THE ORGANIC MATTER ISSUE IN FIBER CEMENT INDUSTRY

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EXECUTIVE SUMMARY
The organic matter contamination of water used in the fiber cement industry is addressed in the present work. Activated carbon adsorption has shown to be a viable alternative to remove organic matter contamination, however, before seeking treatment technology, adjustments in process and cellulose pulp could avoid OM contamination in the first place, and treatment can be applied only when product quality or production process could be negatively affected by OM contamination above admissible limit.

KEYWORDS
Leaching effect, water contamination, active carbon, water reuse.

PERIOD
This research was held from October of 2019 to December of 2021 (which included the pandemic period).

APPROACH 1
In the fiber cement industry, a large amount of water is needed in order to disperse the fibers and the matrix ingredients in the formulation of the composites. In the Hatschek process, after mixing the components, the excess of water is removed enabling the reuse of this process water (PW) in a closed circuit (Figure 1).

During the continuous production process in a closed circuit, the PW becomes more and more contaminated, with organic and inorganic compounds, which results in the necessity of periodically neutralization of the PW, in order to maintain the quality of the final product and the efficiency of the process. The neutralization of the inorganic contamination of PW was already evaluated in a previous study (Mármol et al., 2018). However, to the best of our knowledge, there is no data in literature relating the influence of organic matter (OM) content in PW on fiber cement production or evaluating the necessity or importance of neutralization of this contaminant.

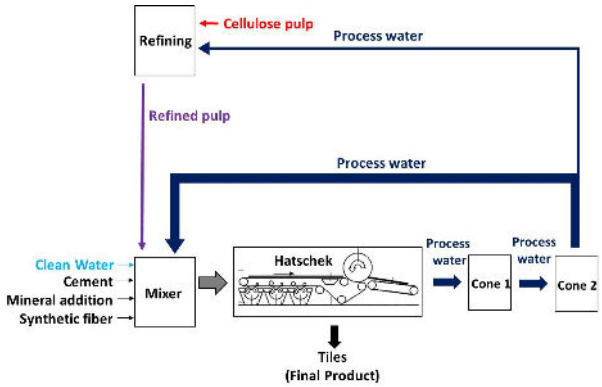

Figure 1: Closed circuit water reuse in the fiber cement industry

The presence of OM in the PW used in the manufacturing of the fiber cement is a possible source of problems to the quality of the final product. Studies in cement hydration have shown that the presence of organic compounds in the water do not promote changes in the products of cement hydration, however it affects the reaction kinetics (Khalil; Ward, 1973; Govin et al., 2005; Govin; Peschard; Guyonnet, 2006; Li et al., 2018). This would interfere in the fiber cement production process and in the final product.

The objective of the present study was to make a thorough evaluation of the OM contamination problem assessing some of the main factors of particular significance in water reuse projects, such as the reclaimed water quality and the process water

characteristics. This includes the source of contamination and the changes of those characteristics during the production process as well as treatment alternatives. Therefore, this study evaluates the origin of the OM contamination of PW in the fiber cement production process and the effect of that contamination in the final product. Three Brazilian industries participated in this study, supplying PW samples and other material necessary for the experiments.

ACHIEVEMENTS

Given the complexity of the components that can constitute the OM, its measurement cannot be done directly, thus, in this research, the OM content was measured as Chemical Oxygen Demand (COD), that is the amount of oxygen required to chemically oxidase the OM, which gives an indirect quantification of it.

The OM present in PW is mainly soluble and non-biodegradable. Thus, adsorption treatments (one of the few viable alternatives due to the OM characteristic) with activated carbon were applied and a 60% OM removal could be observed.

From the 3 industries evaluated, 2 industries presented a stable OM contamination profile during the production cycle (7 days) with an average of 1061 ± 85 mg/L (industry 1) and 872 ± 96 mg/L (industry 2). The industry 3 presented an increasing contamination profile, ranging from 468 mg/L on the first day of cycle to 935 mg/L on the last day of cycle. Thus, treatment necessity requires a case-by-case evaluation (Figure 2 A to C).

From bending tests it could be observed that OM contamination levels over 1800 mg/L statistically reduce stiffness of fiber cement composites, which demonstrate that applying treatments for OM removal depends on the level of contamination observed (Figure 3).

The pH reduction of water used in the refining process of cellulose pulp with low lignin content decreases OM contamination of PW, thus, changes in the production process and feed stock could also be a solution for the OM contamination issue.

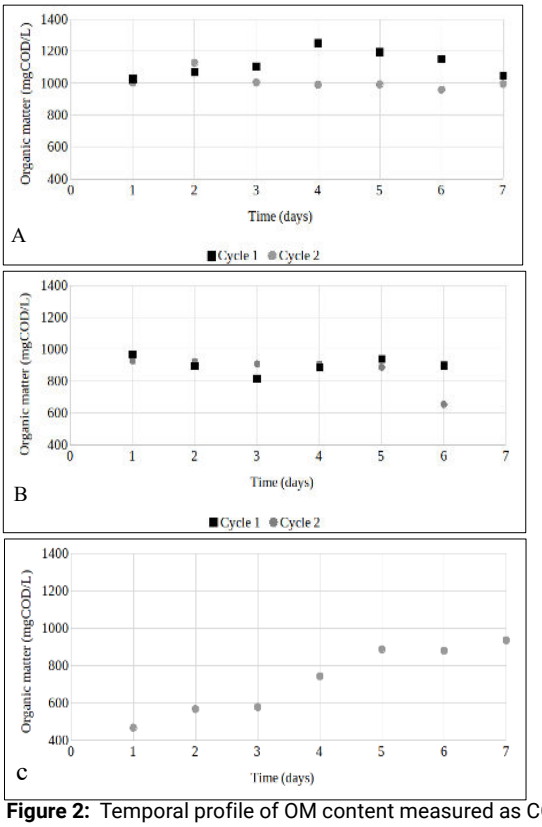

Figure 2: Temporal profile of OM content measured as COD in process water of industries 1 (A), 2 (B) and 3 (C).

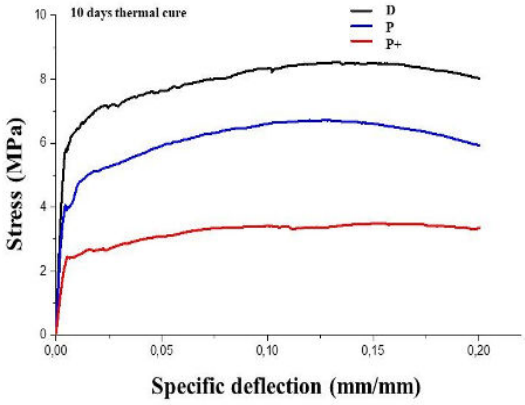

Figure 3: Stress versus specific deflection curves of specimens manufactured with: deionized water (D : COD = 0), process water (P: COD = 918 mg/L), and process water with higher OM content (P+: COD = 1778 mg/L).

Even though adsorption with activated carbon could reduce contamination, monitoring OM content should be prioritized over treatment, since, regarding the process and product quality, OM removal of PW may not be continuously necessary.

CHALLENGE

The characteristic of the OM contamination (soluble and non-biodegradable) and the extreme alkaline condition (pH > 12) narrows the range of treatments that could be applied for OM removal. Besides that, the complexity of the PW contamination, with organic and inorganic compounds is a challenge to be solved in adsorption treatments, one of the few possible alternatives, since the inorganic compounds compete for the active sites of the adsorbent applied and consequently impair OM removal.

DURABILITY OF THIS PROJECT AND ITS RESULTS

Due to the pandemic condition, some treatment alternatives could not be evaluated, such as the ozone (O_3) insuflation for OM removal, for example. Nevertheless, from the results found here, a new perspective should be given for the OM contamination issue, in which the production process is evaluated and changes in it could avoid the contamination problem.

IMPLICATIONS FOR THE INDUSTRY

Before seeking treatment technology, adjustments in process and cellulose pulp could avoid OM contamination in the first place, and treatment can be applied only when product quality could be affected by OM contamination above admissible limit.

DISSEMINATION

Online presentations:

- IIBCC Connect 2021. Process water treatments for the fiber cement industry. Niz, M. Y. K. University of Sao Paulo, Brazil. B. Ojembarrena, University of Madrid, Spain

The results of this project will be shown in different communications in IIBCC 2022:

Oral presentation:

- The organic matter issue in the fiber cement industry. Niz, M. Y. K, University of São Paulo.
- Full paper 1: Process water management and the organic matter issue. Niz, M. Y. K.; Savastano, H. J. University of São Paulo.
- Full paper 2: Organic matter removal of process water in the fiber cement industry. Niz, M. Y. K.; Savastano, H. J. University of São Paulo.
- Research poster: The organic matter issue in the fiber cement industry. Niz, M. Y. K.; Savastano, H. J. University of São Paulo.

In addition, 1-2 scientific papers are expected to be published in high-impact journals soon, dedicated to generating new knowledge in the field of the organic matter contamination in the fiber cement process water.

FEEDBACK ON THE IIBCC-SPONSORED RESEARCH PROJECT

This IIBCC-sponsored research work was presented at the IIBCC 2022.

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