Effects of Discharge Reject Brine on Surface Water in Port Sudan City

Mustafa SirElkhatim Mustafa
Department of Chemical Engineering, Faculty of Engineering, Red Sea University, Sudan
Email: mustafam1979@yahoo.com

Abstract:

The general aim of this study focus on the effects of discharge reject brine into the surface water in Port Sudan city. It considers baseline study in Port Sudan. Three samples of water were taken from sea land lagoon by using TCD (Temperature, Conductivity and Depth) device; on the other hand one sample from open sea (Abu Hashish) was also taken. All the samples were collected during summer and winter seasons.

The obtained results showed a significant increase in the temperature and salinity of the surface water when mixed with the discharge reject brine, this will absolutely affect the marine life. Also the continuous discharge reject brine into water near the intake desalination plants affects the characteristics of the feed water.

Keywords: Reject brine, Khor Arbaat, Desalination plants, Environment

Introduction:

Port Sudan is the main port and largest commercial center of the Sudan located in semi-arid region. Its estimated population in 2010 was about 926,000 inhabitants, whereas the estimated water demand estimated is 120000-150000 m3/day. Portable water produced from Khor Arbaat is 60,000 m3/day in good years; however, it may go down to 30,000 m3/day in bad years [1]. In general, the overall situation of the city is characterized by regular shortages. The shortage of water compensated by desalination plants [2]. It is estimated that the world production of desalination water exceeds 30 million cubic meters per day and the desalination market worldwide is expected to reach $ 30 billion by 2015[3].There are many options for brine management include: discharge to surface water or wastewater treatment plants; deep well injection; land disposal; evaporation ponds; and mechanical/thermal evaporation[3]. The reject brine of high salt concentration is drained into the sea causing environmental impact of aquatic life in the red sea [4].

The present study focuses on the discharge of reject brine into the surface water, as the available desalination plant practiced this method as illustrated in Fig. (1).

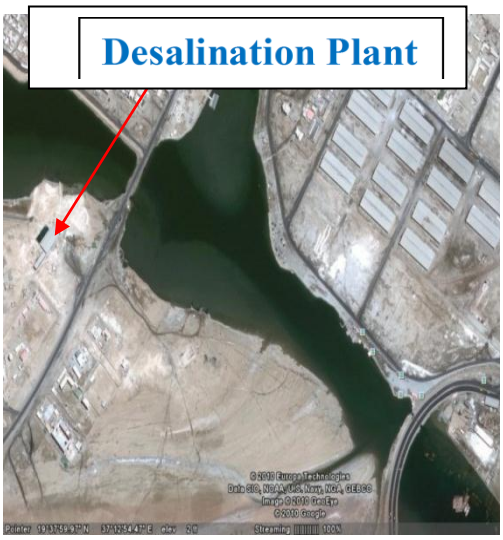


Figure (1): Desalination Plant – Sea Land lagoon

The main factors that determine the costs of reject brine discharge to surface water include: costs to transport the brine from the desalination plant to the surface water discharge outfall; costs for outfall construction and operation; and costs associated with monitoring the environmental effects of the brine discharge on the surface waters [5].

Brine was defined as any water stream in a desalination process that has higher salinity

than the feed , whereas reject brine is the highly concentrated water in the last stage of the desalination process that is usually discharged as wastewater. The reject brine discharged to the sea has the ability to change the salinity, alkalinity and the temperature averages of the seawater and can cause change in marine environment.[4] The characteristics of the reject brine depend on the type of feed water and type of desalination process. They also depend on the percent recovery as well as the chemical additives used[6]

Materials and Methods:

Samples Collection:

60 samples of water taken from sea land lagoon at different depths from May, June and April, September, shown Fig.(2). All the samples taken by using TCD (Temperature, Conductivity and Depth) ,shown Fig.(3)).On the other hand ,20 samples from open sea (Abu Hashish) were also taken at different depths from May, June and April, September, shown Fig.(4) and Fig.(3). All samples collected during summer (May, June) and winter (April, September) seasons.

Figure(2): Locations of samples collection in sea land lagoon

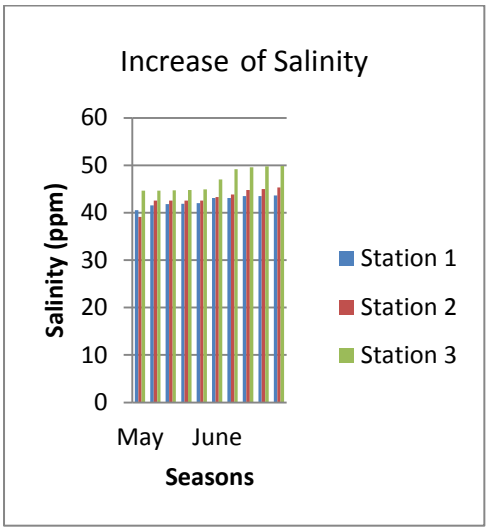
Figure (3): TCD device [7]

Figure (4): Location of samples collection in open sea (Abu Hashish)

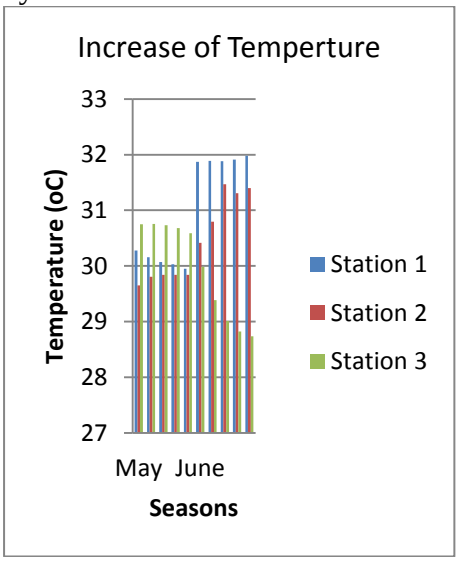
Results and Discussions

Results

Table (1) showed that there was an increase in the salinity and temperature for the samples collected from sea land lagoon. The results also showed a slight increase in salinity and temperature for station 3 compare to station 2and 1



Figure(5):Compare between salinity for three stations



Figure(6):Compare between temperatures for three station

Table (1): Salinity and Temperature in Summer (May, June) and Winter (April, September) seasons for sea land lagoon

Seasons		Stations					
		Station 1		Station 2		Station 3	
		Salinity (ppm)	**Temperature(^{O}C)**	**Salinity (ppm)**	**Temperature(^{O}C)**	**Salinity (ppm)**	**Temperature(^{O}C)**
Summer	May	40.52	30.285	39.13	29.652	44.65	30.748
		41.53	30.163	42.59	29.806	44.66	30.757
		41.79	30.076	42.57	29.843	44.74	30.733
		41.88	30.035	42.55	29.841	44.81	30.681
		42.04	29.958	42.55	29.843	44.91	30.588
	June	43.07	31.870	43.29	30.418	46.99	29.984
		43.09	31.899	43.85	30.797	49.17	29.386
		43.51	31.884	44.79	31.468	49.56	29.013
		43.51	31.913	45.02	31.310	49.76	28.823
		43.63	31.984	45.31	31.397	49.86	28.736
Winter	April	39.91	27.940	40.99	27.872	42.57	28.895
		39.92	27.810	41.04	27.920	43.09	29.289
		39.93	27.774	41.21	28.042	43.22	29.413
		39.93	27.768	41.46	28.406	43.33	29.436
		39.95	27.777	41.87	29.034	43.42	28.933
	September	41.52	31.694	42.79	31.119	45.95	31.002
		42.16	31.534	43.5	31.435	46.41	31.033
		42.38	31.157	43.92	32.048	46.99	31.066
		42.47	31.133	44.14	32.126	47.28	31.041
		42.63	31.225	44.27	32.250	47.45	30.977

Table (2): Salinity and Temperature in Summer (May, June) and Winter (September, April) seasons for open sea(Abu Hashish)

Seasons		Station	
		Salinity(ppm)	Temperature(^{O}C)
Summer	May	38.62	29.452
		38.63	29.426
		38.67	29.413
		38.67	29.417
		38.68	29.406
	June	38.85	30.804
		38.86	30.804
		38.87	30.797
		38.87	30.794
		38.86	30.784
Winter	April	38.48	27.155
		38.5	27.123
		38.5	27.120
		38.51	27.115
		38.51	27.118
	September	39.26	31.580
		39.27	31.581
		39.27	31.582
		39.27	31.581
		39.27	31.581

The results in table (2) indicated the range of salinity less than $40*10^{3}$ ppm(Parts Per Million) .For compare between

table (1) and table (2) ,we found Salinity and temperature (show Figure (5) and Figure (6)) ,thus consider the reject brine discharge into surface water lead to exceed salinity and temperature.

Discussion:

The results confirmed that the discharged reject brine into surface water has increased the salinity and temperature. These results adequately agreed with the previous similar study.

Conclusion:

From the results it can concluded that do not discharge reject brine directly into surface water especially in closed area(Sea land lagoon),also we concluded reverse relationship between salinity and temperature .We remarked the salinity in winter season greater than summer season because the evaporation in winter greater than summer which the move of air is better.

References:

[1] Red Sea State Water Corporation.

[2] Port Sudan Water and Sanitation Rehabilitation and Expansion Assessment and major variation of Programme Design February 2015 – Mott MacDonald.

[3] Muftah H. El-Naas (2011). Reject Brine Management, Desalination, Trends and Technologies, Michael Schorr (Ed.), ISBN: 978-953-307-311-8, InTech, Available from: http://www.intechopen.com/books/desalinationtrends- and-technologies/reject-brine management.

[4] M. S. E. Mustafa, G.A. Gasmelseed. Desalination plants in the red sea state. (IJESIT) Volume 4, Issue 1, January 2015

[5] Mickley, M., Membrane Concentrate Disposal: Practices and Regulation, Second Edition.

U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center, Water Treatment Engineering and Research Group, April 2006.

[6] Ahmed, M., W. H. Shayya, D. Hoey, A. Maendran, R. Morris and J. Al-Handaly, "Use of evaporation ponds for brine disposal in desalination plants," Desalination, 130, 155-168 (2000).

[7] Institute of Marine Research-Red Sea University.