



## Comparison of coagulation, adsorption, ultrafiltration, and hybrid process efficiencies on the kaolin–humic water treatment

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### ABSTRACT

Turbidity (i.e., kaolin) and natural organic matter (i.e., humic acid, HA) are the major impurities that affect the surface water quality. To achieve high standard clean water quality, initially three different treatments were employed including coagulation, adsorption (using natural plant-base mangosteen pericarp, MP, as adsorbent), and ultrafiltration (UF) membrane process. Coagulation result shows higher pH contributed to the higher turbidity removal and humic acid removal. Meanwhile pH10 could hasten the sedimentation time to achieve more than 97% and 93% of turbidity and humic acid removal, respectively. Without the coagulant in the water treatment, the sole MP adsorbent was not effective. For ultrafiltration membrane, it exhibited an excellent treated water permeate with high quality (99.9% turbidity and 99% humic acid removal), but the relative flux sharply dropped within the first 5 min of operation due to fouling. Hence, the hybrid treatments (coagulation–adsorption and coagulation–UF) were further investigated to overcome the limitation of the single process. It was found that coagulation–adsorption was the best with high removals of turbidity and humic acid of above 98%. Also, a minimal chemical coagulant was used and lesser energy was needed for process flow compared to those of coagulation–UF to move towards green sustainable development.

**Keywords:** Water treatment; Coagulation; Adsorption; Ultrafiltration; Hybrid treatment

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