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The Study of Salinity Effect on Flow Rate of Water in Piping System

Mazin. S. Al-Naamani[1] and Nor Azwadi [2]

Research Scholar[1] and Professor [2]

University Of Technology Malaysia

Department of Mechanical Engineering

College of Mechanic

Skudai, Johor Bahru

Malaysia

ABSTRACT

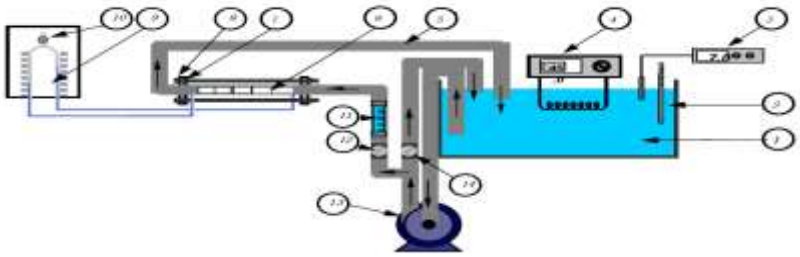
There are several elements that affect the flow rate of water. One of the most convincing factors that resist the flow of water is the salinity. When the salinity takes place in a pipe the minerals *of calcium and magnesium carbonates stick to the surfaces of pipes, which restricts water flow in the pipe. The main goal of this project is to investigate the effect of salinity on the flow rate of water. To achieve project aims, this project includes two experiments, the effect of salinity on the flow rate of water experiment and the effect of salt size on water flow rate experiment. The design of two experiments components is same but the type of salt will be changed. In general, the investigation of salinity influence on water flow rate is observed under fixed temperature and initial flow rate. At the end of the experiments, the results are mentioned in tables and in the line graphs to describe the effect of salinity on the flow rate of water. In the effect of salinity on the flow rate of water experiment, the results show inversely proportional relation between salinity and flow rate of water. To illustrate, when the amount of salinity increase the flow rate will decrease because the salt will restrict the flow of water. On the other hand, the results of the influence of salt size on the flow rate of water experiment show the big size salt restricts the flow of water more than small size salt. So, the using different size of salt will change the flow rate of water that flows in the piping system.*

Key Words: Corrosion, *Flow rate, Salinity,* Microfiltration.

1. INTRODUCTION

Salinity is the measure of all the salts dissolved in water [1]. The minerals of salt stick to the surfaces of pipes, which restricts water flow in pipes. To measure the salinity of water, we have to know the concentration of salts in water by use equation of the mass of salts over the volume of water. Flow rate is the amount of fluid that flows in a given time. Flow rate can be measured in volumetric or mass flow rates, such as liter per second or kilograms per second, respectively.

There are many studies that related to this project .First study is about the Effect of Salt Content on The Corrosion Rate of Steel Pipe in Turbulently Flowing Solutions. The researcher want to investigate the effect of salt content on the corrosion rate of carbon steel pipe in water under isothermal turbulent flow conditions. The working principle of experiment is that the NaCl solution that is in container will be heated by heater and thermometer will be used to measure the temperature of NaCl solution as shown in figure 1.1. By pump, NaCl solution circulates from the reservoir and through specimens then to the reservoir. The NaCl solution will effect on specimen, and then the influence of NaCl solution on rate of corrosion in specimen is observed.



No.	Name	No.	Name
1	0.1 N NaCl Solution	8	PVC Flanges
2	Thermometer	9	Inverted Manometer
3	PH Meter	10	Venting Valve
4	Heater & Controller	11	Rotameter
5	Connection Pipes	12	Test section Valve
6	Specimens	13	Centerfugal Pump
7	Fixation Screw	14	By Pass Valve

Figure 1.1: Effect of Salt Content on The Corrosion Rate of Steel Pipe experiment.

The results seem that the less salt content causes low corrosion rate and high salt content lead to increase in corrosion rate , this due to increase in electrical conductivity of water [2].

Microfiltration is used for filtering oily wastewater; if the sizes of the oil droplets are micrometer-sized this process is useful. The effect of cross-flow velocity, oil concentration and salinity on the critical flux of an oil-in-water emulsion in microfiltration was investigated. The researchers used this experimental setup as described in figure 1.2 to achieve the objectives of this research.

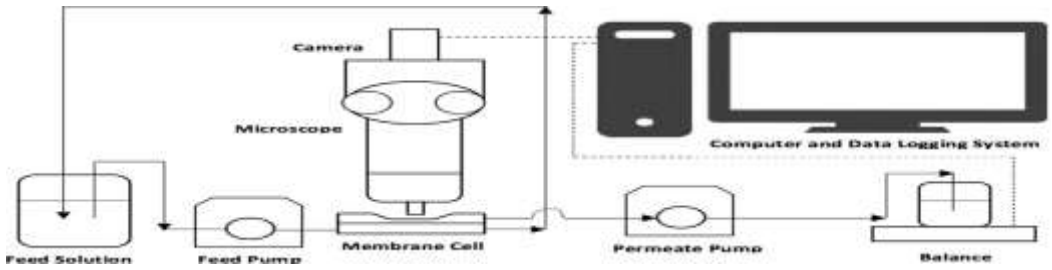


Figure 1.2: Direct Observation through experimental setup.

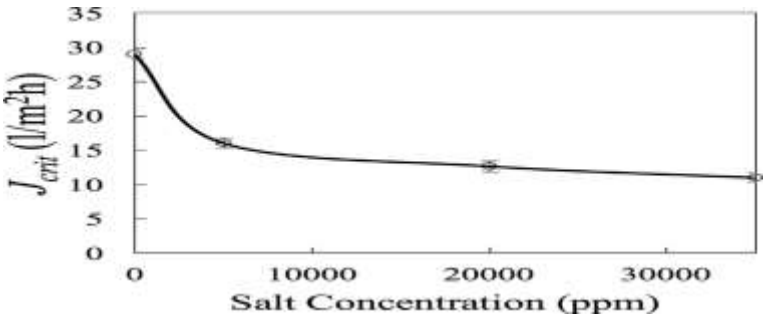


Figure 1.3: Salt concentration Vs Critical flux of oil-water mixture.

At the end of this experiment, results show that when salt concentration of oil-water mixture increase the critical flux of this mixture will decrease because of density increase as represented in figure 1.3 [3]. Another study illustrates the effect of water salinity on flow pattern and pressure drop in oil–water flow. The objective of this study is the investigation of the effect of water salinity on flow pattern and pressure drop in oil–water flow experimentally in 2.25-cm diameter horizontal pipe. The used oil has 781 kg/m3 density and 1.85cP viscosity at 25 C. The water density was changed by dissolving food salt in the water tank [4] .The previous studies discuss the effect of salinity on corrosion rate and the influence of salinity on critical flux but this study will show the effect of salinity on flow rate of water in piping system.

2. MATERIALS AND METHODS:

2.1 Design of experiment: This is the general design of project experiment. It consists of several components like, Valve, pipe, tank, salt, thermometer and table. Water and salt are experiment materials. To get accurate results, the initial flow rate and temperature of water will be constant during the experiment .Valve will assist to control the flow rate and thermometer will use it to ensure the degree of temperature is constant during the experiment. To achieve project objectives, the study contains of two separate experiments that are effect of Salinity on flow rate experiment and Size of salt and flow rate experiment.

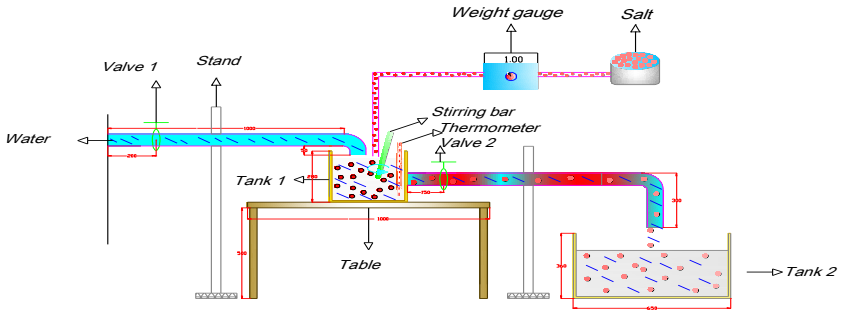


Figure 2.1: Design of experiment.

2.2 Effect of Salinity on flow rate experiment

In this experiment, the change in flow rate of water when the amounts of salinity increase will be investigated .To get an accurate result, the temperature and initial flow rate will be constant. Valve 1 and valve 2 will be opened to ensure that initial flow rate and temperature of water are constant. To measure the flow rate when the salinity is zero, open valve 1 and valve 2 and observe the time required to fill the tank 2.Then , calculate the flow rate by using the equation of Q=V/t . To measure the flow rate when the salinity change, close valve 1 and valve 2 and add salt in tank 1. Salinity is calculated by using this equation of Salinity= Mass of salt / Volume of water. Next, open valve 1 and valve 2 and observe the time required to fill the tank 2.Last step, calculate the flow rate by using the equation of Q=V/t. (Repeat this step for different amount of salinity).

2.3 Effect of size of salt on flow rate experiment:

Different size of salt that lead to salinity in a pipe, will have unlike effect on flow rate of water. So, the study of size of salt effect on flow rate is very significant. In this experiment, two different sizes of salt are used to observe the influence of salt size on the flow rate of water .Two size of salt are soft salt (small size salt) and sea salt (big size salt).This experiment divide to two dissimilar experiments, effect of small size salt on flow rate of water experiment and effect of big size salt on flow rate of water experiment. The steps of this experiment are like previous experiment but with two different size of salt that are small size salt and big size salt as depicted in the figure 2.2 and 2.3.

Figure 2.2: Soft salt (small size salt).

Figure 2.3: Sea salt (Big size salt).

3. RESULT AND DISCUSSION

3.1 Effect of Salinity on flow rate experiment result:

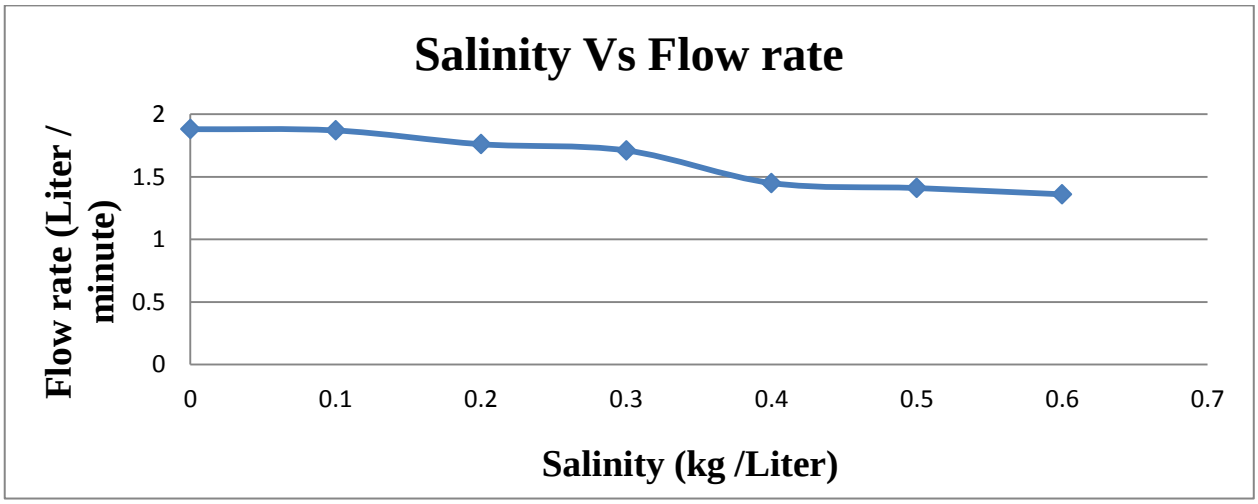


Figure 3.1: The effect of salinity on flow rate.

In the figure 3.1 as shown, the graph is plotted of salinity and flow rate of water. At the end of the experiment, the line graph shows inversely proportional relation between salinity and flow rate. If the water free of salt, the flow rate will reach maximum point because there is no restriction for flow rate of water in a pipe. In the other hand , when the amount of salt will increase the salinity of water will rise and the flow rate will decrease .Moreover , when the amount of salinity are (0 kg /Litre) and (0.1 kg /Litre) the flow rate will be in same point approximately because 1 Kg of salt will not restrict the flow rate more .

3.2 Effect of salt size on flow rate experiment result

The Figure 3.2 illustrates the relation between the size of salt and flow rate. As you can see, the salt size and flow rate have inversely proportional relation .For both salt sizes, when the salinity will increase the flow rate will decrease .The graph shows that the big size salt has small flow rate in different amount of salinity but small size salt has big flow rate because big salt size will restrict water more than small size salt. In salinity (0.1 Kg / Litre) , the small size salt will lead to (1.87 Litre / minute) flow rate but big size salt will give (1.81 Litre / minute).Then , the flow rate of both sizes will decrease until reach (1.34 Litre / minute) for big salt size and (1.36 Litre / minute) for small size salt when the salinity equals to (0.66 Kg / Litre).

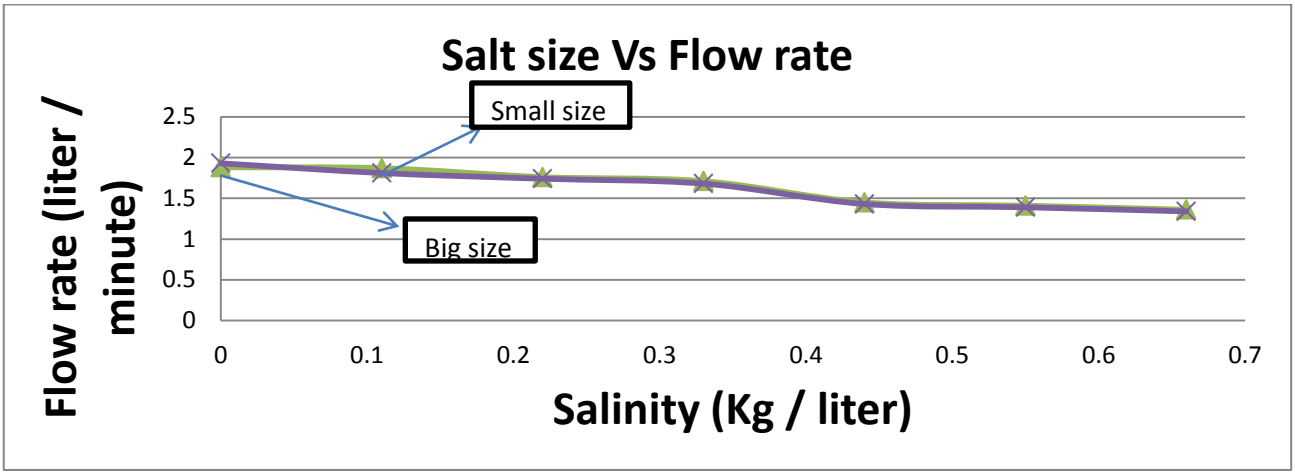


Figure 3.2: The effect of salt size on flow rate.

4. CONCLUSION

This project consists of two experiments, the effect of salinity on flow rate of water experiment and the influence of salt size on flow rate of water experiment. At the end of the experiments, the results are mentioned in line graphs to describe the effect of salinity on flow rate of water. In the effect of salinity on flow rate of water experiment, the results show inversely proportional relation between salinity and flow rate of water .To illustrate, when the amount of salinity increase the flow rate will decrease because the salt will restrict the flow of water .In the other hand, the results of the influence of salt size on flow rate of water experiment show the big size salt restricts the flow of water more than small size salt.

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