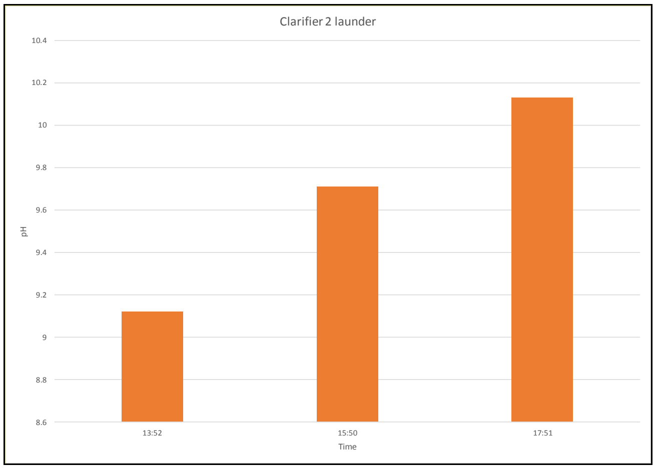

Fig.8: clarifier 1 treated water pH

Two sets of samples were taken to the laboratory for P and M alkalinity analysis. Table VII shows the optimisation results from the laboratory. Though the laboratory results do not indicate an achieved optimum pH from clarifier 2, the chemistry performance for clarifier 2 is showing an improvement. An increase in pH to just above 10 can be seen from clarifier 2 center cone. This confirms the trend observed in Fig 7. The expectation was for the alkalinity relationship to be 2P=M, and it is unfortunate that during the test, optimum conditions were not met. This was due to the challenges experience in the power plant and the test had to be placed on hold.

TABLE VII: OPTIMISATION LABORATORY RESULTS

Optimisation laboratory results					
First set					
Sample Point	pH	P-alk (ppm)	M alk	2P	Alkalinity Relationship
Clarifier 1 Centre cone	9.217	30.8	212.5	61.6	2P<M
Clarifier 2 Centre cone	9.17	31.3	249	62.6	2P<M
Launder 1	9.214	32.8	208.9	65.6	2P<M
Second set					
Clarifier 1 Centre cone	9.659	47	173.7	94	2P<M
Clarifier 2 Centre cone	10.056	72.2	219.2	144.4	2P<M
Launder 1	9.514	46.7	198.9	93.4	2P<M
Launder 2	9.634	54.4	226.4	108.8	2P<M

V. CONCLUSIONS

The results from the optimisation trial show that lime was under dosed. Clarifier 1 and 2 average pH results on the center cone are 9.4 and 10 respectively. The steady increase in pH does indicates that lime was being injected in to the clarifiers. From the results it is evident that the optimum pH was never reached. This is due to the limited time that was given to conduct the trial. Great results could have been obtained, however serious challenges were experienced with regards to plant, chemicals and spares availability.

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REFERENCES

[1] Mkabane, P.T., *Effluent treatment and its re-use for the Kriel Power Station*. 2015, North-West University (South Africa), Potchefstroom Campus.

[2] August, J., *Best Management Practice and Guidance Manual for Cooling Towers*. 2005.

[3] Keister, T., *Cooling Water Management Basic Principles and Technology*. Pennsylvania, ProChemTech International, Inc, 2008.

[4] McCoy, J.W., *The chemical treatment of cooling water*. 1974: Chemical Publishing Company New York.

[5] Fosso-Kankeu, E., et al. *Investigation of the potential of monomeric and polymeric coagulants in the treatment of raw water used at a coal-fired power station*. in *9th Int'l Conference on Advances in Science, Engineering, Technology & Waste Management (ASETWM-17)*. 2017.

[6] Van der Linde, J., et al. *Removal of Total Hardness and Alkalinity from RO—Reject water*. in *9th Int'l Conference on Advances in Science, Engineering, Technology & Waste Management (ASETWM-17)*. 2017.

[7] der Linde, V., et al., *Flocculant types and operating conditions influencing particles settling rates in feed water used at a coal power plant.* 2019.

[8] der Linde, V., et al., *Investigation of effective chemical flocculation conditions for the treatment of reverse osmosis reject water from coal power plant: a case study.* 2020.

[9] Frayne, C., *Cooling water treatment: Principles and practice*. 1999: Chemical Publishing Company New York.

[10] Edzwald, J.K., *Water Quality and Treatment A Handbook on Drinking Water*. 2010: McGrawHill.

[11] Liang, L.-S., D.J. Goldstein, and I.W. Wei, *Chemistry of lime-soda softening of cooling water*. 1980.

[12] Takahashi, K., *Blow system and a method of use therefor in controlling the quality of recycle cooling water in a cooling tower*. 1995, Google Patents.

[13] Venter, P., *Determine Optimum pH for CW Treatment* 2010.

[14] Technology, E.W.S.a., *Chemistry and Microbiology Standard for Condenser Cooling Water* 2016. **240-55864767**.

[15] Boyd, C.E., C.S. Tucker, and B. Somridhivej, *Alkalinity and hardness: critical but elusive concepts in aquaculture.* Journal of the World Aquaculture Society, 2016. **47**(1): p. 6-41. https://doi.org/10.1111/jwas.12241

[16] Bratby, J., *Coagulation and flocculation in water and wastewater treatment*. 2016: IWA publishing. https://doi.org/10.2166/9781780407500

[17] Hudson Jr, H.E. and E. Wagner, *Conduct and uses of jar tests.* Journal-American Water Works Association, 1981. **73**(4): p. 218-223. https://doi.org/10.1002/j.1551-8833.1981.tb04683.x

[18] Cohen, J.M., *Improved jar test procedure.* Journal (American Water Works Association), 1957. **49**(11): p. 1425-1431. https://doi.org/10.1002/j.1551-8833.1957.tb15499.x

[19] McDonald, *Alkalinity &pH relationships.* 2006