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Optimization of Chlorination Plant to Prevent Tube Condenser Leaks

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Abstract: *PT. PJB UP Gresik power plant use sea water as cooling water. There are many fouling by sea water microorganism that should be controlled. Chlorination is the most commonly used anti fouling treatment due to economical and effective against a variety of bio-fouling. This program was successfully implemented with total saving of water in 2018 is 4698.77 m*^{3}*. Reducing fouling, it also mean reducing utilization amount of sea water in condenser, energy and environmental impact.*

Keywords: *Water conservation, Chlorine plant, condenser tube leak, fouling*

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I. Introduction

Cooling system play an important role in all types power plant.They are utilized to remove waste heat (e.g. a cooling system including condensers and cooling towers or protect a boiler's auxiliary equipment against overheating [1]. PT PJB UP Gresik utilize sea water in cooling system. Seawater accommodate fouling organism or bio fouling which can growth uncontrolled without mitigation. Fouling can reduces water efficiency or increase water consumption and energy efficiency in heat transfer equipment, Therefore, fouling mitigation such as sea water treatment should be processed in advanced[2].

Chlorination is the most commonly used anti bio fouling treatment, due too it is economical and effective against a variety of foulingorganisms [3] [4]. Chlorination plant in PT PJB UP Gresik is used to weaken the marine organism in sea water cooling system. Optimum indicator parameter of chlorine in the condenser is shown by the absence of bio shells that live and grow in the condenser tube [5]. The chlorine injection has advantages and drawbacks. Too low chlorine injection will affect to increase bio fouling and increase maintenance cost. On the other hand, too high flow rate of chlorine injection will increase cost of operational [6]. Therefore, the optimization of chlorine injection is required. In addition, the marine organismthat live and grow in a shell will scratch the condenser tube and result in tube leaks. The leak will affect to intermixing between process water and sea water. Process water will contaminate the sea water. The contaminated process water will discharge into the waste water treatment and the condenser must be repaired. The sea water will contaminated with process water and increase environmental problem. This leak effect more important to take care, hence fouling mitigation to avoid leak in condenser should be performed

II. Methods

This research was carried out on PT PJB Gresik Power Plant, Gresik, Indonesia to avoid tube leakedin cooling water system due to fouling by optimizing the chlorination plant. The procedure of this study as follow:
There are several alternatives to increase the level of chlorine according to the parameters that have been determined.

- Replacement of rectifiers / transformers in the chlorination plant in power plant 1 and power plant 2.Replacements are made because the reactor transformer, control transformer and control card was damaged before. The rectifier is over 30 years old, so the reliability in producing chlorine has decreased. After replacement, chlorine production increase so that the purpose of chlorine to protect condensers against marine organism can be achieved.
- Modify the chlorine injection line at the power plant 3 and power plant 4. The previous chlorine condition was too dominant in unit 3, hence the supply to unit 4 was reduced, therefore modification of injection line in chlorination plant unit 4 was carried out.

The formula used in calculation as follows:

1. Normal use of water is assumed when condenser tube no leak occurs. Normal use of water is calculated from Electric production per month (MWh) divided by base production (MWh) times base use of water (m^3). in the rest discussion it will represent as base case.
2. Water saving, Water saving is calculated from normal use of water which is assumed to have no leakage of tube condenser (m^3) minus water usage every month (m^3). If the difference between the normal use of water and the monthly use of water is negative (-), the savings are considered zero (0) or no savings

III. Results and Discussions

In order to complement the program, chlorination injection line was modified as shown in figure no 1. The modification chlorination injection line is necessary to provide optimized chlorine distribution and dozing to all plant.

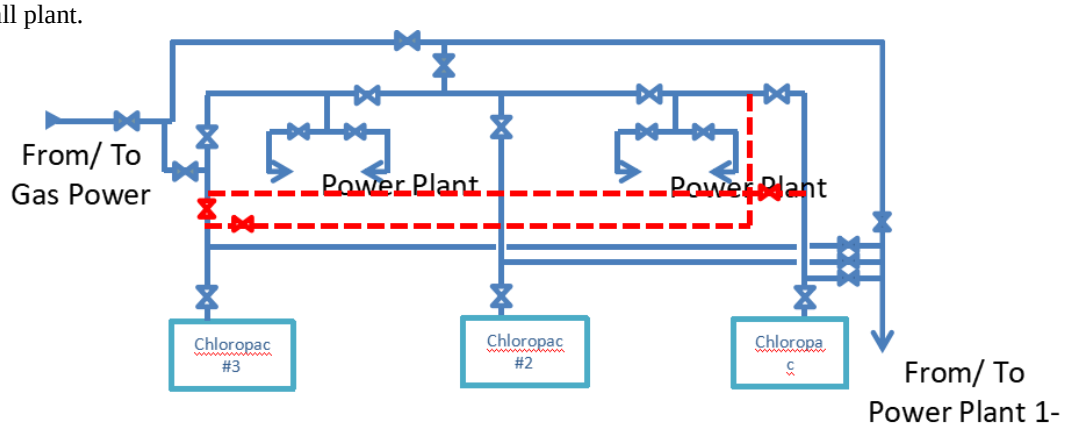

Figure No 1. Modified Chlorination InjectionLine

As mentioned before, This program was implemented in January 2018, The based case was calculated based on data before January 2018 as tabulated in Table 1 and 2. Table 1 shows the amount of water used and electric production as base case and Table 2 shows the amount of water used and electric production after implementation of programs .

Table no 1: Electric Water used and Production Data Base No Leak

October 2017		December 2017		December 2017		August 2017	
Power Plant 1		Power Plant 2		Power Plant 3		Power Plant 4	
Production (MWh)	Water Use (m^3)	Production (MWh)	Water Use (m^3)	Production (MWh)	Water Use (m^3)	Production (MWh)	Water Use (m^3)
36151	732,07	33747	719,19	80743	4056,7	75900	2831

Table no 2: Water Used and Electricity Products Produced After Program Implantation

Month	Power Plant 1		Power Plant 2		Power Plant 3		Power Plant 4	
	Production (MWh)	Water Use (m^3)	Production (MWh)	Water Use (m^3)	Production (MWh)	Water Use (m^3)	Production (MWh)	Water Use (m^3)
January	7075	222,92	35817	829,735	84007	3766,8	0	0
February	29600	735,78	29657	720,545	72312	2869,6	3	882,066
March	42756	789,52	42650	1477,72	95873	4657	0	0
April	46519	746,31	46274	902,75	104158	5138,6	0	0
May	19555	630,69	38744	877,15	89557	4002,2	53336	4019,777
June	24487	1168,3	14026	377,079	76457	1925,4	81010	2563,33
Total	169992	4293,52	207168	5184,979	522364	22359,6	134349	7465,173

By utilizing mentioned formula, the saving can be calculated and tabulated in Table 3.

Table no 3: Water savings from chlorination plant optimization program

Month	Water Saving (m^3)			
	Power Plant 1	Power Plant 2	Power Plant 3	Power Plant 4
January	0,00	0,00	453,89	0,00
February	0,00	0,00	763,51	0,00
March	76,30	0,00	159,86	0,00
April	195,72	83,41	94,52	0,00
May	0,00	0,00	497,33	0,00

June	0,00	0,00	1915,96	458,27
Total	272,02	83,41	3885,08	458,27

Hence, the total saving of water that provide from the program during 2018 is a number of = 4698.77 (m^3). It can be concluded that the optimization of dosing of chlorine injection as anti fouling have been successively reduce the water losses due to condenser tube leaks. The leak may be possibly of microbiological fouling, erosion fouling and deposition fouling. Reducing the fouling will effect to increasing overall heat transfer coefficient and reducing the pressure drop. Therefore, the efficiency plant in term of hydrolic and thermal increase and also increase reliability of plant.

IV. Conclusion

PT. PJB UP Gresik power plant use sea water as cooling water. There are many fouling by sea water microorganism that should be controlled. Chlorination is the most commonly used antifouling treatment due to economical and effective against a variety of fouling organisms. This program was successfully implemented with total saving of water in 2018 is 4698.77 m^3. Reducing fouling, it also mean reducing utilization amount of sea water in condenser, energy and environmental impact.

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References

[1]. P. Regucki, M. Lewkowicz, R. Krzyżyńska and H. Jouhara, "Numerical study of water flow rates in power plant cooling systems,"Thermal Science and Engineering Progress, 2018.
[2]. H. Jenner, C. Taylor, M. Van Dock and M. Khalanski, "Chlorination byproducts in chlorinated cooling water of some European coastal power stations,"Marine Environmental Research, no. 43, pp. 279-293, 1997.
[3]. L. Fox and M. Moyer, "Effects of power plant chlorination on estuarine productivity,"Chesapeake Science, no. 16, pp. 68-74, 1975.
[4]. R. Morgan III and E. Carpenter, Biocides. In: J.R. Schuber and B.C. Marcy Jr (Eds) Power Plant Entrainment: A Biological Assessment, New York: Academic Press, 1978.
[5]. J. Grieve, A program to introduce site-specific chlorination regimes at Ontario Hydro generating stations. In: R.L. Jolley, H. Gorchev and D.H. Hamilton (Eds) Water Chlorination: Chemistry and Water Treatment, Ann Arbor, MI: Ann Arbor Science, 1978.
[6]. E. Vinita, P. Veeramani and V. Venugopalan, "Chlorination for power plant biofouling control: potential impact on entrained phytoplankton,"International Journal of Environmental Studies, vol. 67, no. 4, pp. 515-530, 2010.

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