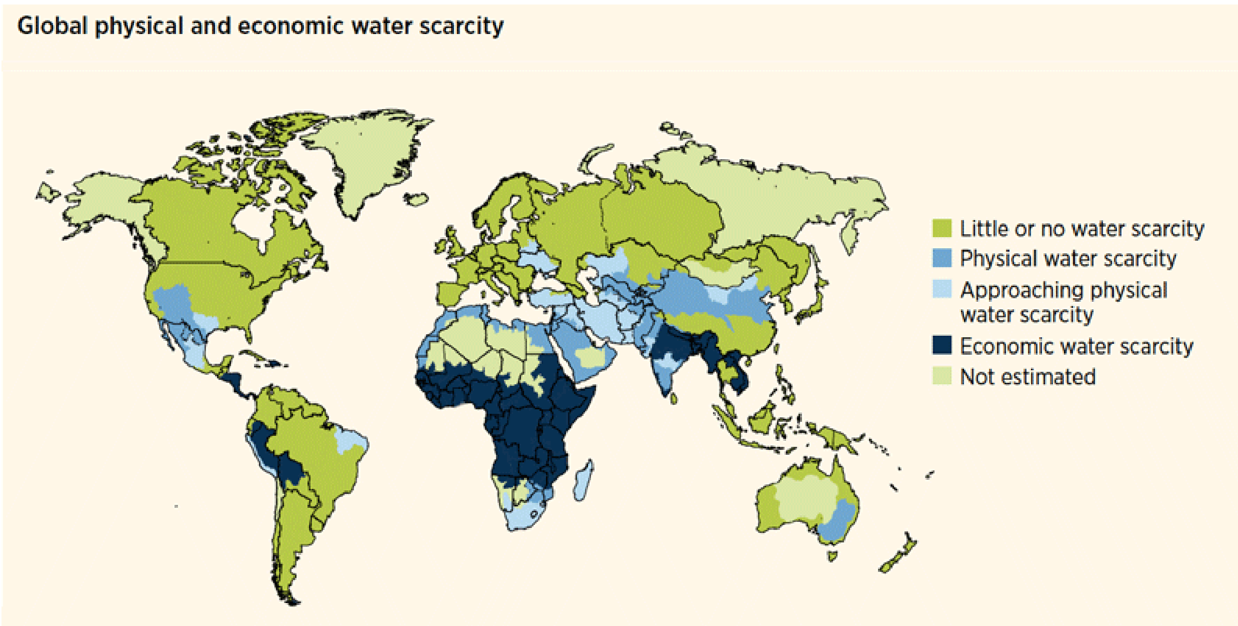
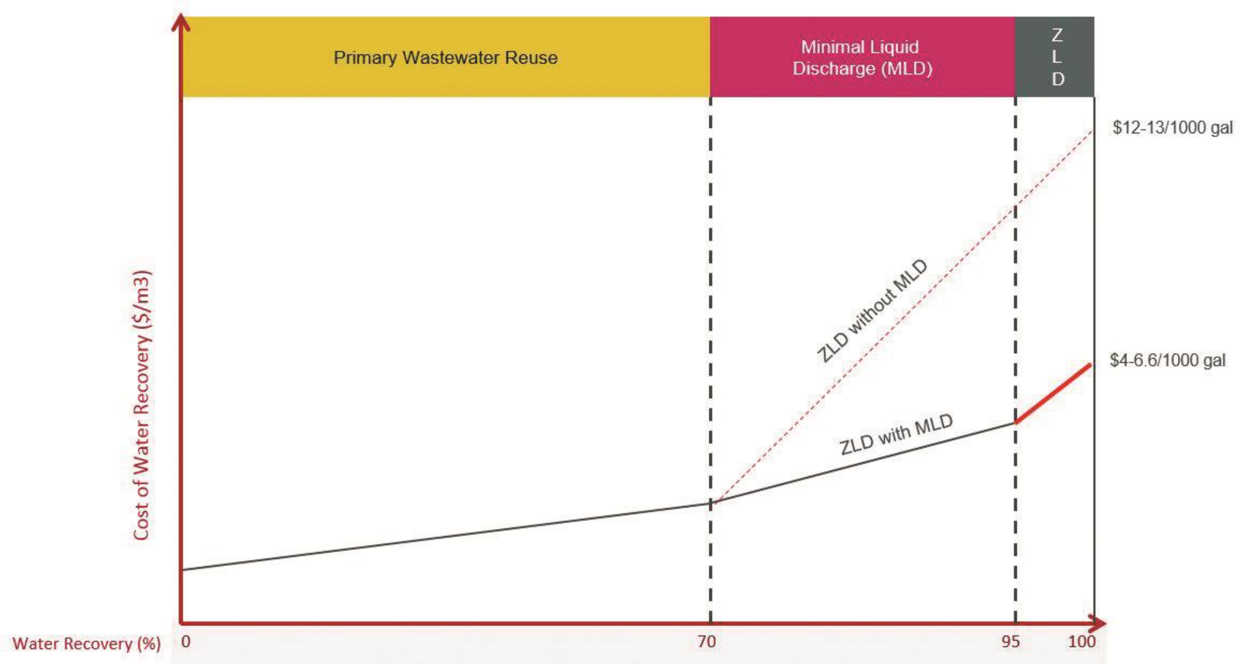


*Source: **World Water Development Report 4**. World Water Assessment Programme (WWAP), March 2012.*

Fresh water sources around the globe are becoming increasingly stressed due to population growth, industry use, and changing climate patterns. These stresses drive the need to make the most out of every drop of water available. Water treatment systems inherently produce a waste stream that contains contaminants removed during the treatment process. This waste stream can often constitute 20-30% of the total water fed to the treatment system, representing a significant loss of a precious resource both in human and economic terms. Minimizing this waste stream is a key part of the solution to solving the water crisis for both industry and people.

This is where the concept of Minimum Liquid Discharge (MLD) comes in to play. As discussed by Unrau (2019), MLD techniques often serve as preconcentration steps to reduce the overall cost of Zero Liquid Discharge (ZLD) applications. On its own, MLD can provide a substantial economic advantage and water savings where Zero Liquid Discharge (ZLD) is not required, as indicated by Hermsen, Rosenberg and Gorenflo (2016). The chart below illustrates the incremental cost of MLD relative to traditional water treatment and its impact on the overall cost of ZLD.



Bond, R.G. and Veerapaneni, S. Journal AWWA, 2008, 100 (9), 76-89.

For the incremental cost of MLD shown above, the operator often realizes substantial savings. Achieving 95-98% water recovery through MLD drives:

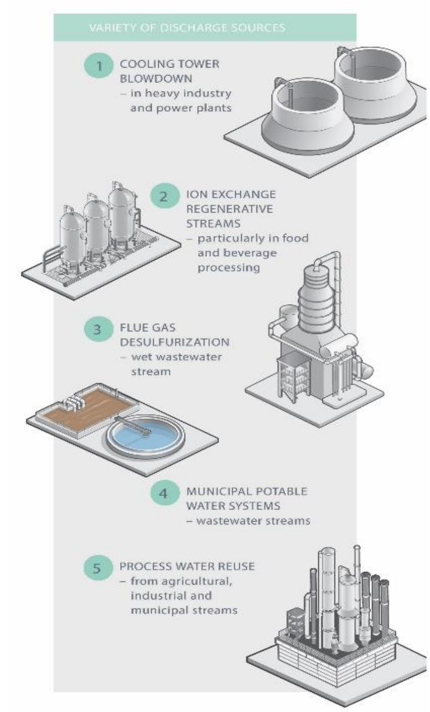
- A reduction in discharge costs,
- A reduction or prevention of regulatory fines,
- Increased water supply in water-stressed regions, and;
- Overall sustainability of municipal and industrial plants

The Challenges of Achieving MLD

Increasing the recovery of a water treatment system to 95-98% is not a trivial task. Oftentimes, one of the most challenging contaminants to remove from the waste stream is total dissolved solids (TDS). TDS removal is usually energy intensive, with thermodynamics demanding more energy for more salt removal, and can present operability challenges due to scaling and fouling. Additionally, as the water recovery increases, more energy is required to keep the salts in the waste stream separated from the product stream. Scaling by constituents such as calcium sulfate, calcium carbonate, and silica compound the challenges of high recovery for MLD. These contaminants reduce the efficiency of separation processes such as reverse osmosis and can limit water recovery.

Designing an MLD Solution

Two common scenarios arise in designing an MLD solution: increasing the recovery of an existing reverse osmosis system, or installing a brand new water treatment system. In the case where a reverse osmosis system is already installed, the brine can be treated to achieve MLD. More stages can be added to the existing train; however, there is a point at which this approach has diminishing returns with regards to energy consumption and membrane fouling (often at 90% water recovery or less). Traditional electrodialysis reversal may be used to treat reverse osmosis brine, but energy consumption and capital cost can limit the impact of MLD on operator savings. For greenfield sites, water quality must be carefully analyzed to determine the best treatment system. This analysis must include the pretreatment required to avoid scaling of the membrane system at 95-98% recovery and the overall energy consumption of the system. Pretreatment for traditional membrane systems can often be a significant source of cost and additional footprint in MLD systems.



Source: Hermsen, Rosenberg and Gorenflo (2016)

Achieving Savings with MLD – Maximum Recovery, Minimum Energy™

Any goal worth obtaining involves commitment, perseverance, and careful consideration of the obstacles that inevitably arise. To succeed at reversing trends in water scarcity, water waste must be minimized and recycled wherever possible. MLD is a method of achieving this water savings, and MI Systems provides a path through the traditional challenges of MLD to deliver economic and resource savings. Whether you need to recover brine from your existing reverse osmosis system or are looking to design a new treatment system, MI Systems can help achieve your goals through excellent design and service. MI Systems END® technology is an electrically-driven desalination process that optimizes every component of the cell, including electrodes, ion exchange membranes, and perhaps most importantly, the membrane spacers. The process design enables high resistance to membrane scaling and fouling for difficult-to-treat liquid waste streams, and the END® system's efficient design yields minimum energy consumption with maximum recovery. The result is an MLD solution that delivers the most bang for your buck.