

SIIC104

A REVIEW OF THE USE OF NATURAL AND CHEMICAL COAGULANTS IN TURBIDITY REMOVAL OF WASTEWATER

*Muhammad Farouk Bin Muhamad¹, Ainnie Rahayu Binti Abdullah² and Dr. Norain Isa³
^{1,3}Faculty of Chemical Engineering, Universiti Teknologi MARA, Kampus Permatang Pauh,
UiTM Pulau Pinang, 13500 Permatang Pauh, Pulau Pinang*

*²Faculty of Applied Science, Universiti Teknologi MARA, Kampus Permatang Pauh, UiTM
Pulau Pinang, 13500 Permatang Pauh, Pulau Pinang*

**Corresponding author: ainnie153@uitm.edu.my*

Abstract:

The introduction of natural materials into the coagulation-flocculation process need to be practiced as common as possible. The previous literature indicated that utilization of natural material is worth to be developed and if possible, into the commercial one. However, the application of natural coagulants itself as the primary treatment is not enough, due to the rise in constraints which limited its performance. Emerging technologies and depth studies are helping these limited conditions to grow them as good as the performance of chemical coagulants. Alternatively, the natural-based coagulants are commonly used as coagulant aids alongside chemical coagulants, which have created a highlight in water research. This review covers the comparison of type of coagulants used in the coagulation-flocculation of wastewater treatment in the usage of natural-based coagulants and chemical coagulants. This review paper also outlines the prospects of natural materials as aids and its potential as sustainable composite coagulants.

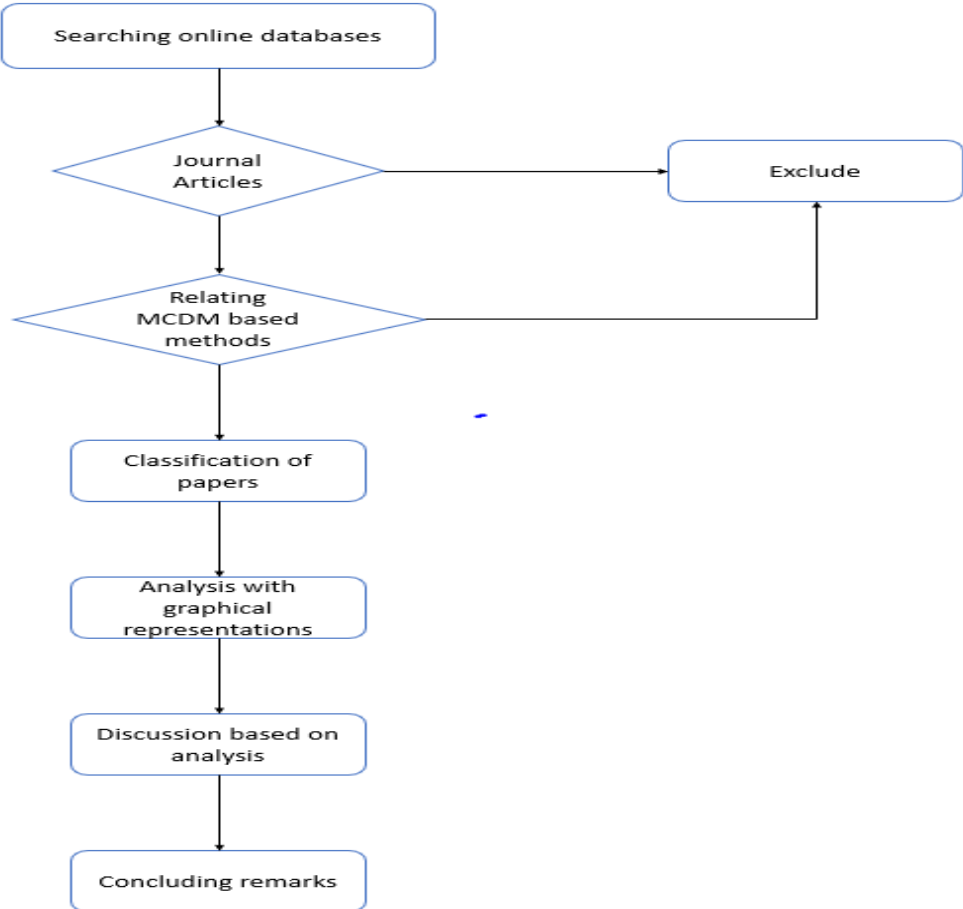
Keywords:

Coagulant, Wastewater, Coagulation, Flocculation, Chemical

Objectives:

- To review the performance of contaminant removal between chemical and natural coagulants in wastewater treatment.
- To determine the effectiveness of coagulation and flocculation process in wastewater treatment between synthetic coagulants and chemical coagulants by determining the advantages and disadvantages.

Methodology:



Results:

Table 1: Synthetic coagulants advantages and disadvantages

Name	Advantages	Disadvantages
Aluminium sulphate (alum), $Al_2(SO_4)_3$	<ul style="list-style-type: none"> • Easy to handle and apply • Most commonly used • Inexpensive 	<ul style="list-style-type: none"> • Adds dissolved solids (salts) to water • Has an alkalinity and hydroxide demand • Large amount required
Sodium aluminate $Na_2Al_2O_4$	<ul style="list-style-type: none"> • Effective in hard waters • Small dosage usually needed 	<ul style="list-style-type: none"> • Often used with alum • High cost • Ineffective in soft waters
Poly-aluminium chloride (PAC) $Al_{13}(OH)_{20}(SO_4)_2 \cdot Cl_{15}$	<ul style="list-style-type: none"> • In some applications, flocs formed is denser and faster settling than alum 	<ul style="list-style-type: none"> • Not commonly used • Little full-scale data compared to other aluminium derives
Ferric sulphate $Fe_2(SO_4)_3$	<ul style="list-style-type: none"> • Effective between pH 4-6 and 8.8-9.2 	<ul style="list-style-type: none"> • Add dissolved solids to water • Usually, need to add alkalinity

Table 2: Previous studies of natural coagulants

Type of coagulant	Operating condition		Findings
	pH	Dosage	
Moringa oleifera	5-7	2-3 g/L	Removed 54% of TSS in the coffee fermented wastewater. The removal of 84% of turbidity and 88% E. coli.
	7	50 mg/L	

Roselle seeds	4	40 mg/L	In the synthetic wastewater 93% turbidity removed. The removal of 87% turbidity industrial wastewater.
	10	60 mg/L	
Banana pith	4	0.1 kg/m ³	Removed 80% of turbidity, sulphates, nitrates, lead, zinc, iron, chromium and copper.
Orange peel	7.5	0.2 g/L	In the dairy wastewater, about 97% turbidity was removed.
Jackfruit	-	60 mg/L	In the kaolin water, the turbidity removed was 43%.
Rice starch	3	120 mg/L	In 30 minutes about 30% of microalgae removed.
	4	120 mg/L	The removal of 50% of kaolin and by using PACl in the second step of coagulation increase the removal up to 78%.

Conclusion:

Natural material is relatively environmentally friendly, making it an attractive substance in the wastewater treatment process. Natural or bio-flocculent used in the treatment of wastewater are isolated from various natural sources. These coagulants are used as primary or auxiliary coagulants in coagulation and flocculation process. These are economical and used as alternative coagulant. The use of natural coagulants can be further commercialized by addressing their limiting factors by promoting them as adjuvants or as a compound. Despite the drawbacks of some chemical coagulants and the limited ability of natural materials to work at their best, the formation of coagulants from both materials could be the next great solution. Indeed, the growing curiosity in exploring water and wastewater treatment industries, especially through coagulation flocculation method, demonstrates the bright future of natural coagulants. In this review we have discussed the use of natural coagulants and synthetic coagulants which have been used effectively for wastewater treatment.