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THE SEAWATER DESALINATION

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ABSTRACT

All over the world, access to potable water to the people is narrowing down day by day. Most of the human diseases are due to polluted water resources. Even today, under developed countries and developing countries facing huge water shortage . The groundwater quality problems present today are caused by contamination and by over exploitation, or by combination of both. The only nearly unlimited sources of water are the oceans, which, however, are of high salinity.

I. THE SEAWATER DESALINATION is the process of separation of salts from seawater which requires large amounts of energy. We know that the Conventional and non-conventional methods are used to distil the water. There are two collection systems included as direct and indirect systems. The example of direct collection systems is the solar still. Indirect collection systems employ two subsystems; one for the collection of renewable energy and one for desalination. For this purpose, standard renewable energy and desalination systems are mostly employed. Only industrially-tested desalination systems are included in this paper and they comprise the phase change processes, which include the multistage flash, multiple effect boiling and vapour compression and membrane processes, which include reverse osmosis and electrodialysis. It also includes a review of various systems that use renewable energy sources for desalination as well as a review of various systems, characteristics of the major desalination system and REDS Technology.

II. INTRODUCTION

There are two most important topics on the international environment and development agenda which is water and energy. These two critical resources are inextricably and reciprocally linked so the production of energy requires large volumes of water while the treatment and distribution of water is equally dependent upon readily available, low-cost energy. The existing water resources are being smaller due to

• Progressive increase in the demand of water for irrigation, rapid industrialization, population growth and improving life standards.

• due to unequal distribution of rain water and occasional drought.

• excessive exploitation of ground water sources and its insufficient recharge.

• Deterioration of water quality due to the discharge of domestic and industrial effluents without adequate treatment. This is resulting into water scarcity.

The only nearly inexhaustible sources of water are the oceans. The main drawback is their high salinity. According to World Health Organization (WHO) the permissible limit of salinity in water is 500 parts per million (ppm) and for special cases up to 1000 ppm, while most of the water available on earth has salinity up to 10,000 ppm, and seawater normally has salinity in the range of 35,000– 45,000 ppm in the form of total

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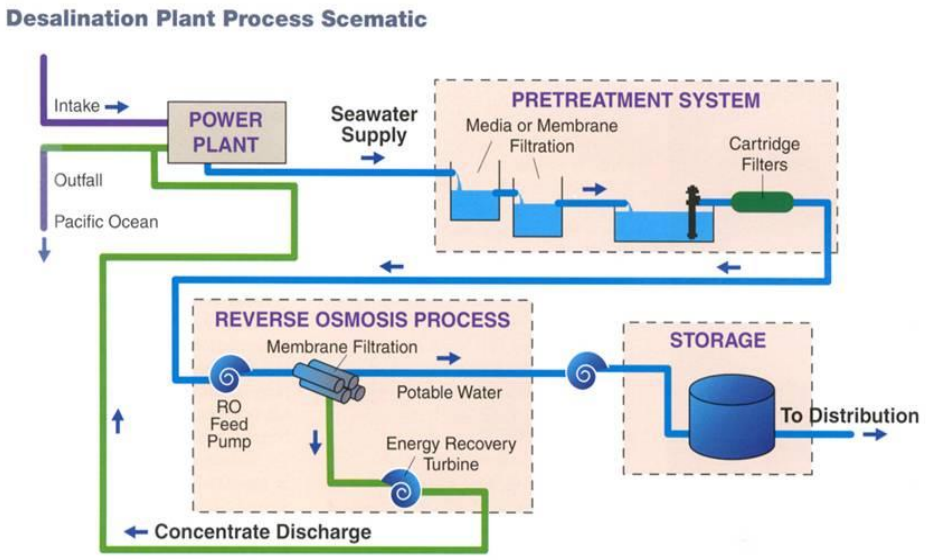
dissolved Salts. The purpose of a desalination system is to clean or purify brackish water or seawater and supply water with total dissolved solids within the permissible limit of 500 ppm or less. . Many countries in the Middle East, because of oil income, have enough money to invest in and run desalination equipment. .It has been estimated by Kalogeria that the production of 1000 m3 per day of freshwater requires 10,000 tons of oil per year. The dramatic increase of desalinated water supply will create a series of problems, the most significant of which are those related to energy consumption and environmental pollution caused by the use of fossil fuels. This can be achieved by use natural energy sources like wind or solar.

III. DESALINATION PROCESS



IV. DESALINATION

Desalination refers to the process by which pure water is recovered from saline water using different forms of energy. Saline water is classified as brackish water or seawater depending on the salinity and water source. Desalination produces two streams as - freshwater and a more concentrated stream i.e.brine.

Desalination systems have two main categories:

1. Phase-change or thermal processes
2. Membrane or single-phase processes

4.1 Thermal Processes

In the phase-change or thermal processes, the distillation of seawater is obtained by utilizing a thermal energy source. Water is heated and producing water vapour that in turn condenses to form distilled water. The thermal energy may be obtained by a conventional fossil-fuel source, or by a renewable energy sources such as nuclear energy, geothermal energy, and solar pond.

4.2 Membrane Processes

In the single phase or membrane process, the distillation of seawater is achieved by utilizing electricity. The electricity may be obtained solar or

wind energy, which is used to drive the plant. Solar energy can directly or indirectly support for desalination.

V. THERMAL DESALINATION PROCESSES

5.1 Multi-stage flash evaporation/distillation(MSF)

In multi-stage flash evaporation the saline water (sea or brackish) is heated and evaporated; the pure water is then obtained by condensing the vapour. When the water is heated in a vessel both the temperature and pressure increase; the heated water passes to another chamber at a lower pressure which causes vapour to be formed; the vapour is led off and condensed to pure water using the cold sea water which feeds the first heating stage. The concentrated brine is then passed to a second chamber at a still lower pressure and more water evaporates and the vapour is condensed as before. The process is repeated through a series of vessels or chambers until atmospheric pressure is reached. Typically, an MSF plant can contain from 4 to about 40 stages. Multi-stage flash evaporation is considered to be the most reliable, and is probably the most widely used of the three principal distillation processes [3].

5.2 Multiple-effect evaporation/distillation (MED)

Multiple-effect distillation (MED) is also known as long-tube vertical distillation (LTV) and is in principle similar to multi-stage flash evaporation, except that steam is used to heat up the seawater in the first stage and the resulting vapour is used in subsequent stages to evaporate the water, and the seawater/brine is used to cool and condense the vapour in each successive stage so that the temperature gradually falls across each stage of the process. As in multi-stage flash evaporation, many stages are used in commercial plants. The MED process is used for what, at the time it began operating, was the largest desalination plant in the world in Jubail, Saudi Arabia, producing over 800,000 m^3/day [4]. The plant began operating in April 2009.

VI. MEMBRANE DESALINATION PROCESS

6.1 Electrodialysis (ED/EDR)

The salts in seawater are composed of positive ions (called cations) and negative ions (called anions). For example, common salt (which is sodium chloride, NaCl) dissolves in water to produce positively charged sodium ions an negatively charged chloride ions. Thus:-NaCl = Na+ + Cl-. Electrodialysis uses a stack of ion-exchange membranes which are selective to positive and negative ions. Under the influence of a direct electrical current (DC) the positive sodium ions pass through a cation membrane and the negative chloride ions pass through an anion membrane as The incoming saline water is thus converted into two streams, one of concentrated brine and one of desalinated (fresh) water. Industrial electrodialysis plants consist of stacks of hundreds of membranes. Fouling of the ion exchange membranes can occur and this can be partly overcome by reversing the direction of the DC current; this process is known as electrodialysis reversal or EDR.

6.2 Reverse osmosis (RO)

Osmosis is the process in which water passes through a semi permeable membrane from a low concentration solution into a high-concentration solution. It is a process which occurs in plant and animal tissue including the human body (e.g. the secretion and absorption of water in the small intestine). If a pressure is applied to the high concentration side of the membrane the reverse process occurs, namely water diffuses through the semi-

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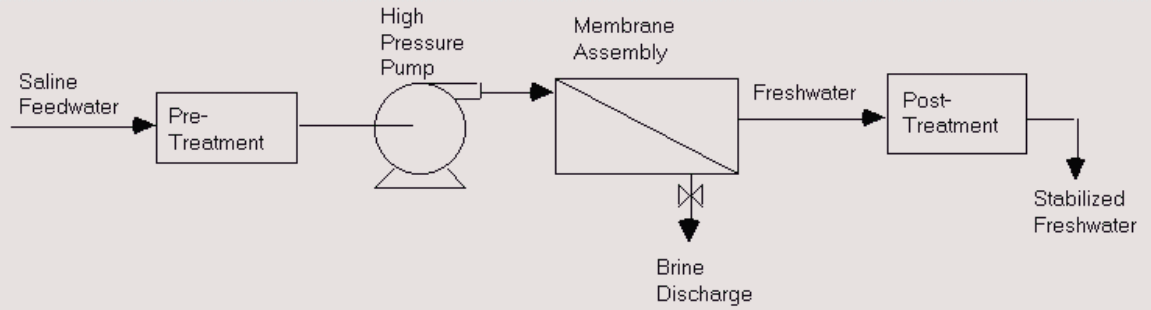
permeable membrane from the high concentration solution into the low concentration solution, i.e. reverse osmosis. As seawater is pumped under pressure across the surface of the membrane, water molecules diffuse through the membrane leaving a concentrated brine solution on the feed-side of the membrane and fresh water on the low-pressure product side. The brine solution is rejected as wastewater and can be in the region of 10% to 50% of the feed water depending on the salinity and pressure of the feed water. RO membranes are manufactured from modern plastic materials in either sheets or hollow fibres. In a modern RO plant the membranes are grouped together in modules which are linked together according to the size of plant required. RO plants use four alternative configurations of membrane, namely tubular, flat plate, spiral-wound, and hollow fibre. Reverse osmosis is becoming the most widely used method for the desalination of brackish and sea waters.



VII. CONCLUSION

In this paper, a comparison of the various other desalination systems are presented together. The selection of appropriate RES desalination technologies depends on various number of factors. These include, the plant size, the feed water salinity, the remoteness, the availability of the grid electricity, the technical infrastructure and the type of the local renewable energy resources. Among the many possible combinations of desalination and renewable energy technologies, some seems to be more applicable in terms of economically and technologically feasible than others. It should work when installed and work and deliver suitable amounts of fresh water at the expected quantity and quality and cost for the life of a project. The most popular combination of technologies is MED with the thermal collectors and reverse osmosis with PV. PV is particularly good for small applications in dry areas. For the larger units, wind energy may be more attractive as it does not require like as much ground. This is mostly the case on islands, where there is a good wind regime and often limited flat grounds. With distillation process, large sized plants are more often taken into consideration due to the relatively large amount of heat loses from small units. Energy cost is one of the most valued elements in determining water costs when water is produced from desalination plants. By keeping in mind the climate protection targets and strong environmental considerations, future water desalination around the world should be mostly powered by solar, wind and other clean natural resources.

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