

# Water Desalination and Purification Technology

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## ABSTRACT

Water desalination is a process that extracts mineral components from saline water. More generally desalination refers to the removal of salts and minerals from target substances. Salt water desalinated to produce water suitable for human consumption or irrigation. One by-product of desalination is salt. Desalination is used on many seagoing ships and submarines. Most of the modern interest in desalination is focused on cost-effective provision of fresh water for human use. Along with recycled wastewater, it is one of the few rainfalls –independent water sources. Due to its energy consumption desalinating sea water is generally more costly than fresh water from rivers or ground water. Water recycling and water conservation. However, those alternatives are not always available and depletion of reserves is a critical problem worldwide. Currently, approximately 1% of the world's population is depend on desalinated water to meet daily needs, but the UN expects that 14% of the world's population will encounter water scarcity by 2025. Desalination is particularly relevant in dry countries such as Australia, which traditionally have relied on collecting rainfall behind dams for water. According to the International Desalination Association, in June 2015, 18426 desalination plants operated worldwide, producing 86.8 million cubic meters per day, providing water for 300 million people. This number increased from 78.4 million cubic meters in 2013, a 10.71% increase in 2 years. The single largest desalination project in Ras-Khair in Saudi Arabia, which produced 1025000 cubic per day in 2014, although this plant is expected to be surpassed by plant in California.

## INTRODUCTION

Removal of salts (sodium chloride) and other mineral it from the seawater to make suitable for human consumption and or industrial use, the most common desalination methods employ reverse osmosis in which salt water is forced through a membrane that allows water molecules to pass but blocks the molecules of salt and other minerals. Desalination is an immense part of our world. Desalination provides us a supply of water to go around since not many in areas have access to water; it makes the whole process easier, instead of going to river for a supply of water. Desalination is a major source all over the world since it gives us the supply of fresh water all over the world. Where in areas brisk water is source for example Australian Human Consumption, businesses, advertisement and much. The simple hurdle that must be overcome to turn seawater into fresh water is to remove the dissolved salt in seawater. That may seen as easy as just boiling some seawater in a pan, capturing the steam and condensing it back into water. The most popular methods used in desalination are multi-stage flash distillation ,which uses heat to evaporate water, leaving the salt behind, and which accounted for 84% of desalination in 2004, and reverse osmosis desalination which less energy intensive but still requires a great deal energy to pump water. The Minjur desalination plants is the largest plant in India being built on a 60 acre site in Kattapulli villages near Chennai .The pre-treatment of the raw seawater will include coagulation –flocculation gravity and pressure filtration. Salt water is desalinated to produce water suitable for human consumption or irrigation, one by-product of desalination is salt. Desalination is used in many seagoing ships and submarines. Most of the modern interest in desalination is

focused on cost-effective provision of fresh water for human use. Along with recycled waste water, it is the one of the few rain fall independent water sources. Even with all the water in Earth's oceans, we satisfy less than half of a percent of human water needs with desalinated water, We currently use on the order of 960 cubic miles(4000 cubic kilometres) of fresh water a year, and overall there is enough water to go around. There is increasing regional scarcity. The problem is that the desalination of water requires a lot of energy, salt dissolves very easily in water ,forming strong chemical bonds, and those bonds are difficult to break .Energy and the technology to desalinate water are both expensive and this means that desalinating water can be pretty costly. There are environmental costs of desalination as well. Sea life can get sucked into desalination plants, killing small ocean creatures like baby fish and plankton, upsetting the food chain also. There is the problem of what to do with the separated salts, which are left over as very concentrated brine pumping this super salty water back into the ocean can harm local aquatic life, reducing this impact is possible, but it adds to the costs. Despite the economic and environmental hurdles, desalination is becoming increasingly attractive as we run out of water from other sources. We are over pumping ground water we have already built mare dams than we can afford economically and environmentally and we have tapped nearly all of the accessible rivers. For most must be done to use our existing water more efficiently, but with the world's population escalating and the water supply dwindling. The economic tide may soon turn in favour of desalination.

## METHODS AND MATERIALS

One common method of desalination reverse osmosis pushes water through a membrane that keeps out the salts—a costly and energy-intensive process, the University of Illinois said in the release. By contrast the battery method uses electricity to draw charged salt ions out of the water. At least three principle methods of desalination exist: 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 salts behind. There are numerous methods of desalination described as below.

### REVERSE OSMOSIS

Reverse osmosis is a process where pressure is used to push the water solution through a membrane preventing the larger solutes (the salt) to pass through. Reverse osmosis is generally considered to be the least energy consuming of all the large scale process. There are several set back of reverse osmosis membranes are currently prone together too much bacteria and “clog up”, although they have improved since they were first used. The membranes deteriorate when chlorine is used to treat the bacteria.

### FORWARD OSMOSIS

Forward osmosis utilizes the natural osmotic processes, a substance moving from an area of low concentration to an area of high concentration .It generally requires about half of the cost of reverse osmosis due to less energy being used to complete the process instead of forcing the solution through a pressure gradient, this process allows it to naturally occur .When desalinating water ,a solution of sea water moves across a semi permeable membranes to a highly concentrated solution of ammonia salts, leaving the sea salts on the other side of the membrane. Afterwards, the solution is heated to evaporate the ammonia salt and that salt is reusable.

### ELECTRODIALYSIS

Electro dialysis reversal utilizes a membrane like that in reverse osmosis, but sends an electrical charge through the solution to draw metal ions to the positive plate on the side, and other ions (like salts) to the negative plate on the other. The charges are periodically reversed to prevent the membrane from becoming too contaminated as typically found in regular electro dialysis .The ions located on both plates can be removed, leaving pure water behind. Recently developed membranes reportedly have been chlorine resistant, and generally remove more harmful ions (not just salt) than reverse osmosis.

### THERMAL DESALINATION

Thermal desalination is a method of cleaning water than can occur through many different processes and include removing salt as well as other contaminants. All thermal desalination is the process of heating the water solution and gathering pure water when the vapour cools and condensation occurs.

### DISCUSSIONS

Desalination plants can provide drinking water in areas where no natural supply of potable water exists. Some Caribbean island gets almost all of their drinking water through

desalination plants, and Saudi Arabia gets 70% of its fresh water via the process. Even in countries where fresh water is plentiful .Desalination plants can provide water to drier areas or in times of drought .It is very costly to build and operate desalination plants. Depending on their location building a plant can cost from \$300 million to \$2.9 billion as of 2008.Once operational, plants require huge amount of energy. Energy costs account for one third to one half of the total cost of producing desalinated water because energy is such a large portion of the total costs, the cost is also greatly affected by changes in the price of energy. The California cost commission estimated that a one cent increase in the cost of a kilowatt-hour of energy raises the cost of one acre-foot of desalination water by \$50.As new technological innovations to reduce the capital cost of desalination, more countries are building desalination plants as a small element in addressing their water crises. According to MSNBC a report by Lux, Research estimated that the worldwide desalinated water supply will triple between 2008 and 2020.However, not everyone is convinced that desalination is or will be economically viable or environmentally suitable for the foreseeable future. Debbie Cook the former mayor of Huntington beach ,California has been a frequent critic of desalination proposals ever since ,she was appointed as a member of the California desalination task force Cook claims that in adding to being energy intensive, desalination schemes are very costly often much more costly than desalination proponents claim..In her writing on the subject Cook points to a long list of projects that have stalled or been aborted that water stressed regions would do better to focus on conservation or other water supply solutions than to invest in desalination plants. Desalination is not a perfected technology and desalinated water can be harmful to human health as well. By product of the chemical used in desalination can get through into the pure water and endanger the people who drink it. Desalinated water can also be acidic to both pipe and digestive systems. In an age where energy is becoming increasingly precious; desalination plants have the disadvantages of requiring large amounts of the power. Other water treatment technologies are more energy efficient. Major environmental challenges of desalination are the disposal of the highly concentrated salt brine that contains other chemicals used throughout the process. Because all large costal seawater desalination plants discharge brine into oceans and estuaries, including all of the proposed plants in California, steps must be taken to ensure its safe disposal at this stage, we know very little about the very long term impacts of brine disposal of the marine environment.

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