International Journal of PharmTech Research
CODEN (USA): IJPRIF, ISSN: 0974-4304, ISSN(Online): 2455-9563
Vol.15, No.01, pp 01-06, 2022

Biosorption for Desalination: A Short Review

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Abstract : Background: The need of fresh and potable water is increasing day by day as the population is growing in an exponential way throughout the globe. As the saline water is more in seas and oceans, the need of desalination is more at present to get the fresh water. **Methods:** Different innovations have been utilized to desalinate saline water with diverse execution characteristics. This review article traces the advancement of current desalination processes and compares their execution in terms of input and yield of freshwater purity, energy requirement, impact on environmental conditions and economy**. Findings:** It was found that biosorption desalination innovation could be a promising strategy for desalinating seawater due to its low cost and less impact on environmental conditions as it uses the waste biological materials.
Keywords : Desalination, Adsorption, Reverse Osmosis, Chemical Precipitation, Bio sorbent.

Rakesh Namdeti *et al*/International Journal of PharmTech Research, 2022,15(1):01-06.

DOI: http://dx.doi.org/10.20902/IJPTR.2022.150101

Introduction

There are two types of water resources present in the world, fresh water, and salty water. As compared to salty water freshwater quantity is very negligible. Only 2.5 % of total water is considered as freshwater. Sea, oceans are the main sources of salty water whereas the main source of freshwater are mainly underground water or compress water lake sometime snow or ice. [1], [2].

Among all quantity of freshwater only 0.3 % used by the total population of the world. So as a result, there is lack of supply of freshwater. Desalination of salty water maybe one of the alternatives of the water crisis. There are mainly three major types of desalination process or technology is applied all over the world [3-6]. First one is the most common technique that is simultaneous evaporation as well as condensation of water. This is a thermal process where the salts are separating from the water by means of their boiling point. Second one is a pressure design process where high pressure is applied two separate the water molecule from the salt when it passes through a semipermeable membrane. In this process high pressure is required to separate water molecules from the salt. The third one is entirely chemical driven process. [7 - 9].

The first process consists of different technique of desalination process. For example, multi effect distillation, desalination followed by humidification and dehumidification, flash distillation by solar energy and freeze-drying process are most common among them. In most of the technique either boiling or freezing of the salty water is done and the water is transformed into its vapor state or ice form and it is separated from the salt.

Different types of Technology, mainly electro dialysis, forward osmosis, reverse osmosis; nano-filtration is used at high temperature for thermal driven process [10]. Gas hydrate formation, liquid-liquid extraction, desalination by Ion exchange resin or any other different precipitation process is used in case of chemical driven process. [11]. But unfortunately, there are a very little research found on absorption technology in this arena [12]. In this process silica gel is used as the adsorbent which has a high attraction with water is used to separate water from the salt molecules. [13]. Figure 1 states the pictorial representation of various techniques of the saltwater desalination process.

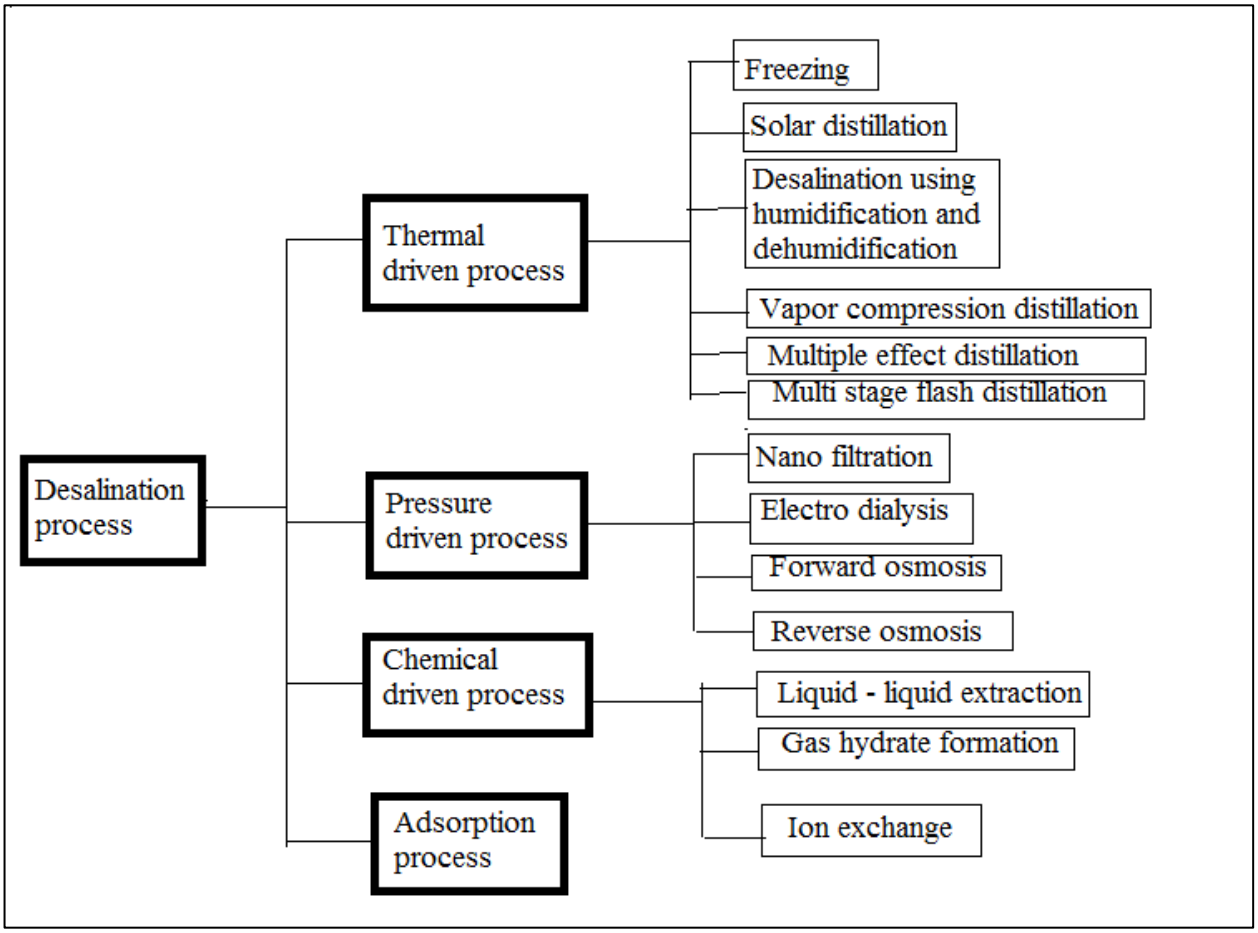
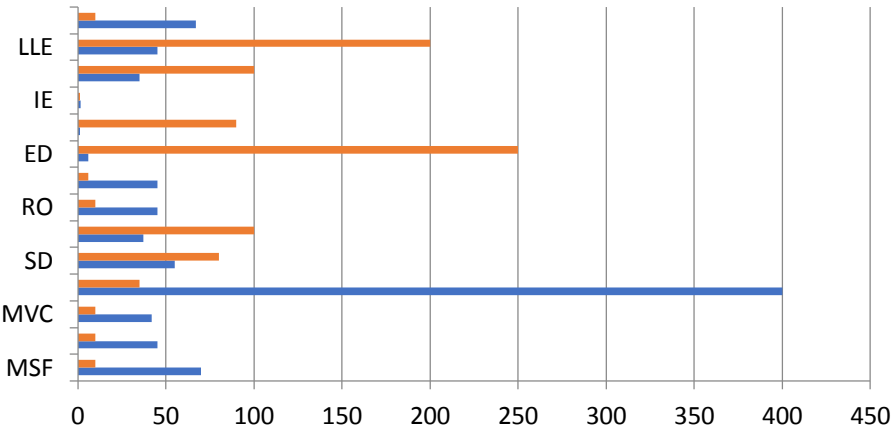


Figure 1. Variation of the desalination process [14], [15], [16], [17].

Results and Discussions

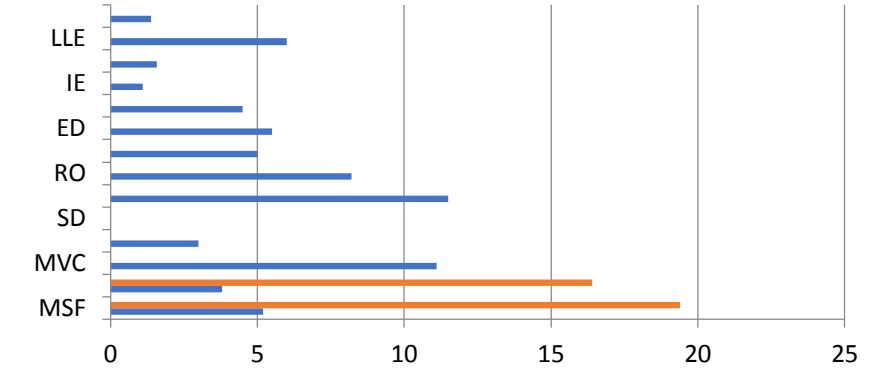
Various methods have been adopted for the desalination process and different variable main effect the using of these systems. [18]. Variable includes call to water quality pollution load in the saltwater level of salt concentration into the process water energy consumption and input environmental effect and cost of the process. The salinity of water depends on total dissolved solids concentration, and it is classified as sea water and brackish water. the salt concentration in the brackish water somehow higher than the drinking water but lower than the salt sea water total dissolved solids concentration should be less than 200 mg per liter in the process water [19, 20] and around 25000 ppm for brackish water [21] and 35000 ppm for sea water [22]. The figure 2 represents the classification of feeding water and treated water salinity level for the different technologies [23].



	MSF	MED	MVC	HDH	SD	FRZ	RO	FO	ED	NF	IE	GH	LLE	ADS
Process water	10	10	10	35	80	100	10	6	250	90	1.3	100	200	10
Raw water	70	45	42	400	55	37	45	45	6	1	1.5	35	45	67

Salt concentration of process and raw water x 1000 ppm

Figure 2. Salt concentration of various desalination method of raw and process water [24].



	MSF	MED	MVC	HDH	SD	FRZ	RO	FO	ED	NF	IE	GH	LLE	ADS
Thermal Energy	19.4	16.4	0	0	0	0	0	0	0	0	0	0	0	0
Electrical Energy	5.2	3.8	11.1	3	0	11.5	8.2	5	5.5	4.49	1.1	1.58	6	1.38

Energy requirement (kWh/m3)

Figure 3. Energy requirement of various desalination method of raw and process water [25,26].

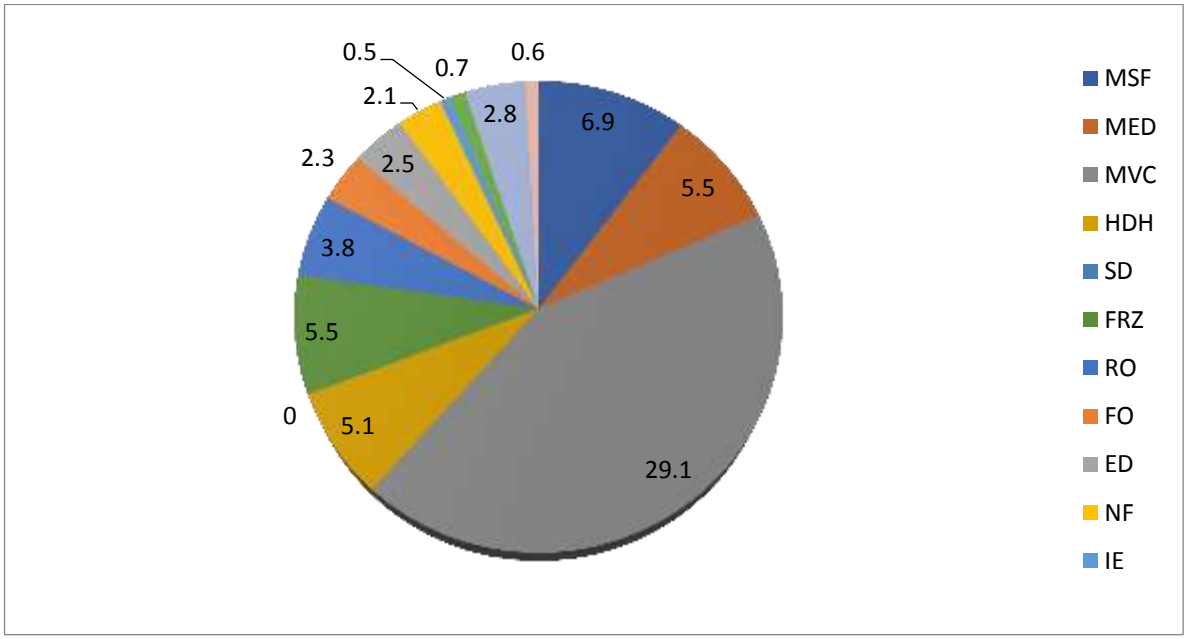


Figure 4. Carbon dioxide production in kg/m3 of various desalination method [27].

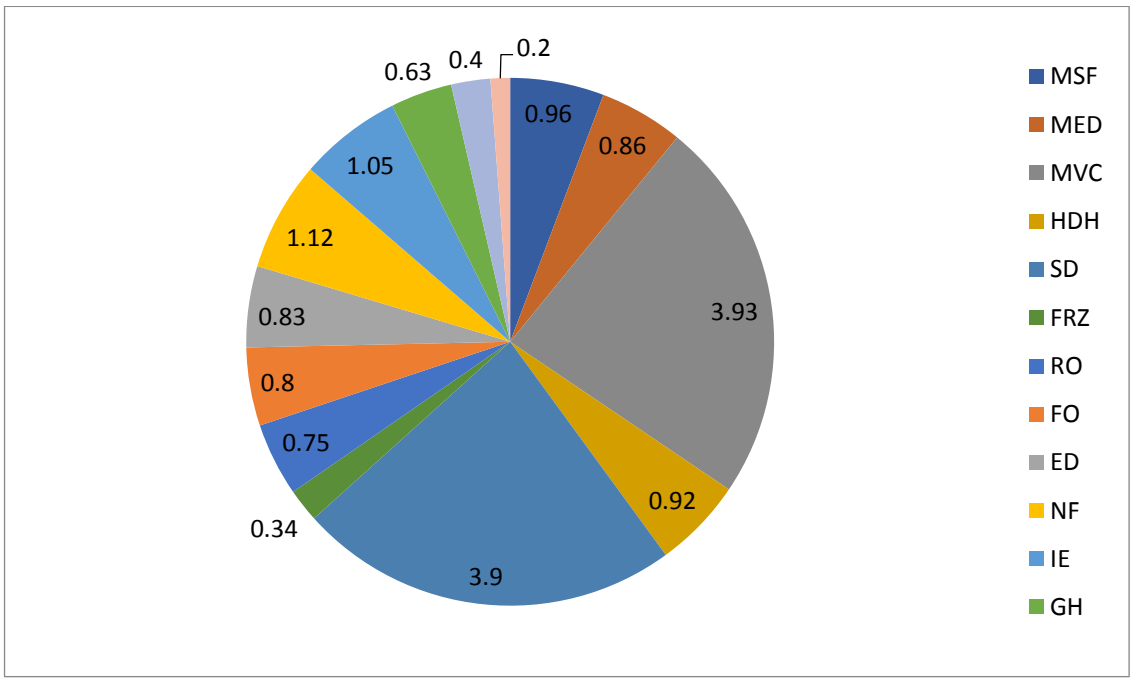


Figure 5. Production cost if process water in $/m3 of various desalination method [28,29].

It is assumed from figure 2 that salinity of feed water of desalination process in case of Ion exchange process is produced less desalination whereas HDH process is produced more process water which is 400 PPM to 35 PPM [29]. The figure 3 represents the electrical and thermal energy requirement of the different desalination technique. It is also revealed from the figure 3 that in most of the process require the electrical energy but few processes required thermal energy. In case of thermal energy requirement, the cost of the process is also quite high. In case of IE process only the electrical as well as thermal energy requirement is quite low but in case of HDH process it is quite high that is 120-kilowatt hour per cubic meter. The figure 4 represents the amount of

release carbon dioxide for different dissolution technique which is measured in kg per cubic meter. It is also revealed from the figure 4 that the highest concentration of carbon dioxide released by HDH process which is 29.1 kg per meter cube whereas Ion exchange process [30] the carbon dioxide release is less as compared to other desalination processes.

Conclusion

For the treatment of wastewater into the process water or potable water, the desalination technique is gradually more important. These techniques are cost effective as well as accepted worldwide. There are certain limitations of these technologies also. Some of the techniques required high electrical as well as mechanical power and high release of carbon dioxide gas as compared to different Technologies available for desalination process. adsorption based desalination technique can meet the energy requirement as well as can treat large process water efficiently. The running cost of that adsorption process is also quite low as evident from the figure 5. This study concluded that the adsorption-based desalination technology is best suited for the desalination of wastewater or sea or brackish water efficiently.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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