IMPACT OF COAGULANTS ON THE TSS SEPARATION PERFORMANCE IN CLEAN WATER PRODUCTION: AN EXPERIMENTAL FINDINGS

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ABSTRACT: *This paper reports an experiment conducted with a feed water contained low level total suspended solid (TSS≤ 10 mgL^{-1}). This research aims to investigate a problem to justify whether coagulants is required to filter that feed water to produce required clean water (TSS≤ 1.0 mgL^{-1}). This research has been conducted with combined use of Multi Media Water Filter (MWF) and Micro Filter (MF). The water filtration rate of this experiment was 20.0 $m3(d)^{-1}$. The TSS in product water (PW) was 0.735 mgL^{-1} when the plant was operated with coagulants. When the plant operated without coagulants the TSS content in PW was 0.876 mgL^{-1}. Two sets of experimental data were analysed and tested with paired-samples t-test at a 95% confidence level. The result demonstrated that the P-value was more than 0.05 (>0.05) when compared to the mean difference between the data sets. This finding indicates that the TSS content in PW of these two processes is nearly equal, and there is no significant difference between the two processes. This finding could be a reference to the water industry, engineering professionals and policy implementation agencies relating to the use of coagulants in the WF process. This study concludes that coagulants are not required in the WF process when feed water contains TSS less than 10 mgL^{-1} and the MWF can significantly remove TSS from feed water to produce the required clean water. This study recommends similar further research with various types of feed water to develop a standard model for the WF process to achieve SDG 6, SDG8, and SDG13.*

Keywords: Sustainable Water Supply, Water Filter, Low Pressure Water technology, clean water, Production performance, Economic Sustainability (SDG 8), Environmental Sustainability (SDG13), Sustainable Development Goal (SDG).

1.0 BACKGROUND OF THE STUDY

This paper reports an experiment conducted with a feed water contained low level total suspended solid (TSS≤ 10 mgL^{-1}) by MWF. The experiments were conducted in two phases. At the first phase, MWF was operated with the dosing of coagulants. In the second phase, MWF was operated without coagulants. Historically, the TSS is an integral part of run-off water that arises from land erosion, dissolution of minerals, decay of vegetation, discharges wastewater from residences and industries. All these impurities are required to be removed from feed water stream as it causes the deterioration of product water quality [1, 2]..

The MWF is used as a primary water filter for catering clean water to secondary and tertiary water filtration [3]. Though, MWF is not an advanced water treatment process, it still has a demand in water industries due to economic benefits [4, 5]. The combination of MWF and membrane system (MS) is popular in water industries due to its simple design, higher productivity and easy operations [6-8]. The performance of MWF in producing clean water depends on a few operating factors. The potential factors are the quality of feed water, MWF plant cleaning performance, and optimization of the coagulants dosing rate [9, 10].

MWF with coagulants have been used to increase TSS and pollutant separation efficiency. The coagulants act as a binding agent to combine the small particles of impurities and transform them into larger aggregates flocs that adsorb dissolved organic matter from feed water. Thus, MWF with coagulants contribute to removing impurities from feed water [2].

With this background, this study has undertaken to reveal the operating conditions of MWF to achieve sustainable performance in water filtration (WF) by reducing coagulants dosing rate that may contribute towards achieving economic (SDG8) and environmental (SDG13) sustainability.

1.2 Problem Statement and Research Objectives

Studies on clean water production by the use of MWF have established a relationship between coagulants dosing rate and productivity in clean water production. Research findings demonstrate that the coagulant dosing rate into the feedwater in clean water production by MWF has been playing a vital role in managing the water crisis. It was also reported that the residual coagulants affect quality of the environment, run-off water, aquatic lives and biodiversity. This statement has raised the question of "**Are coagulants always essential for the water filtration process?"** This research project has undertaken to answer the question stated.

1.3 Research Objective

The broad objective of this research is to determine the effect of coagulants on TSS separation performance. Achieving the research goal, the objective of this experiment is divided into three specific objectives:

1.3.1 To determine the TSS separation efficiency when the WF plant operates with coagulants to produce required clean water.

1.3.2 To estimate the TSS separation efficiency when the WF plant operates without coagulants to produce required clean water.

1.3.3 To evaluate the impact of coagulants on the overall performance of the water filtration process in producing required clean water.

2.0 LITERATURE REVIEW ON PERFORMANCE OF WATER FILTRATION

The MWF is a low-pressure driven system widely used in water industry for producing cleane water for residential use, power plant's cooling system, and industries for product processing MWF has been installed at the primary level in the WF process to cater feed water for secondary and tertiary water treatment [11, 12]. A few indicators have been used for measuring the MWF's performance; the indicators are productivity in clean water production, efficiency in separating impurities from feed water, energy consumption rate [$kWh(m^3\text{-water})^{-1}$] [13]–[16]. Chemical oxygen demand (COD), Biological oxygen demand (BOD), natural organic materials (NOM) and water-born