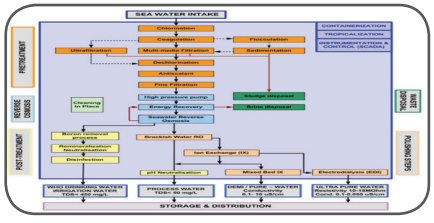
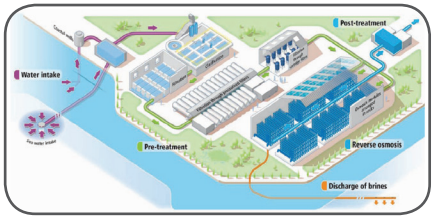
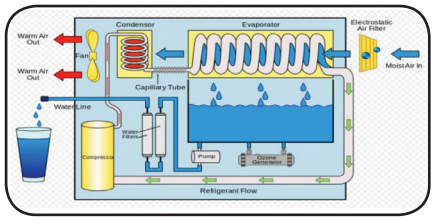
The Joys and Challenges of Desalination







The Joys and Challenges of Desalination How can we transform the desalination industry to environmentally compliant?

By Garry de la Pomerai

There isn't a person in India who is not affected or impacted by floods and drought and shortages of water. Each day the media report on the water crisis. More recently transborder with the Asam floods[9] simultaneously reports warning of 21 cities exhausting their aquifer reserves [5].

In amongst this news are the individuals within their homes, schools, small businesses, all vying to survive and maintain some continuity of life, falling heavily dependent upon Government and Utility companies to protect or provide their basic life resource, Water..

However the questions are often asked, what can the individual do to help themselves, their community or their schools. The monsoon rains come and go, more recently providing less rain than expectation. The precipitation falls as a deluge as opposed to steady continuous extended rains which have for generations recharged the aquifers.

So what can we do as an individual?

SAVE WATER is the obvious solution. But this requires a collaboration of community initiatives. People look for simple answers. Indeed this is what we all seek are solutions to the multiple complexities of the water resource crisis. Maybe not unsurprisingly, we can not simply provide a blueprint for everyone across India to follow. It is therefore important that no one simply follows blindly individual recommendations without due diligence and the correct local advice from Local Authorities, Healthcare Officials and respected Hydrogeologists[4] familiar with your topography. Included are the wider issues of rain water catchment and its usage appropriate to everyone. We need assume that many families already implement significant water saving procedures, which are touched upon in other articles which equally will benefit from the awareness of the challenges and the options discussed.

To meet the required capacity of water provision, offering a few thousand litres of water is insufficient and insignificant to the needs of cities. So what are the options? To date what has been the strategy to satisfy the thirst of our greater populations? The damming of rivers; creation of reservoirs; continuous extraction via bore wells of our aquifers; and of coarse extraction of sea water and its transformation into drinking water via desalination processes.

Desalination has been used for thousands of years, as Greek sailors used to boil water to evaporate fresh water away from the salt, and Romans used clay filters to trap salt. Today's sophisticated methods still generally use the concepts of distillation or filtration.

There are about 15,000 desalination plants around the world. The biggest plants are generally in the United Arab Emirates, Saudi Arabia, and Israel. Saudi Arabia has some the largest desalination facilities in the world including the Shoaiba complex, producing over 880 million litres per day, and the Al Jubail complex producing over 800 million litres per day. These plants use a variety of desalination technologies.

Israel's Soreq plant is the largest seawater reverse osmosis membrane plant producing 540 million litres per day, and Algeria's Magtaa plant produces 500 million litres per day.[1]

There are multiple processes that can achieve desalination to various capacities of efficiency but only two primary processes used to achieve desalination are: thermal and pressure. The oldest

method, thermal distillation, has been around for thousands of years. In thermal distillation, the water is boiled and then the steam is collected, leaving the salt behind. However, the vaporization phase change requires significant amounts of energy. More modern methods of distillation make use of various techniques such as low-pressure vessels to reduce the boiling temperature of the water and thus reduce the amount of energy required to desalinate [2]

The pressure method of desalination is reverse osmosis, which is the primary modern process in which pressure is used to drive water through a selectively permeable membrane, leaving the salt behind. This requires a large footprint of high energy use pre-treatment before the physical reverse osmosis units, which includes Chemical pre-treatment and cleaning are a necessity in most desalination plants, which typically includes prevention of bio fouling, scaling, foaming and corrosion in thermal plants, and of suspended solids and scale deposits in membrane plants.

Whilst the RO method is widely used as opposed to the older version of thermal, RO desalination plants remain devastating to the ecology and biodiversity along our coast lines, from where extraction is sought and equally where the final residual discharge is expelled.

Its necessary to understand the complex pre processing that the desalination plant undertakes before the water reaches the reverse osmosis stage. The pre processing is necessary because of the significant debris and human activity contaminates that first need be removed before the salinity is removed. This pre-processing requires considerable energy and footprint. Consequently the set up and operation of desalination is expensive and an eyesore along the coastlines, much of which are in fact is the attraction and beauty of the country for tourism and coastline leisure activities. But now there is increasing need and demand for expanding this devastation.

This diagram [fig.3] image demonstrates the scaled footprint of the various staged processes, identifying the differential scale between the final reverse osmosis process and the larger pre treatment. Another adverse aspect of present practice of coastline desalination is their intake. The vast suction intakes vacuums the surrounding biota including migrating crustaceans, starfish and shoals of fry, small enough to pass through the initial mesh filters. In addition there will be plastics and discarded debris drifting along the coastline, remnant from river discharges, land run off from rains floods and debris or discarded items or catch from shipping and fishing boats.

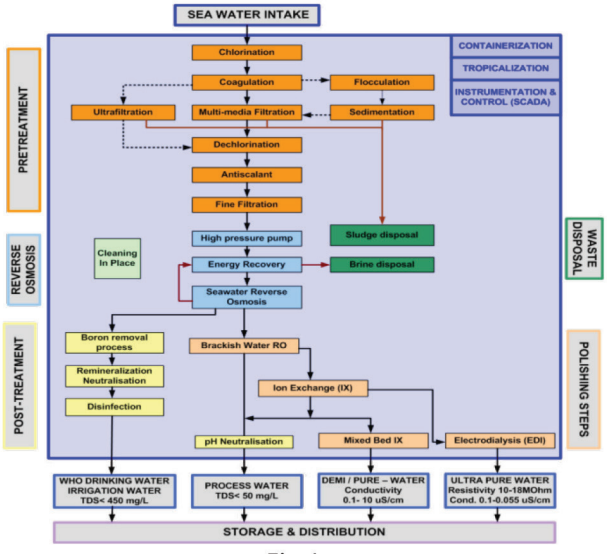


Fig.1

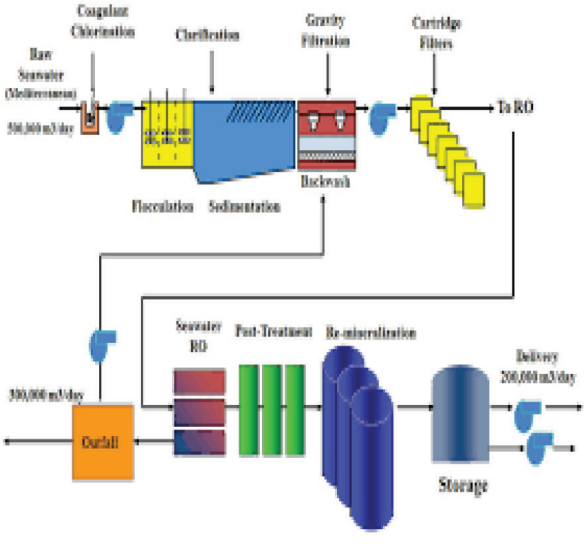


Fig.2

These simplified diagrams [Fig.1 & Fig.2] demonstrates that there is a high percentage of extreme brine and chemical processing discharge generated.

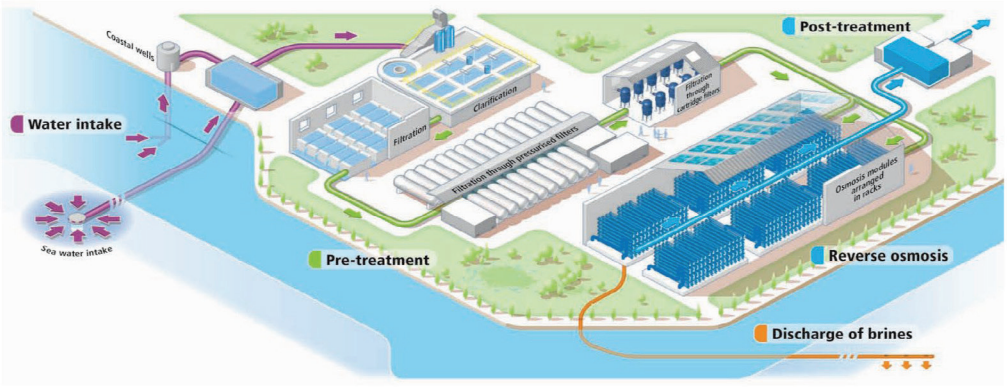


Fig.3

It's the intakes and the discharge locations [Fig.4] that cause the concentration of destruction to the biota along the coastline. So how did we get to this stage of seeking and indeed reliance upon such a destructive water manufacturing process and do we have any alternatives?

The how is easy, in fact by an amalgamation of failures and occurrences, including Reservoirs globally are drying up; climate change is altering our traditional precipitation rates; non regulated ad hoc ground water extraction; mismanagement and greed and corrupt political manipulation; Water as a resource cannot be offered for free in today's' society; A significant failure has been not to recognise the need to manage flood waters; Commercial agendas to gain control of 'God water'; Political manipulation of water supplies; Apathy and Complacency; Disrespect for water; and the Heavy reliance upon inefficient technologies.

We have already suggested what the individual can do to assist the situation, so this leaves industry, which we have also identified relies upon the most damaging processing of water. Is there any other technologies surfacing that might offer alternatives? Yes, but the challenge is meeting the capacity production of drinking water require by fast developing and thirsty cities. However, multiple units stationed as satellite facilities around a city, not reliant upon a ground water source, offering up to 20 cubic metres of water per day is certainly a start.

The source of the water is sustainable and requires minimal consumables and easily located without engineered facilities. Its source replenishes itself automatically and cannot run dry by the simple equation that most of the source if from the oceans anyway which cover two thirds of the earth surface.
Atmospheric water extraction[6] through state of art processing has been in existence for a considerable time, in fact it stretches back at least a thousand years in Algeria. However during recent decades the present business model has been wrong and costly, the water industry selling the largely unnecessary consumables as opposed to selling the water.

This is now changing wit science combined with IT developments providing refined algorithms with automated adjustments within the processing, which enable far greater parameters of operations and significantly scaled up production. 'Water For You' have broken the previous confinement of this process and are implement globally and continue to develop and refines to enable greater capacity output with the global aim to replace inland and

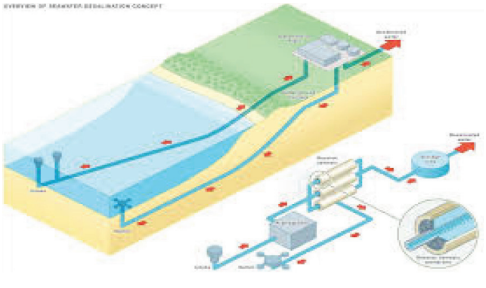


Fig.4

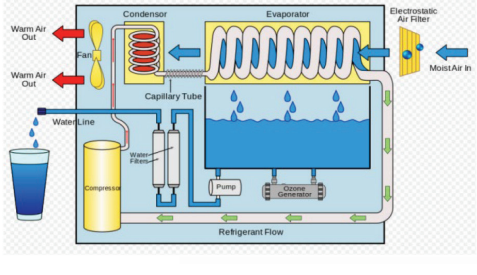


Fig.5

individual pure reverse osmosis systems, which presently also dump over 50% of their intake back into the delicate aquifer networks as high contaminate residual discharge.

But atmospheric water extraction does not presently anywhere near meet the production demands that desalination can satisfy, unfortunately with its destructive nature. This the need to explore how to improve a desalination process that has basically remained the same for decades is the dominant challenge. The three main components of a desalination that need rectification are the intake, the pre processing and the discharge volume with its high contaminant contents. So what is on the horizon of change?

If we can refine the brine discharge sufficiently, there already exists a periphery technology awaiting to take advantage in the form of mineral extraction. These minerals include every know mineral that come into contact with our oceans, including the highly desired lithium for batteries.

So lets review the desalination process and explore some of the obvious requirements if we are to make changes to the downsides, which include destructive intakes which present highly contaminated sea water embellished with all manner of live biota, all of which must be extracted by numerous filtration processes. Then we have the counter processing to remedy the extreme chemical treatment. This is all serviced by very high energy consumption, producing a non realistic carbon footprint for the 50% water production from intake. But there hasn't been a choice. The present process is then culminating in a yet again destructive discharge in an alternative location along the coastline[7], down current and at a significant distance from the intake, decimating the biota yet again, with increased temperatures, increased concentrated brine and extracted contaminates, resulting in vast stretches of proximate coastline becoming bleached with its whole biodiversity being destroyed, affecting the feeding grounds and food chains of deep sea fish. Semi enclosed seas such as the Persian Gulf within arid regions are quickly dissolving into dead seas.

So any solution requires to address protecting the biota, eliminating vacuuming the crustaceans, reducing the pre processing, eliminating chemical usage, reducing the energy requirements, reducing the discharge if not eliminating any discharge, and what discharge is created needs be benign to harming the coastline bio diversity. And simultaneously in an ideal world the desalination plant offer the opportunity to produce energy and provide an additional produce in addition to the desired potable water production. A tall order to achieve it all. Or is it?

The method of extraction is the main problem and generates all of the adverse processing and damage to ecology before and after processing. It also demands the high energy and it limits any other befits other than a 50% usage of the water intake. Consequently it is the intake method that holds the secret to change.

So what alternatives exist other that sucking sea water in via the traditional sea bed surface methods? Extraction from the sea surface offers no advantages, in fact liable to vacuum additional floating debris. Extraction from further out to sea, within a continental shelf also offers limited if any advantages, except lengthens the infrastructure investment requirement and creates additional challenges for access to maintain open bed intake grills.

To reduce the energy of the plant, it is necessary to reduce the processing footprint, which is predominantly extracting the contaminants from the sea water. To even consider generating any form of additional energy, it is necessary to remove all variants from the intake. To consider suggesting that any eventual residual discharge becomes benign, requires an even more extensive filtration system than the existing pre processing, which seems to contradict the aims and goals if one is to use mechanical means.

Consequently we are looking for a silver bullet that enables the desalination process to completely transform from destructive, inefficient system that provides minimal potable water output, into environmentally advantageous, energy producing, benign system that ultimately uses 100% of its water intake, offering 100% as desalinated water, and a return on all of its extractions as a commodity. Fairy tale stuff, that the water industry will be totally transformed by and the world safely alleviated from that vast majority of its water shortage problems. We believe that time and practical application has indeed arrived. Upon consideration, the obvious location in the process to start addressing this problem is at the intake. But not with additional technology but with less technology, using the natural resources available off shore within the continental shelf. Thus by using the sea bed sand itself as the filter through the process of Telesis extraction, a process developed by UK engineers in Bahrain [8], all of the adverse processes within desalination can be addressed, including offering additional benefits.

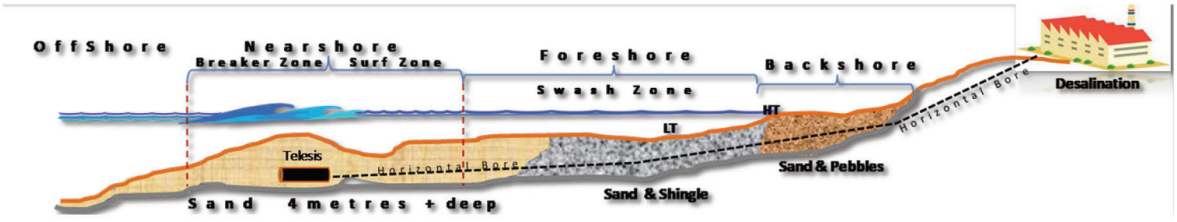


Fig.6

Telesis revolutionises the desalination process by enabling an environmentally benign intake and a benign discharge, significantly improving desalination efficiency and ensuring robust resilient procedures, whilst utilises a reduced footprint and enables a green, ecologically friendly, commercially affordable fresh water production process. The process reduces the desalination OPEX by ≥50% including a 30% energy reduction and a 30% CAPEX saving, simultaneously enabling significant breakthroughs in addressing the political environmental concerns for desalination. The 'platform' for the TELESIS processes,is the innovative use of the seabed sand layer as a perpetually maintained, highly effective filter which enables the complimentary desalination 'partner technology' enhancements. At a time where water resources are in critical globaldem and, this is a true game changer, satisfying both the need for secure supplies and the environmentally conscious market place.

Its contributory Partner benefits include:

- Significantly improving conversion of seawater intake into high-quality (Chemicals-free potable water and averting the production of a toxic and carcinogenic residual effluent.
- The subsurface seawater abstraction process technology [fig.6] is environmentally 'harmless to coastline biodiversity', eliminating significant intake and destruction of, all marine Biota some of which significantly clog and slow the desalination process.
- The process is impervious to all shut down events – Red Tide, Oil Leaks, inclement weather, etc. no longer creating the frequent operational shut-down events otherwise experienced; eliminating the costly pre treatment processes; and significantly reducing the physical plant site footprint requirements.
- Elimination of all chemical consumables and their associated costs and their harmful, destructive consequences
- offering additional, parallel free cooling services
- the process enables renewable energy production option by Heat conversion providing 30% energy cost reduction
- The 'Chemicals-free' brine is a benign purer residue opening up opportunities for recycling and alternate use or diluted discharge methods.

In summary extraction process design is available to both new projects and retro-fitting the existing (costly, inefficient and destructive) existing facilities, circa 20,000 When retrofitted, the entire process remains environmentally benign and significantly reduces the footprint [fig.7]

This enables at such a significant time of global shortage, a significant breakthrough in helping the desalination industry to improve its image and reputation, by meeting environmental standards in protecting coastal biodiversity, whilst potentially and simultaneously eliminating its fossil fuel and chemical usage. The bespoke sub seabed extraction process delivers the critically

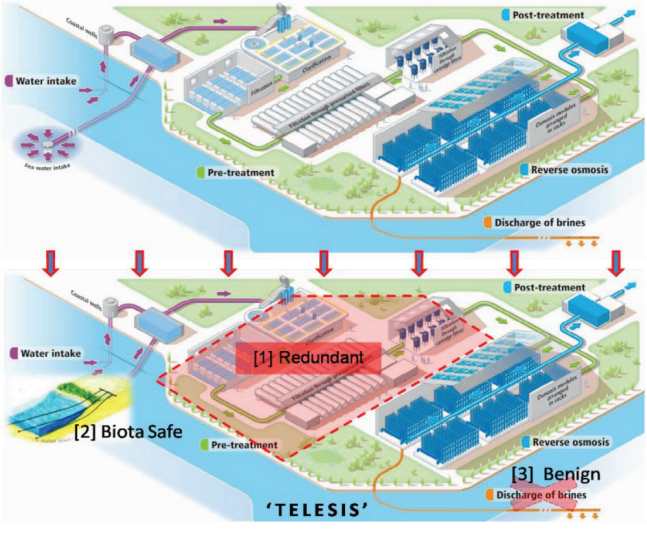


Fig.7

needed paradigm shift in the environmental impact, cost, and security of desalination, accomplished by simply and successfully changing the method by which the feed-source is acquired and thereby significantly improving the underlying processing technologies associated within desalination and indeed opening opportunities to better address usage of the enabled benign residual discharge.

Consequently, the opportunity to embrace desalination now avails itself in the majority of required locations. Obviously there will always be circumstances where it becomes inappropriate, but the fundament approach has now changed. Coastline desalination is not the silver bullet for water provision and certainly does not release the state from developing its water resource management strategies. We must learn to promote water conservation, reduce contamination and excess agriculture fertilizers and we need learn how to use the resources available such as floods. We need improve our aquifer management and review the urban designs that promote needless run off to rivers instead of managed aquifer recharge. But of course new strategies and culture change within practices requires time, so meanwhile, whilst such technologies as Atmospheric water extraction upgrades its capacity, we must look to technology that satisfies the population of today, whilst minimising the adverse effects upon the environment. Combined with better resource management strategies, recovery of existing surface lakes and rivers, control of industrial discharges, formalisation of urban sanitation systems and education of better agricultural irrigation practices, the new approach to desalination may well offer the life line to the 21 cities in India bereft of water.

About The Author



Garry de la Pomerai.DOB 1959. Independent DRR consultant to UNISDR, UNESCO, UNCRD 2005 Co-Pioneered Safe Schools Strategy & Contributor to Resilient Cities Programme; Advocate for INRULED Education for Rural development and Sustainability & IFRC for integrated DRR legislative mechanisms 2009 to present promoted ICL development of Seismic Early Warning Systems strategy and EEWS project installation project manager meanwhile Developing integrated MHEWS strategies and protocols Since 2011 Advocate and field scientist developing Water Resource Management Strategies and Water Enhancement Solutions across Asia and Africa Chairman of UNESCO Global Task Force for the Built Environment. Co-founder of the Coalition for Global School Safety & UNISDR GADRRRES. soluzioninfo@aol.com