Desalination of Sea Water

A presentation on "Desalination: The Quest to Quench India's Thirst for Drinking Water" was made at our Chapter by K. K. Mehrotra, Former Chairman-cum-Managing Director, MECON Limited, on 12th December 2015. Reproduced below are the salient points:

Water is life because plants and animals cannot live without water. Water is needed to ensure food security, feed livestock, maintain organic life, take up industrial production and to conserve the biodiversity and environment. Hence, there is no life without water. Earth is the only plant, so far known to have water and this makes it fit for human living.

Global Scenario of water availability

70% of the earth surface is covered with water, which amounts to 1400 million cubic kilometres (m km^3). However, 97.5% of this water being sea water, it is salty & can't be used for drinking / industrial purposes.. Fresh water availability is only 35 million km^3 and only 40% of this can be used by human beings. Out of the total fresh water, 69 % is frozen in ice caps, 30% is stored underground and only 1.0 % water is available on the surface of the earth. Out of the surface water, 87% is stored in lakes, 11% in swamp and 2% in rivers.

Long before, when the population was low and lifestyle was simple, water was available in plenty and was considered as a free resource. However, with growing demand for water and depletion of the available water, assured supply of good quality water is becoming a growing concern. As the water resources are not evenly distributed, across different continents, some countries have surplus water while many other countries are already facing scarcity of water. Skewed growth of population in different continents is

further adding to this crisis. Table 1 shows region–wise availability of fresh water against share of world population.

Table : 1

Region	Available fresh water resources , %	% world population
Asia	42	72
Africa	12	13
Australia/ Oceana	5	1
North/ Centre America	15	8
South America	26	6

Since generations, the pattern of water use in different countries is mostly dependent on their culture, lifestyle and industrial development, as availability of water was not a serious concern. With growing population world over, need of fresh water has also increased substantially. Continent - wise per capita water consumption is presented in Table 2.

Table : 2

Continent	Per capita water use (m3/yr)
Africa	245
Asia	519
North/ Centre America	1861
South America	478
Europe	1280

Major consumption of water is for agriculture, industrial production and domestic purposes, apart from being used for fishery, hydro-power generation, transportation and maintaining biodiversity and ecological balance. The proportion of water used for agriculture and industries varies from country to country depending on the lifestyle, extent of industrial development and water use efficiency.

Developed countries are using comparatively less water for agriculture and more for industrial and domestic purposes, while the developing countries in Asia and Africa use 80-90% of the water for agriculture and only 5-12% of the water for industrial use. This is reflecting on inefficient use of water in agriculture and poor investments in industrial development.

Scenario of water availability in India

India is blessed with good rainfall well distributed over 5-6 months in the year. The average annual rainfall in the country is 1170 mm with a wide range between 100 mm in desert areas of Rajasthan to 10000 mm in Cherapunji. The total available sweet water in the country is 3000 billion m^3 per annum. Out of this, over 1050 billion m^3 water is lost due to evaporation, transpiration and runoff, reducing the available water to 1950 billion m^3 and the usable water to 1123 billion m^3.

Only 18% of the rainwater is used effectively while 48% enters the river and most of which reaches the ocean. Out of the total usable water, 728 billion m^3 is contributed from surface water and 395 billion m^3 is contributed by replenishable ground water. Per capita water availability over last 6 decades is given in Table :3

Table : 3

Year	Population (Million)	Per capita water availability (m3/yr)
1951	361	5177
1991	846	2209
2001	1027	1820
2011	1200	900 *
2025	1350	<800*

A country is considered water stressed if it has less than 1700 m3/person / yr water availability and water scarce if availability drop down to less than 900 m3/person /yr .

The projected water demand in the country by 2025 & 2050 will be about 1093 & 1447 billion cum respectively against the demand of 634 billion cum in 2000. Factor responsible for high demand of water in future is due to rapid industrialization to match projected GDP growth of the country, massive shift from rural to urban population.

Water requirement of various sector of Industries had almost doubled during last decade and are expected to increase more than threefold by 2050. Water consumption by major industrial units in % is shown below.

Thermal Power Plant	88
Engineering	5
Paper & Pulp	2.2
Textile	2.0
Steel	1.3
Sugar	0.5
Fertilizer	0.2
Others	0.8

Need for desalination plant

India is already in the bracket of water scarce country and is bound to face severe scarcity of water in future. Potential for increasing the volume of utilization of water is hardly 5-10 % and cannot meet growing demand for industrial & domestic requirement. On the other hand Country has vast coastline of 7500 km covering 9 states and 2 Union Territory. Many major industrialized cities / towns are located on these coastline. During last one decade , desalination technology has matured with high reliability of system./ equipment , lower capital cost, effective treatment of saline/ brackish/ mershy water.

Desalination Processes

The two most commonly used processes are Multi Stage Flashing : which involve s heating of sea water to produce steam & then condensing the same Reverse Osmosis (R.O) : involve forcing water through cartridges that contain thin film composite polyamide membrane which trap salt & other impurities but allow fresh water.

The overview of R.O process is depicted in Figure1.

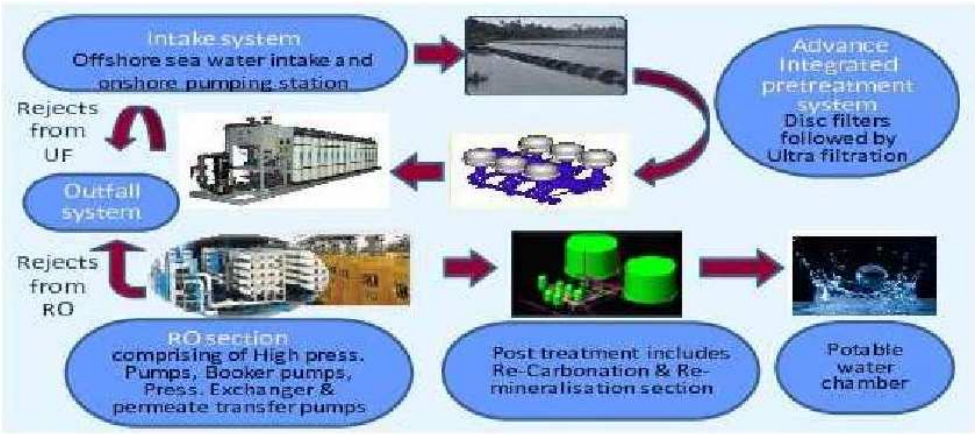
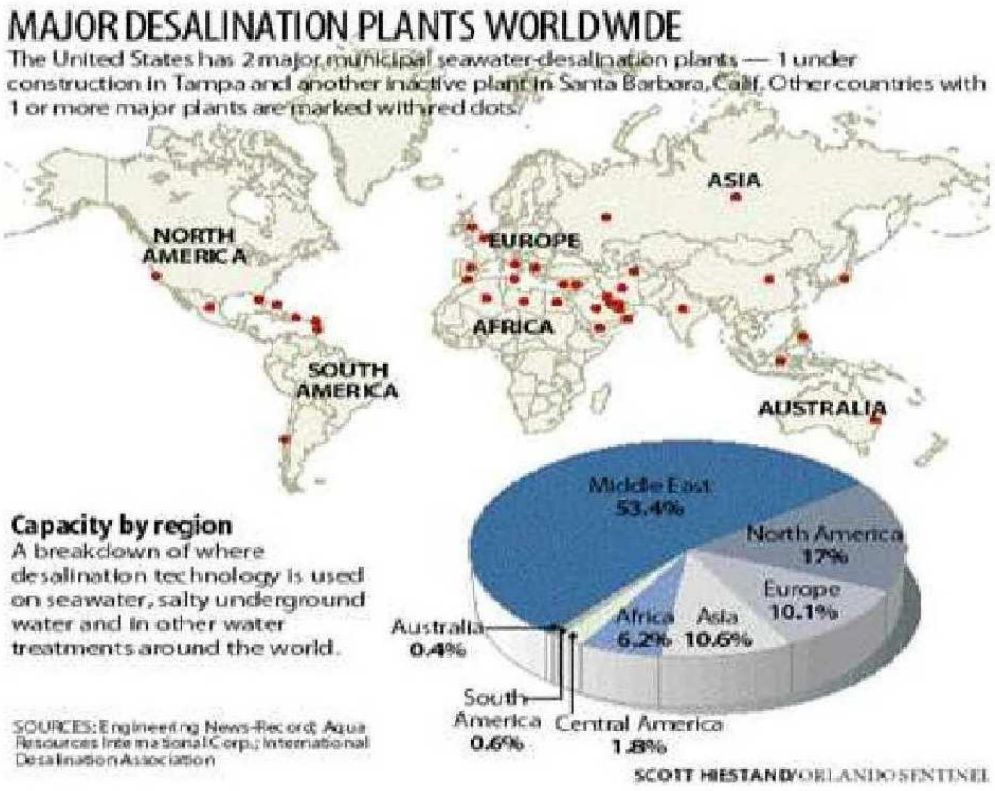


Figure: 1: Overview of R.O Process

The major desalination plants world-wide is shown in Figure 2



Desalination plants in India:

Two desalination plant presently in operation are at Minjuar & Nemelli, Tamilnadu with 100 MLD capacity each. Salient features of Minjuar & Nemmali R.O Plants are given below:

1 Minjur Sea Water R.O at Kattupalli, Chennai
Technology Provider : Abengoa-Spain
Capacity : 100 MLD
Cost : Rs 5.15 billion (Euro 91 million)
Commissioned : 2010
Cost of water : Rs 49 / kl
Facilities : R.O membranes, pressure vessel, pressure exchanger, high pressure pumps & pressure filter vessels

2 Nemmeli Sea Water Plant – Nemmeli, Chennai

Technology provider : VA Tech Wabag, Autria & IDE Technologies, Israel
Engg. & PMC : MECON Limited
Capacity : 100 MLD
Cost : Rs 6.50 billion (US$ 100 million)

Commissioned : Feb, 2013
Cost of Potable water : Rs 40/ kl

- Plant design parameters : TDS - 41,900ppm, Temp. 24 -32 deg C, TSS- 50ppm (hourly avg.) & peak -200ppm, Turbidity - 50 NTU, product water TDS < 500ppm & IS 10500 Std quality.
- 1032m long ,1600 mm dia. HDPE Sea water intake pipeline , with state of art intake velocity head
- 734 m long ,1200 mm Dia. HDPE pipe reject outfall with diffuser
- Raw Seawater inflow to the plant :11060 m3/hr (265 MLD)
- Advance all integrated membrane system with automatic back washable disc filter for pre-treatment
- Modular skid design for Ultra filtration & Reverse osmosis, with VFD & ERI pressure exchangers for energy recovery
- 45.5% minimum permeate recovery in RO membrane & 37.7% over plant recovery
- Potable water production : 4200 m3/hr (100 MLD)
- Designed for continuous 24 x 7 uninterrupted operation
- Efficient re-carbonation & re-mineralisation systems including limestone storage and re-charging system.
- Guaranteed 3.85 KWh/m3 of product water and minimum use of chemicals

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