

OPTIMIZING WATER QUALITY FOR WATER TUBE STEAM BOILER: A COMPREHENSIVE TESTING AT EXTERNAL WATER TREATMENT

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ABSTRACT

The significance of boiler feed water treatment cannot be overstated, serving as a pivotal factor in safeguarding boilers for optimal efficiency and safe operation. This study delves into both internal and external water treatment methods, with a specific focus on external approaches, notably employing sand filters and water softeners. Rigorous adherence to standardized test procedures ensured the successful execution of hardness tests and the determination of total dissolved solids (TDS). The ultimate objective was to produce high-quality water, meticulously treated in the initial stages, setting the foundation for enhanced boiler performance and longevity.

KEYWORD

Steam boiler, water treatment, sand filter, water softener

INTRODUCTION

In the quest for consistently delivering high-quality steam, effective boiler water treatment plays a pivotal role, in addressing issues of steam purity, deposits, and corrosion. The process encompasses two primary methods: internal boiler water treatment and external boiler water treatment. External treatment focuses on the removal of suspended solids, dissolved solids—especially calcium and magnesium ions crucial for scale development—and dissolved gases like oxygen and carbon dioxide. Employing techniques such as reverse osmosis (RO) treatment, ion exchange (demineralization), and deaeration, this external approach ensures meticulous control. However, a prerequisite to these treatments involves clearing raw water of suspended particulates and turbidity, preventing potential contamination of the resins used in subsequent stages of treatment (*Boiler Water Treatment Basic*, n.d.). Sand filters (Figure 1) and water softeners (Figure 2) are external treatment methods that are used at the water-tube steam boiler, thermodynamic lab, UTM.



Figure 1: External Water Treatment Unit at Water-Tube Steam Boiler (sand filter)



Figure 2: External Water Treatment Unit at Water-Tube Steam Boiler (water softener)

MATERIAL AND METHODOLOGY

There are two water sample points for the external water treatment unit at the water-tube steam boiler that must be tested. The sample points are at the inlet sand filter and outlet water softener. The tests conducted at both sample points are the hardness test and total dissolved solids (TDS) test. The hardness test was conducted by using Hardness Yes/No tablets as shown in Figure 3. Firstly, a sample of water from the softener was taken in the sample container, filling to the 50 ml mark. Then, one Hardness Yes/No tablet was added and the container was shaken until the tablets had completely disintegrated. If the color of the sample turns red, the softener requires regeneration or replacement. If the sample turns green color, softened water is being produced (Palintest., n.d.).



Figure 3: Hardness Yes/No Tablets.

For the total dissolved solids (TDS) test, Three Range DS Meters were used to conduct the test as shown in Figure 4. Initially, the Range Switch was turned to the desired range. For both sample points, it was set to 10. Then, the cell cup was rinsed three times with the water sample. The sample of water must be below 160°F (71°C). After that, the cell was filled with another sample at least 1/4" (6 mm) above the upper electrode. Then, the black button was pressed and the dial value was indicated by the pointer. The dial value was multiplied by the range setting to determine parts per million (ppm) (Myron L Company, 2021).



Figure 4: Three Range DS Meters.

RESULT AND DISCUSSION

The hardness test results at the sand filter inlet are shown in Figure 5. Figure 6 shows the hardness test results at the water softener outlet. Figure 7 shows the results of total dissolved solids (TDS) test at sand filter inlet and softener outlet.



Figure 5: Hardness test result at inlet sand filter.



Figure 6: Hardness test result at outlet water softener.

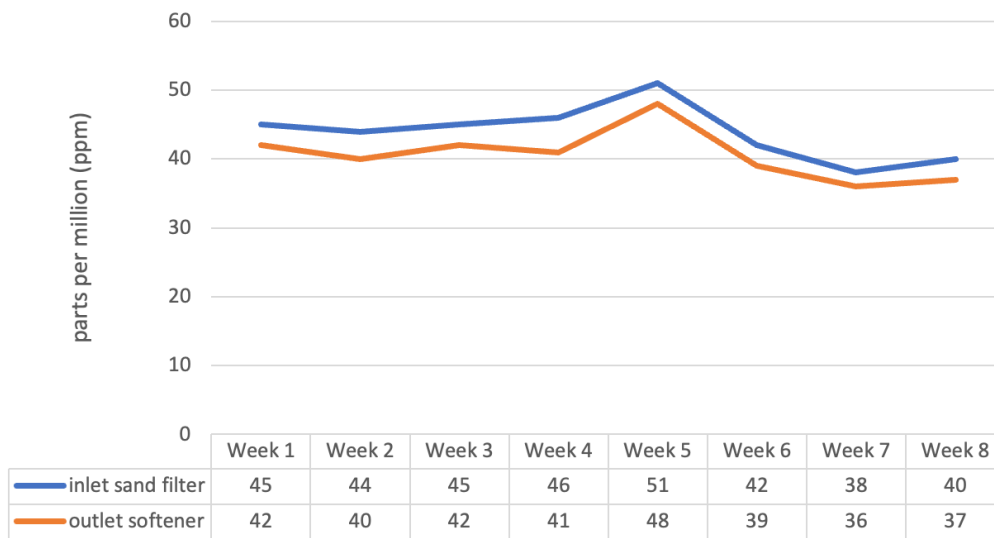


Figure 7: Results of Total Dissolved Solids (TDS) Test at inlet sand filter and outlet softener.

CONCLUSION

Sand filter and water softener treatment was done at the water-steam boiler by conducting hardness and total dissolved solids (TDS) tests. By following the standardized procedure of the test, water treatment can be done successfully to ensure high-quality steam production for later stages.

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REFERENCE

Boiler Water Treatment Basic. (n.d.). Boilersinfo.Com. Retrieved December 22, 2023, from <https://boilersinfo.com/boiler-water-treatment-internal-external-boiler-water-treatment/>
 Myron L Company. (2021). Three range DS meters operation instructions. Myron L Company. <https://www.myronl.com/>
 Palintest. (n.d.). Hardness Yes/No Tablets Instructions. Palintest.