Test to compare the performance of resin-based ion trap in soft water system during manufacture producing guide with detecting hardness

Pramual Wangkasem
Department of Mechanical Engineering
Faculty of Engineering Siam University
38 Phetkasem Road Bangwa Phasi Charoen Bangkok 10160
E-mail address: pramual@siam.edu

Abstract

Improving water conditions prior to import into the cooling system of the chiller by reducing the hardness of the water that the solution at the point of slag resulting in cooler. Most of which are caused by the introduction of water (tap water) entered directly into the system without adjusting the water hardness before.The fix is generally use resin to reduce water hardness. Water softener which is in the process resins will make the ion trap (calcium and magnesium ions), which triggers the slag. This has been tested performance resin using water through the ion trap resin ago tested for hardness by the titration. According to the hardness of the water technology industry. Department of Water Technology and Industrial Environment set at no more than 50 ppm for guide of the companies that produce soft water. Resin systems and equipment provided without the hardness of the water produced in each production cycle.But let's just soft water produced each production cycle only. Test results show that the resin has the ability to trap ions that causes the slag. The increase of about 10 grams per liter of resin. The original manual 66.65 grams per liter resin was 76.67 grams per liter of resin. And soft water can produce more than 40 cubic meters from 260 cubic meters to 300 cubic manual meters, which reduces production costs and low production cycle and contribute to the energy savings of cold water as well.

Keywords: Ion trap, Soft water, Hardness

1. Introduction

The practice program of the mechanical engineeringdepartment, engineering faculty, Siam University. To study ways to improve the condition of the water in the cooling system(Chiller) to prevent fouling of the system and reduce the problem of such scale. Preparation and testing of water quality as a measure to implement. According to a study from the establishment to the soft water using an ion exchange resin (Ion Exchange Resin) has prepared this project to guide the study.

Improving water conditions prior to import into the cooling system of the chiller by reducing the hardness of the water that the solution at the point of slag resulting in cooler. Most of which are caused by the introduction of water (tap water) entered directly into the system without adjusting the water hardness before.The fix is generally use resin to reduce water hardness. Water softener which is in the process resins will make the ion trap (calcium and magnesium ions), which triggers the slag. This has been tested performance resin using water through the ion trap resin ago tested for hardness.

2. The process produces soft water and Testing

2.1 The process of restoring the resin to produce soft water.

Washing backward is a necessary step in restoring (regenerate), it is intended to destroy the capture ofresins and make resin has expanded to accommodate salination. The brine can be inserted into thoroughly to clean up contaminated sediments from the resin with water on the residual resin by washing backward to release water from the bottom of the filter to flow back up to the top, and then let it be extended until the resin and the water comes out clear. Take15 minutes to wash the back.

Washing brine and washing the salt off slowly when the filter has made clear. Next step into washed with brine to restore effective resins by salt water is sucked through a vacuum (ejector) using pressurized water (at least 30 psi.) through nozzles located within ejector. It is causing a vacuum can be sucked into salt water mixes with water and then it flows into the tank through the top layer of resins. Reactions between Na ion with Mg or Ca ion on layer of resin are exchanged and then dropped them back to the bottom. Resin can return to work as usual.The process produces soft water are shown in Fig. 1

2.2 The process of analyzing the water hardness.

1) Made standardization solution Ethylene DiamineTetraacetic Acid (EDTA).
2) Fill EDTA solution into the burette and set zero.
3)Pipette calibration of $CaCO_3$ 25 ml into bottle flask250 mland then fill buffersolution pH 10 3 mland indicator Eriochrome Black T (EBT) 2 drops into it.
4) Titration EDTA solution with solution that prepare in 3 until the end point of solution. It will changes from magenta to blue, save the results and repeat three times.
Calculate the average volume of EDTAsolution that volume used to calculate the actual concentration of EDTA solution.

5) Pipette 25 ml water sample into bottle flask 250 mland then fill buffersolution pH 10 3 ml andEBT 2 drops into it and then the titration with EDTA until the solution changes from magenta to blue, save the results and repeat three times.

Calculate the average volume of EDTAsolution used and applied to calculate the total water hardness in ppm of $CaCO_3$ (equivalent to mg / L of $CaCO_3$).

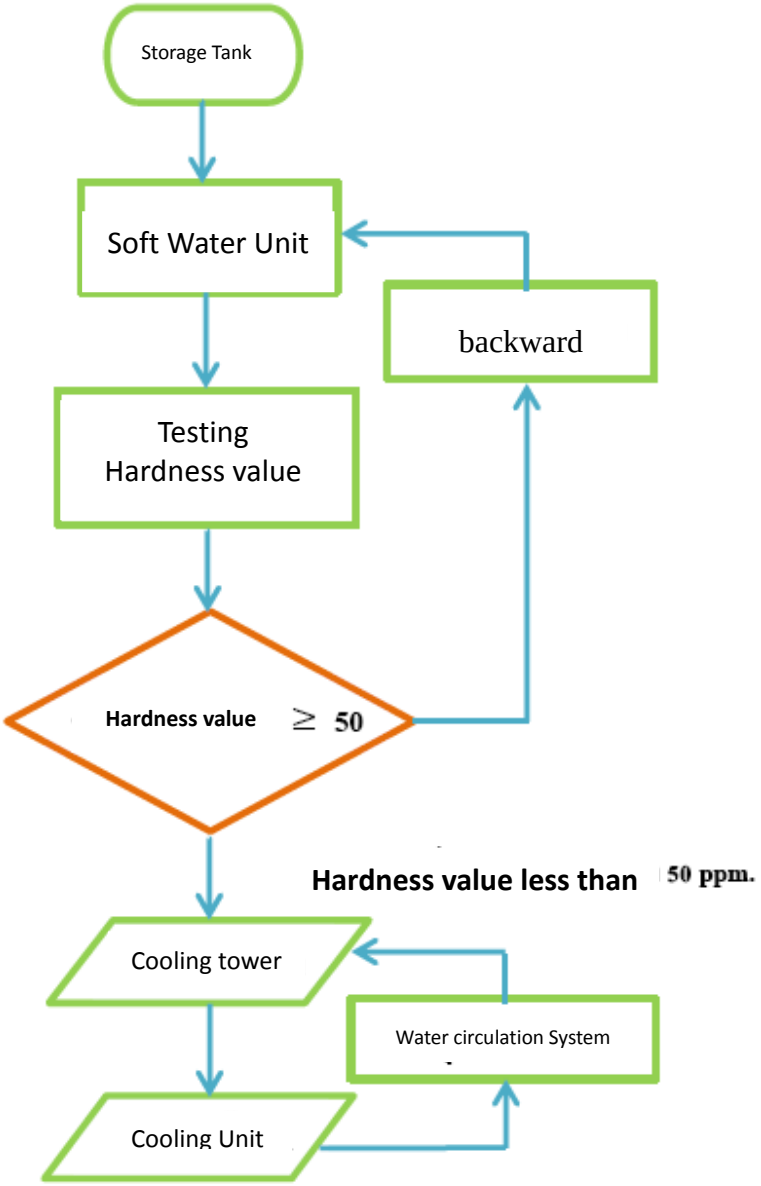

Fig. 1 The process produces soft water

3. Results and Conclusions

Sampling of soft water produced each day to test the hardness of water by means of EDTA Titration and the test result is calculated. The efficiency of the system depends on producing of soft water.Test results of water each day shown in Table.1 and trends of total water hardness are increased shown in Fig. 2

Table. 1Test results of water each day(On July 2015)

Date of collecting water sample	Accumulate total water hardness (mg per liter)	Accumulate volume of soft water produced (m^3)
2	10.85	0
3	14.10	28
6	15.19	56
7	18.45	71
8	21.70	97
9	23.87	153
10	29.30	180
13	32.56	196
14	39.90	211
15	41.24	233
16	43.41	248
17	45.58	267
20	46.66	281
21	47.75	297
22	49.92	314
23	56.43	331

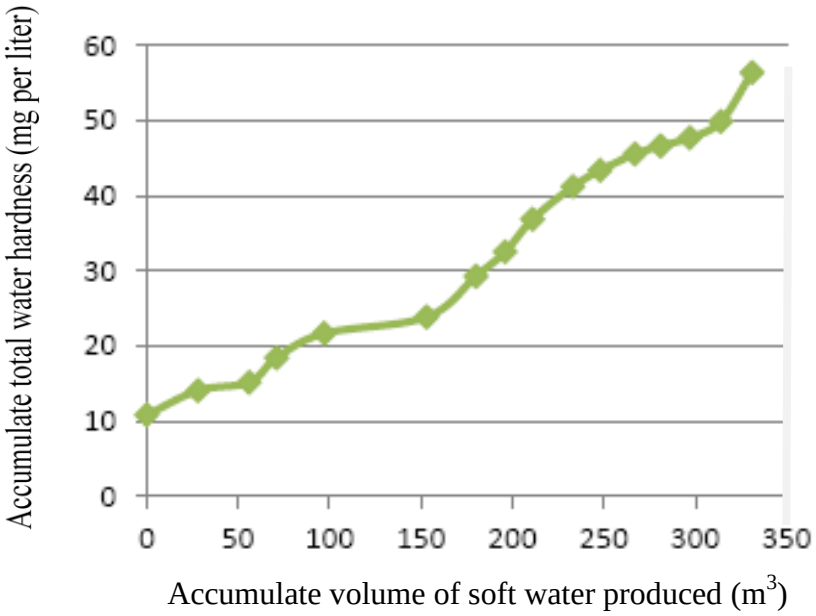

Fig. 2 Total water hardness

Estimation of soft water produced plan to make the most of resin regeneration. The data shows that soft water production will outweigh the estimated 300 cubic meters. Water refill system (makeup water), which is not to exceed 50 mg per liter, then be calculated using methods. Industrial Water Technology Group,Water and Environmental TechnologyDepartment to display the indicators with the following equation:

Basic ability to eliminate the hardness of the resin

$$= \frac{\text{Hardness (mg per liter)} \times [\text{The amount of produced water + Salt water rinse}]\ (m^3)}{\text{Amount of resin (L)}}$$

The recommended value should not be less than 70 (grams per liter of resin)

The data from manufacture producing guide
-Soft water producedamount260 cubic meters (suggest)
-Amount of water per wash 6.4 cubic meters
-The amount of resin in tank 400 L
-Raw water hardness of 100 mg per liter.

From the above equation
Basic Capacity = 100 mg per liter × [6.4+260] m^3 / 400 L
Basic Capacity = 66.6 grams per liter of resin.

The data from after detecting hardness
-Soft water produced amount300 cubic meters (testing hardness)
-Amount of water per wash 6.4 cubic meters
-The amount of resin in tank 400 L
-Raw water hardness of 100 mg per liter

Basic Capacity = 100 mg per liter × [6.4+300] m^3 / 400 L
Basic Capacity = 76.6 grams per liter of resin.

The result of the calculation is to compare parameters. During manufacture producing guide and after detecting hardness as shown in Table. 2 Comparison show that Soft water system can produce more than 40$m^3$and has the ability to handle the relentless increase of 10 grams per liter of resin.By improving this do not invest at all in any way. The conclusion is that the benefits of living and the cost.

Table. 2 Comparison During manufacture producing guide and after detecting hardness

Parameters	Manufacture producing guide	Detecting hardness
Soft water produced amount m^3	260	300
Basic Capacity grams per liter of resin	66.6	76.6
Cost of Soft water produced Baht / m^3	1.18	1.03
Cost of Soft water produced Baht / year	6,251.50	5,417.25

Acknowledgements
This research was information supported by Thai Airways (Public) Co., Ltd, Technical Department, Don Mueang, Bangkok, Thailandand Chemical Department, Science Faculty, Siam Universityis truly acknowledged for the experimental equipment and useful discussions.

4. References

1) P. Pongpobphibul.*Improvement resin regeneration for production soft water*. Industrial Water Technology Group, Water and Environmental Technology Department. Thailand

2) P.Samonkaisornkit. *Basic exchange ion for production soft water*. Industrial Water Technology Group, Water and Environmental Technology Department. Thailand

3) A.Jamulitrut. *Hardness of Water*. Industrial Water Technology Group, Water and Environmental Technology Department. Thailand

4) Achieving Brine Efficiency in Softening. (2015)Retrieved from http://www.watertreatmentguide.com

5) Cooling Water Treatment System**. (**2015) Retrieved from http://www.squarecooling.com/coolingwater_treatment.html

6.) Drinking Water Treatment.**(**2015) Retrieved from http://ianrpubs.unl.edu/live/g1491/build/g1491.pdf

7.) Ion Exchange for Dummies. **(**2015) Retrieved from http://www.lenntech.com/Data-sheets/Ion-Exchange-for-Dummies-RH.pdf.