Economic evaluation of fixed and floating desalination plants on the shores of Makran

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ABSTRACT

Water plays an important role in human life and is one of the first human needs for survival. Therefore, due to population growth and industrialization and therefore the lack of water resources in the world and especially in Iran, its supply needs special attention. Currently, 97.5% of the water resources on the planet cannot be used.

The main purpose of this study is the economic study of the use of fixed and floating freshwater in Makran beaches. One of the most important methods in this field is the desalination and desalination processes of seawater. Given that for government projects only the final price or in other words the cost price is considered, the method of levelized cost of production over the useful life has been chosen.

According to the information of the Electricity and Energy Master Planning Office of the Ministry of Energy, the results show that desalination of sea water in the form of building a factory (fixed desalination plant) is more economical compared to the floating desalination plant, in such a way that the levelized cost of production in fixed desalination technology is 2000 and in floating desalination technology is 9700 rials per cubic meter.

Also, sensitivity analysis tests based on discount rate, production capacity coefficient and escalation rate of fuel cost show that on one hand, floating desalination technology is more sensitive to the above variables than fixed desalination, and on the other hand, the change of this variable has no effect on changing the economic priority.

The results show that seawater desalination in the form of a factory (fixed desalination) is economical compared to floating desalination.

Keywords

Seawater Desalination, economic analysis, final price, Makran beaches.

Introduction

The growth of the population and the increase in the standard of living and the growth of urbanization along with the expansion of the industrial and technological aspects of life in the world have caused the optimal use of water and water bodies in the world to move with better reflection and planning.

The lack of access to fresh water sources and the growing demand have intensified the need to use more non-conventional water sources, especially in countries facing water crisis, so that today about 60% of the volume of desalinated water in the world is in the Persian Gulf is concentrated.

Many solutions have been proposed to deal with this problem, that desalination of sea water is considered as a potential opportunity to supply fresh water, which, of course, requires economic justification.

The number, size, and efficiency of desalination units in the world are growing rapidly with the aim of compensating for the water shortage, and only in the meantime, cost reduction in desalination processes is considered as the main challenge facing this industry.

In Iran, considering the hot and dry climate, the issue of water crisis is of double importance compared to other countries. It is expected that the volume of desalinated water in this region will increase to 9 billion cubic meters by 2030 [1].

The purpose of this study is to investigate the economic use of fixed and floating water desalination plants on the Makran coast based on reverse osmosis method. Reverse osmosis is generally the most economical process for producing fresh water from seawater. It is also a more appropriate method in terms of initial investment and energy and technology consumption [2].

Methodology

There are various methods for the economic evaluation of projects, including the present value method, annual value, return on investment, and internal rate of return, annual uniform method, and levelized cost of production.

In the levelized cost of production (LCOP) method, costs are converted into a uniform annual payment. In other words, the cost is equal to the fixed amount of income per product unit sale, which can cover all project expenses during the service life. levelized cost is a method based on the calculation of the present value of investment costs and production exploitation during the life of the project, in which the production of one liter of fresh water is calculated by dividing the present value of the total costs incurred to produce produced fresh water [3].

$$LCOP = C_K + \left[\sum_{t=0}^{PL}\frac{C_{O\&M}\times(1+e_{O\&M})^t}{(1+r)^t}+\sum_{t=0}^{PL}\frac{C_{Fuel}\times(1+e_{Fuel})^t}{(1+r)^t}+\sum_{t=0}^{PL}\frac{C_P\times(1+e_P)^t}{(1+r)^t}\right]\times \frac{r(1+r)^{PL}}{(1+r)^{PL}-1}$$

$$C_K = \frac{DR\times TPC(1+r)^{CL}}{HY}$$

According to the above relations, the costs are discounted to the current year's cost to calculate the present value of the project. Multiplying the present value of maintenance and repair cost variables, fuel cost and personnel cost with their factor $\frac{r(1+r)^{PL}}{(1+r)^{PL}-1}$ turns it into a levelized annual cost [4].

Table 1: Information about fixed and floating desalination plants [5]

Variables	floating desalination plants	fixed desalination plants
Capital Cost	1.9	0.4
Depreciation Rate	5	4
Plant Cost	170140	50300
Construction Life	1	3
Discount Rate	14	14
Plant Life	20	25
Hours Per Year	7008	7884
Capacity Factor	70	85
O&M Cost	6100	6070
Total Of O&M Cost	1.4	1.03
Escalation Rate Of O&M Cost	2	2
Fuel Cost	24700	1010
Total of Fuel Cost	5.7	0.1
Escalation Rate of Fuel Cost	5	5
Personnel costs	2600	2530
Total of Personnel costs	0.5	0.4
Escalation Rate of Personnel costs	5	5
Escalation Rate of Exchange Rate	7	7
Levelized Cost of Production	9700	2000

According to Table 1, based on the information of the Electricity and Energy Planning Office of the Ministry of Energy, the levelized cost of production of producing two fixed and floating water desalination technologies has been calculated as 2000 and 9700 Rials per cubic meter, respectively. It should be noted that the calculation of the levelized cost of production of two fixed and floating water desalination technologies has been calculated with a nominal currency of 28500 Tomans.

Discussion and Results

In Figures 1, 2, 3, and 4, sensitivity analysis is performed based on the discount rate, production capacity coefficient, escalation rate of fuel cost, and escalation rate of exchange rate. As can be seen in Figure 4, the increase in the discount rate causes an increase in the uniform cost of production. As it can be seen, regarding fixed desalination technology, with the increase of interest rate in a period of 20 years, the changes in the levelized cost of production have increased from 1.8 Rials per cubic meter in the first period to 2.26 Rials per cubic meter.

With the increase in production capacity, the levelized cost of production in fixed technology has decreased from 3.57 Rials per cubic meter to 2.55 Rials per cubic meter.

With the increase in escalation rate of fuel cost, the uniform cost of production in fixed technology has increased from 3.55 to 7.67 and in floating technology from 9.5 to 17.52 rials per cubic meter.

With the increase in escalation rate of exchange rate, the uniform cost of production in fixed technology has increased from 19 to 35.4 and in floating technology from 5.325 to 11.505 rials per cubic meter.

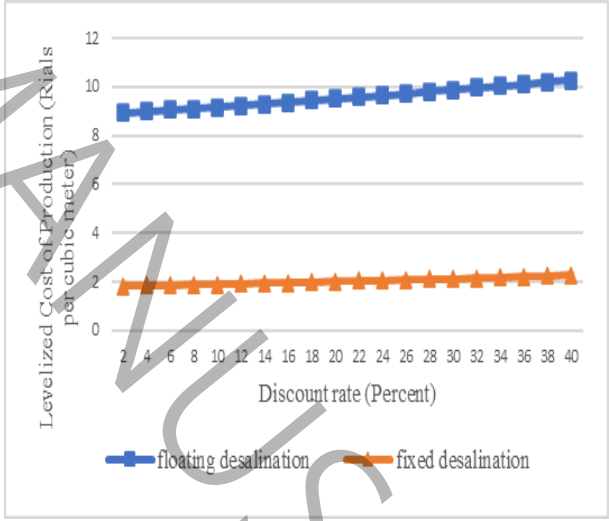

Figure 1: Sensitivity of levelized cost of production under discount rate

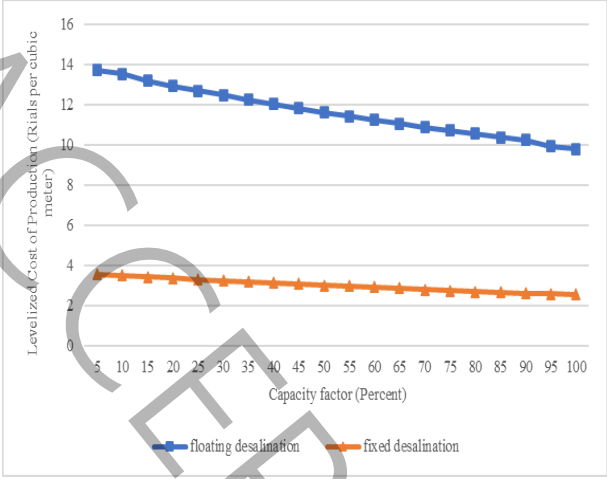

Figure 2: Sensitivity of levelized cost of production under production capacity factor

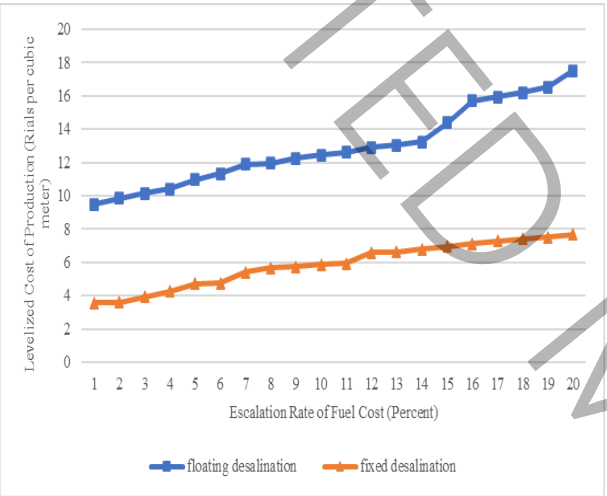

Figure 3: Sensitivity of levelized cost of production to escalation rate of fuel cost

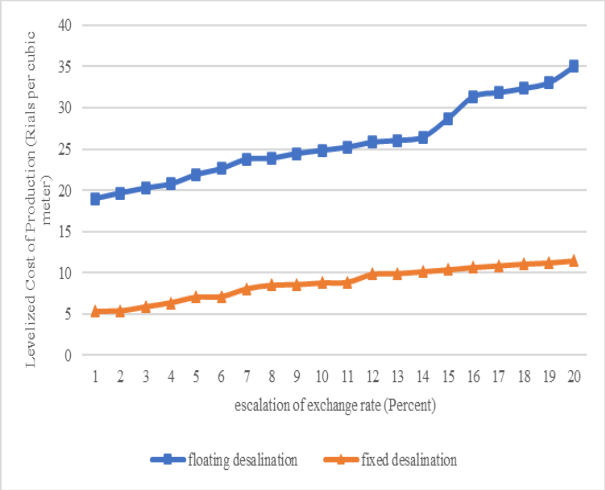

Figure 4: Sensitivity of levelized cost of production to escalation of exchange rate

Conclusions

With the investigations, it was concluded that water desalination in the form of fixed facilities or the construction of a factory in the target area (coasts of Makran) than water desalination in the form of floating facilities or the ship dedicated to desalination. Water is economically beneficial.

Therefore, according to the rich resources that our country has in the field of water areas (both in the northern region of the country and in the southern region), such potential can be used for desalination of sea water, and by establishing several factories in the north and south, the country can be The category of water crisis was kept safe especially in the not so distant future and by creating warehouses in the whole country as water bases, desalinated drinkable water can be stored in those warehouses and as a result, drinking water can be provided in every province or every country. The area is divided according to an optimal pattern for the consumption of the society.

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