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EFFECT OF PARAMETER CONDITIONS ON OXIDATIVE DEGRADATION OF DYES USING PEROVSKITE CATALYST: A REVIEW

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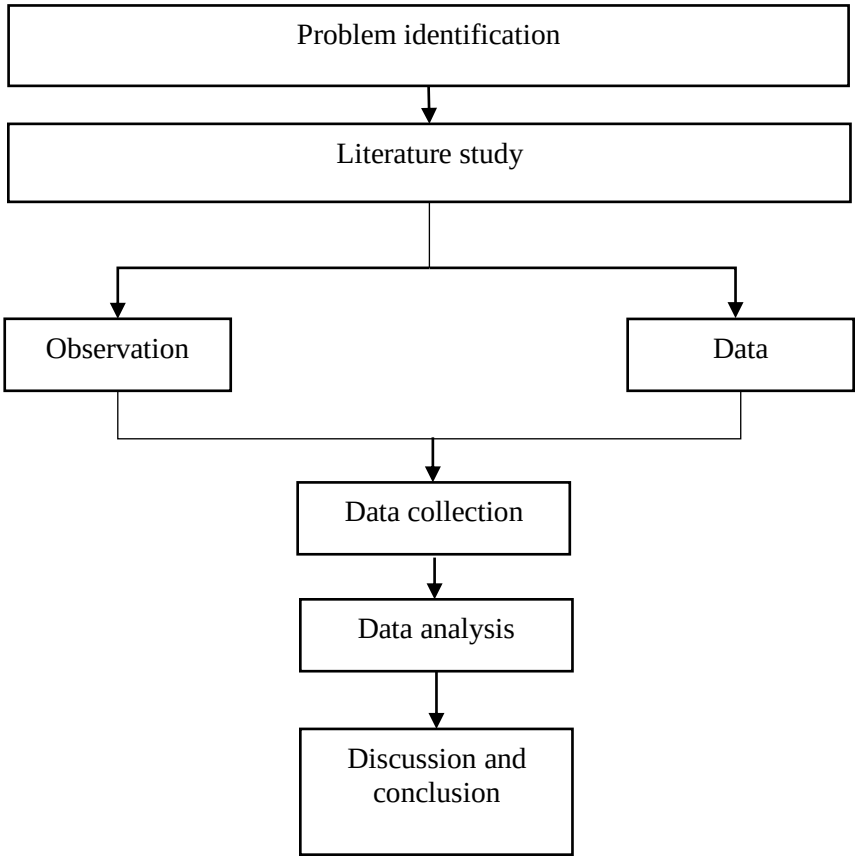
Abstract:
A review was conducted regarding the effect of parameter conditions on oxidative degradation of dyes using perovskite catalyst. Four parameters were studied which are effect of dye initial concentration, pH of solution, the amount of catalyst dosage and the temperature of the solution. Research methodology were also studied to identify suitable methods to conduct the review, within the allowable actions permitted by the respective authorities given to the current situation in the country. Flow chart for the methodology were prepared. The data obtained on the four parameters which affecting the oxidative degradation of dyes using perovskite catalyst was lined up and elaborated in a short but informative manner. This review concluded that in the initial dye concentration section, the higher concentration would lead to a lower efficiency of the dye degradation. High concentration of dyes would lead to the inability of the perovskite catalyst to process it efficiently. Results of the reviewed paper also shows that excessive amount of initial dye concentration leads to the inability of the degradation process to degrade the dyes at all. The presence of the catalyst highly influences the efficiency of the degradation process when compared to the one where the catalyst is absent. Next, the result obtained from reviewed paper also shows that the most suitable pH solution for degradation of dye process is in alkaline solution, between the range of 1-3 specifically. Most of the high efficiency and high degradation rate occurs in the range below pH value of 4. The study shows that alkaline solution would result in the lower performance of perovskite catalyst and the degradation efficiency. The higher the amount of catalyst dosage would lead to an increased efficiency of the degradation of dye. The higher the amount of the catalyst dosage would lead to increased rate and ability to degrade the dye solution. Finally, this review also found that a higher temperature is more preferable for the process of dye degradation.

***Keywords*:** Perovskite catalyst, Advanced Oxidation Process, Oxidative degradation , Heterogeneous catalyst, Dye treatment.

Objectives:

- To review the effect of parameter conditions on oxidative degradation of organic pollutants using perovskite catalyst.
- To compare the performance of the catalytic activity using perovskite catalyst at different parameter conditions.

Methodology:



Results:

Table 7 Effect of initial dye concentration on dye degradation summary

Catalyst	Type of dye	Initial dye concentration (ppm)	Effectiveness of decolorization and degradation	Reference
50 mg BiOBr catalyst	Reactive black 5 Reactive blue 198 Reactive yellow 145	10, 30, 50, 70, 90, 110	45 – 83.9%	[60]
$La_{0.5}Ca_{0.5}NiO_3$ (LCNO) catalyst.	Reactive Blue 5 (RB5)	50, 100, 150, 200, 250	40 – 100%	[61]
$[KNbO_3]_{0.9}$-$[BaNi_{0.5}Nb_{0.5}O_{3-\delta}]_{0.1}$ (KBNNO) catalyst.	Methylene Blue (MB)	10, 15, 20, 25, 30	30 – 55%	[62]
Lanthanum orthoferrite (LFO) catalyst.	Methyl Orange (MO)	10, 20, 30	40 – 65%	[63]

Table 8 Effects of pH value on dye degradation summary

Catalyst	Type of dye	Effective pH value for decolorization and degradation	Reference
$LaTi_{0.4}Cu_{0.6}O_3$ (LaTiO) catalyst	Rhodamine B (RhB)	4 – 9	[65]
$La_{0.7}$-$Sr_{0.3}MnO_3$ catalyst	Methyl orange	1.4	[67]
LaFeO, $LaCaFeO_{3-\delta}$ catalyst	Methylene blue	5.5	[68]
$LaMnO_3$ catalyst	Rhodamine B (RhB)	1.0	[69]
$LaFeO_3$ perovskite catalyst	Acid Orange 7 (AO7)	3.0	[70]

Table 9 Summary of effect of solution temperature on dye degradation

Catalyst	Type of dye	Experiment temperature range (ºC)	Effective solution temperature for decolorization and degradation	Reference
$La_{0.8}Ca_{0.2}Fe_{0.94}O_{3-\delta}$ perovskite catalyst	Methylene blue	5 ºC, 24 ºC and 37 ºC	37 ºC	[68]
$L_{1.15}FO$ catalyst	Methyl orange	25 ºC, 30 ºC, 35 ºC and 40 ºC	40 ºC	[60]
$LaCo_{1-x}Cu_xO_3$ perovskites.	Phenol	15 ºC, 25 ºC and 35 ºC	35 ºC	[71]
$LaCoO_3$, $LaCuO_3$, $LaFeO_3$ and $LaNiO_3$ catalyst	Rhodamine B	30 ºC, 40 ºC and 50 ºC	50 ºC	[72]

Table 10 **Summary for the effect of catalyst dosage on dye degradation**

Catalyst	Type of dye	Catalyst dosage tested	Catalyst dosage effectiveness	Reference
$LaNiO_3$ catalyst	Reactive Black 5	Without catalyst, 0.75 g/L, 1.0 g/L and 1.5 g/L	1.5 g/L (84.4% – 89.6%)	[75]
$H_4SiW_6Mo_6O_{40}/SiO_2$ catalyst	Fuchsin aqueous solution (organic dyes)	1 g/L, 2 g/L, 4 g/L, 6 g/L and 8 g/L	4 g/L	[76]
$Ca_2Fe_{1-x}Sm_xBiO_6$ double perovskite	Rhodamine 6G	Ratio catalyst to solution, x = 0,0.2, 0.4, 0.6, 0.8 and 1.0	0.6	[78]
$La_4Ni_3O_{10}$ perovskite catalyst	Methyl orange	5 mg/L, 10 mg/L and 15 mg/L	5 mg/L	[48]
$BaPbO_3$ catalyst	Methylene blue	0.1 g/100, 0.2 g/100, 0.3 g/100 and 0.4 g/100	0.4 g/100	[79]

Conclusion:

As a conclusion, high initial concentration would inhibit the perovskite catalyst in performing at a maximum efficiency as the dye concentration would overwhelm the amount of catalyst prepared to do the degradation and decolorization process of the wastewater effluent. Therefore, the increase in the initial concentration of dye would result in lower efficiency and degradation performance of the perovskite catalyst in Advanced Oxidation Process. Based on the comparison of data made, most of the data exhibit the tendency of high efficiency of dye degradation at pH value from 3-7. The alkaline condition of the solution pH would result in low rate and efficiency of degradation and decolorization. From the data comparison and analysis process, the degradation process of dyes prefers higher than average atmospheric solution temperature (>40ºC) based on the data collected. The higher solution temperature lead to better degradation efficiency as compared to lower solution temperature. For the catalyst dosage, the amount of dosage is preferred at a medium ratio to the total solution amount so that the degradation of dye can be done with the maximum performance. This is mainly depending on the physico-chemical properties of the catalyst itself. The excessive catalyst dosage may result to lower rate of degradation.