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Design of reverse osmosis membrane for softening of groundwater at site of agriculture College –University of Tikrit –Iraq by using ROSA-72 software

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ABSTRACT

This research paper is accomplished for designing reverse osmosis membrane for desalination and softening of groundwater at Tikrit University Site. The raw groundwater has TDS ranged between 1570 and 2910 mg/L, temperature, (23–25)C pH(6.27–8.6), Electrical conductivity (3070–3620) μs/cm, Ca(492–640) mg/L, Mg(41–437) mg/L, Total hardness (1400–3400) mg/L, SO4 (700–1296) mg/L, NO3(18.5–40) mg/L. Dissolved oxygen (1.5–4.5) mg/L and Turbidity (1.3–5)NTU. ROSA72, Reverse Osmosis System Analysis is applied to design the reverse osmosis system for softening the groundwater. The result showed reliable design criteria and high quality water which are feed water 0.3 m^3/h, feed press 7.91 bar, concentration flow 0.26 m^3/h ,membrane area 2.6 m^2 permeate flow 0.05 m^3/h. water recovery 15%, permeate TDS 39.41 mg/L. ROSA-72 software can be used efficiently in design of reverse osmosis systems.

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1. Introduction

Many arid and semiarid countries in the world have not rivers for supplying fresh water; therefore they are depending on groundwater to provide their demands. Groundwater is distinguished by low turbidity as a result of passing through soil which is representing a porous media or filter; but this groundwater has high TDS (total dissolve solids) that make it hard and unpleasant taste. Several methods are used to soften and desalinate of groundwater these are distillation, ion exchange, electro dialysis, freezing, magnetic separation, and reverse osmosis membrane technique (RO) [1]. RO is physical process used to overcome the osmotic pressure which is created between pure and brackish through a membrane and causing transform the water from low concentration to high concentration water by imposing external pressure on high saline water in reverse direction since the membrane allowed to pass pure water in both directions. Fig. 1 shows osmosis and reverse osmosis phenomena's. [2].

Ibrahim S. Al-Mutaz et al. [2] state the following equation to calculate osmosis pressure

$$\frac{0.0385\mathrm{TDS}(t+273)}{1000-\frac{\mathrm{TDS}}{1000}}=\pi \quad (1)$$

Where, π = osmotic pressure, psi, TDS = total dissolved solid mg/L, and t = temperature °C

Takashi Asano et al. [3] mentioned the following equations for salt rejection percentage by membrane and recovery rate percentage via membrane

$$\mathrm{SaltRejection}\% = (1-\frac{\mathrm{productTDS}}{\mathrm{feedTDS}})\times 100 \quad (2)$$

$$\mathrm{Recoveryrate}\% = (\frac{Qp}{Qf})\times 100 \quad (3)$$

Where Qp = permeate flowrate and Qf is feeding flowrate, m^3/s

The reverse osmosis membrane system is consisting of inlet feedwater applied by external pressure, outlet Retentate water (concentrated water), and outlet permeate water as shown in Fig. 2.

Reverse Osmosis technique is called also hyper filter is act as barrier to remove all dissolved solids and inorganic molecules. The rejection ratio is ranged between 95 and 99% depending on

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