Enhancing the Heat Transfer Efficiency of Seawater

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Introduction

Problem Statement

- Heat Exchangers are devices that exchange heat from a medium to another.
- Heat exchangers use a fluid to transfer heat, a common fluid in industry is seawater as it is cheap and easy to get.
- Seawater based heat exchangers are common in industry, however, efficiency of transferred heat will decrease with time due to fouling.
- Fouling has four main types which are: chemical (scaling), corrosion, biological, and deposition.
- The heat transfer efficiency of a new seawater based heat exchanger is about 70-80%, however, efficiency can decrease to 40% after some time due to fouling as shown in table 1.

Heat Exchanger number	Q (THEORETICAL) (kJ/h)	Q (ACTUAL) (kJ/h)	%EFFICIENCY
1	626016160	232487092.4	37.13755446
2	626016160	317982885.8	50.79467689
3	626016160	321128343	51.29713313
4	626016160	266275717.3	42.53495904
5	626016160	294354280.3	47.02023672
6	626016160	258101016.8	41.22913005
7	626016160	305856609.7	48.85762209

Table 1: Heat Exchanger Efficiency Data for marafiq.

Constraints

The goal is to design a process that takes seawater and modifies it to get higher heat transfer efficiencies for the heat exchangers while considering the following:

1- Post treatment total suspended solids (TSS) should not exceed 30mg/L.

2- Water temperature should not exceed 3-4°C increase after treatment.

3- Post treatment total dissolved solids (TDS) should not exceed 25-35g/L.

Concept

Specifications

The main objective is to reduce fouling to increase the efficiency of heat transfer this can be achieved by:

1- Using corrosion inhibitor at 0.1-0.2 mol/L.

2- Maintain pH between 7.0-8.5.

3- Install filters with pore size of 200 mesh filter.

4- Decrease salinity by 10-15%.

Project Impact

The project aims to increase heat transfer efficiency and reduce maintenance costs.

The project aims to increase heat efficiency by 15-20% which will save a lot of energy.

The project aims to reduce cost and number of maintenance by 50%.

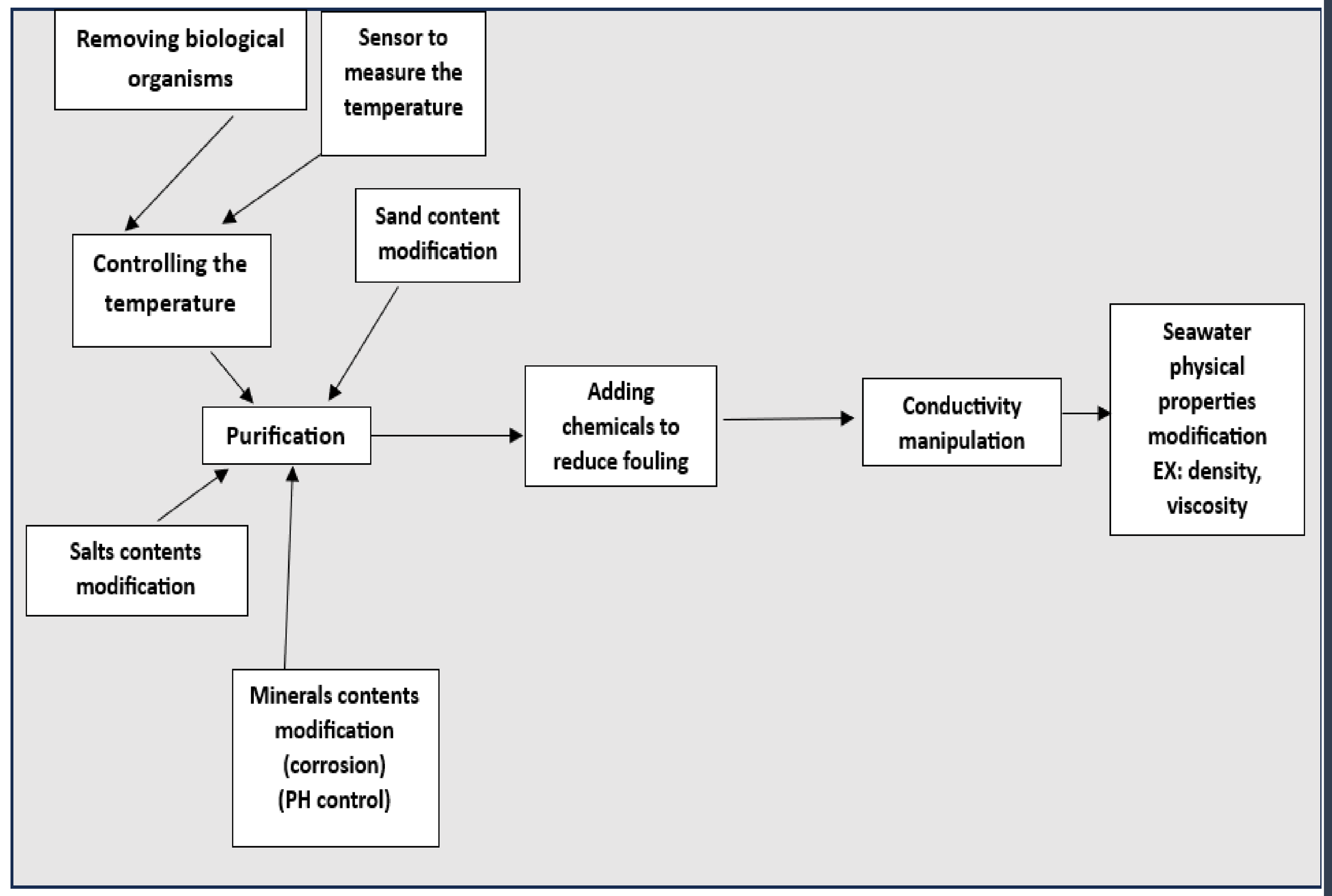

Figure 1: Scheme of the Overall Process.

Prototype design

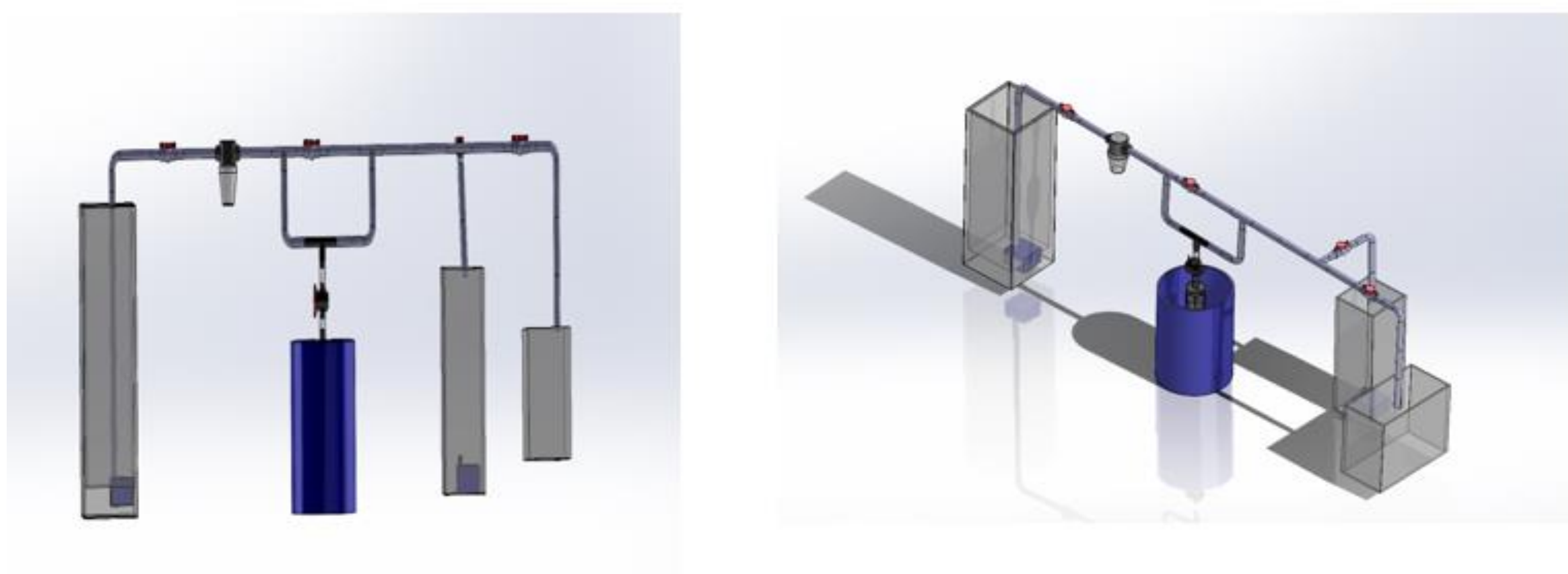

Figure 2: Clear View of the process. Using SolidWorks.

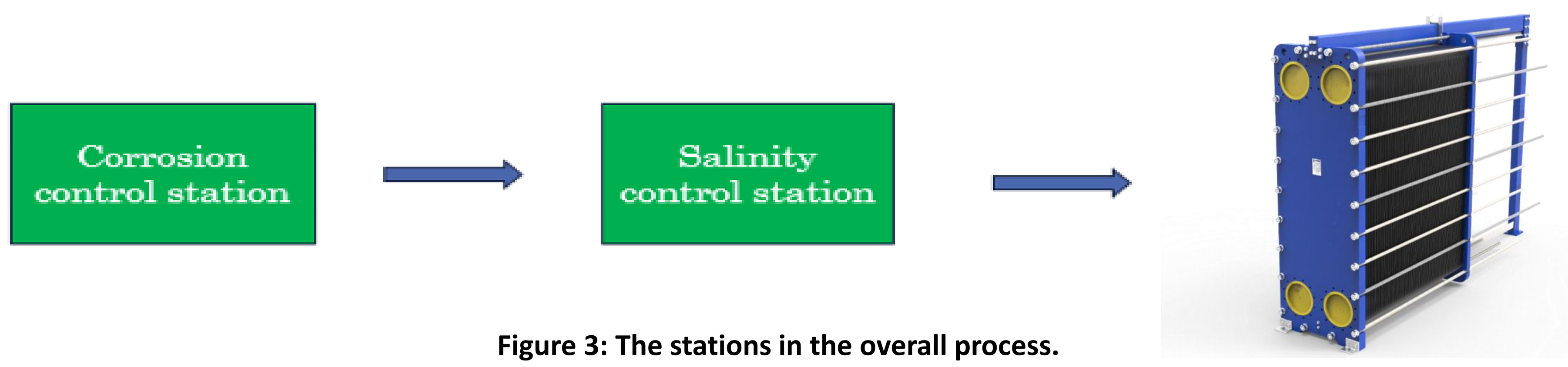

Figure 3: The stations in the overall process.

Validation

Figure 4: Used filter with pore size of 200 mesh filter.

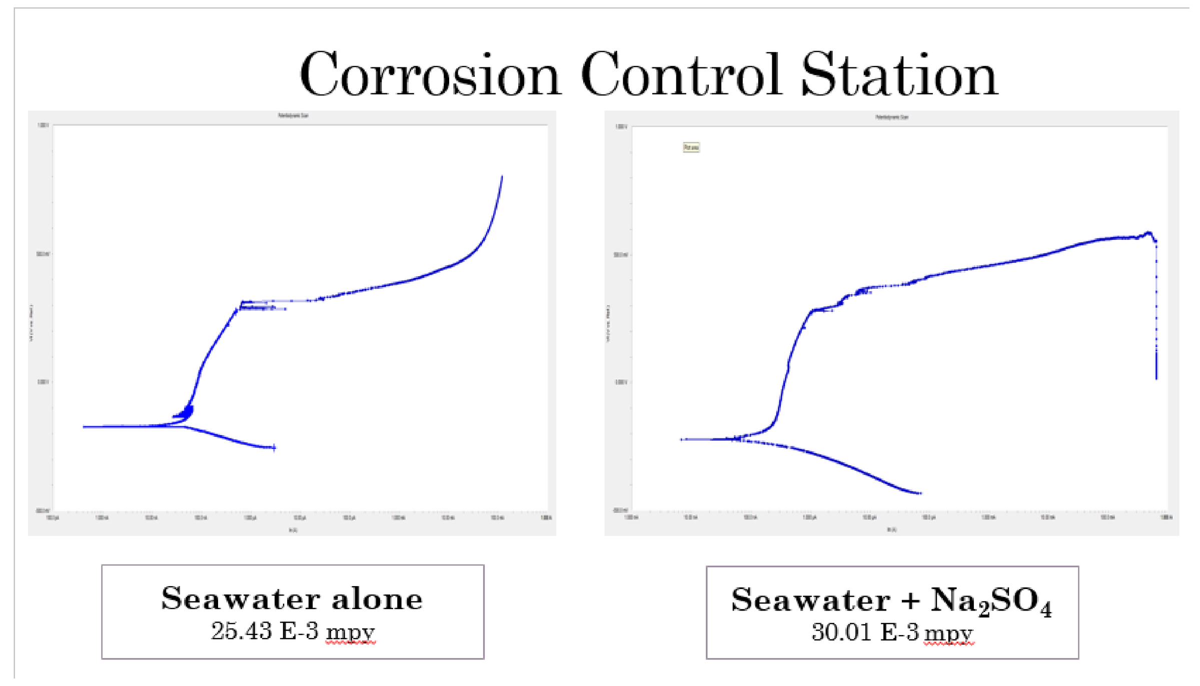

Figure 5: Potentiodynamic polarization test for 304 Stainless steel.

Na_2MoO_4 ppm	Zn^{2+} (0 ppm)	
	IE %	CR (mdd)
50	27	4.93
100	34	4.46
150	42	3.92
200	49	3.44
250	55	3.04

Table 2: Sodium molybdate corrosion inhibition data for 304 stainless steel.

Conclusion

- Herein we report a process to modify seawater to be used in heat exchangers.
- The process include corrosion and salinity control stations, which will help in keeping efficiency high.

References

Raymond, P., Regis, A. P., & Rajendran, S. *Sodium Molybdate –Zn^{2+} System as Corrosion Inhibitor for AISI 410 Stainless Steel in Sea Water.*