Feasibility of reuse filter backwash water as primary/aid coagulant in coagulation-sedimentation process for synthetic effluent

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Abstract

The purpose of this study is to evaluate the feasibility of reusing filter backwash water (FBWW) from the water treatment plant (WTP)as a substitute for the conventional coagulants (primary coagulant) in the coagulation-sedimentation process applied for synthetic effluent.The coagulation effect on the elimination of the turbidity and UV_{254} was investigated by treating synthetic effluent using FBWW as a substitute for conventional coagulants.

Keywords: Filter backwash water; Coagulation; Recycling; Organic matter; Synthetic effluent.

1. Introduction

Several researchers have evaluated the effect of FBWW recycling up stream of the drinking WTP on the purification efficiency and the quality of treated water (Bourgeois *et al.* 2004; Arora *et al.* 2001; Gottfried *et al.* 2008; Huang *et al.* 2010. FBWW are characterized by high concentrations of suspended solids, total organic carbon (TOC) and inorganics like Al and Fe as well as the chemical precipitates derived from the use of inorganic coagulants (e.g., $Al_2(SO_4)_3$, $Fe_2(SO_4)_3$ and $FeCl_3$). This study aims to experimentally evaluate the feasibility of reusing FBWW as primary coagulant and coagulant aid in the removal of both the turbidity and water organic matter from synthetic effluent by the coagulation-sedimentation process. The schematic diagram of the FBWW reuse as primary/aid coagulant for this scheme is presented in Figure 1.

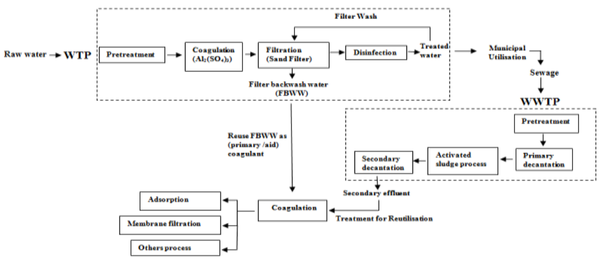


Figure 1. The schematic diagram of the FBWW reuse as coagulant (primary/aid)

2. Materials and Methods

2.1. Characteristics of the synthetic effluent and FBWW

FBWW water samples collected from WTP was used in the experiments. The raw water comes from Keddara dam which undergoes the coagulation by $Al_2(SO_4)_3$ and filtration by sand filters**.** Synthetic water composed of humic acid (HA) and kaolin was also used.

3. Results and Discussion

3.1 Fourier Transform Infrared (FTIR) analysis

Figure 2 shows the FT-IR spectrum of FBWW. The prominent intense sharp peak at 1385 cm^{-1} are assigned to the presence of carbon-hydrogen (CH_3), -carbon (CC) and -oxygen (C=O) deformations (Kubicki et al., 1999). The band at 560 cm^{-1} corresponds to Al-O stretching mode (Sarkar et al., 2007).

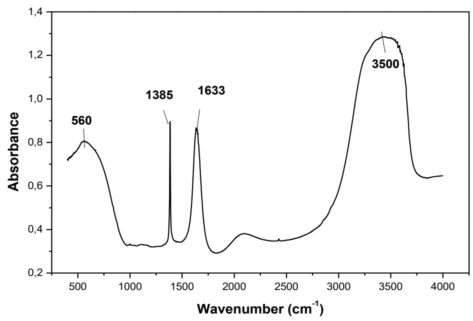


Figure 2. FTIR spectrum of FBWW

3.2 Performances of FBWW as primary coagulant

In jar tests, different doses of FBWW ranging from 5 up to 45 mg Al/L were studied. We notice that the turbidity decreases with raising the dose of FBWW (Figure 3).

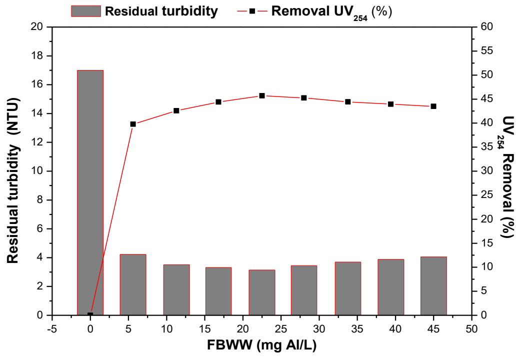


Figure 3. The effect of FBWW dose on the residual turbidity and UV_{254} removal efficiency

3.3 The effect of pH on coagulation efficiency

The evolution with pH of the residual turbidity and UV_{254} removal for the synthetic effluent is showed in Figure 4. The best yield was obtained at a slightly acid pH with an optimal value around 5, a result in agreement with previous studies that showed an optimal destabilization of HA at acidic pH (O'Melia et al. 1999).

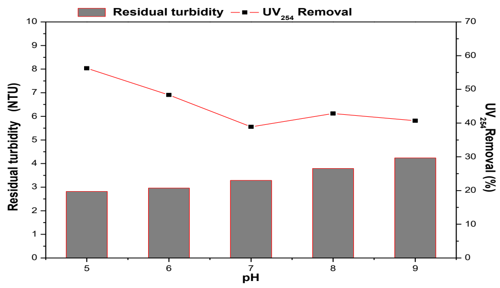
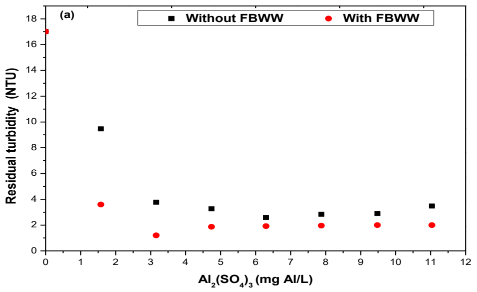


Figure 4. The effect of pH on the coagulation performance of FBWW

3.4 Reuse FBWW as coagulant aid

Figures 5(a) and 5(b) represent the evolution of the residual turbidity and removal efficiency of the organic material (UV_{254}) using $Al_2(SO_4)_3$ without and with addition of FBWW (16.9 mg Al/L) as coagulant aid. At the optimal coagulant dose (6.3 mg Al/L), the turbidity removal of the synthetic effluent reaches 84.7 %, without addition of FBWW, which corresponds to 2.6 NTU, and a reduction of UV_{254} of 56. 3%. By contrast, with addition of FBWW, the residual turbidity and the UV_{254} removal reached 1.9 NTU (88.7%) and 64.9 %, respectively for the same dose (6.3 mg Al/L).



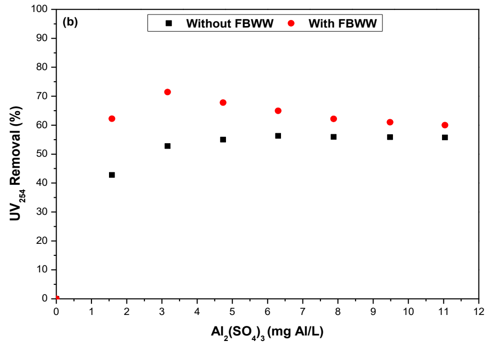


Figure 5. *Coagulation by $Al_2(SO_4)_3$* without and with filter backwash for the synthetic effluent*: (a) Residual turbidity (b) UV removal (%)*

4. Conclusion

In the course of this work, the feasibility of the reuse process of filter back washes water as primary coagulant and coagulant aid was demonstrated. This study allowed us to economize coagulating reagents and minimize their concentrations.

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