TREATMENT OF DEVICE DYEING WASTEWATER BY PHOTOCATALYST WITH THE ABSORBENT

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Abstract

There are various processes for silk weaving and one of the most important stages is dyeing. Removal of synthetic dyes from dyes wastewater is concerned research and innovation based on the decolourisation. The dye treatment vessel imitates the strainer by the photocatalytic oxidation is compared for the water quality before and after oxidation. This research demonstrates the dye treatment vessel. It consists of 4 parts. First, the dye wastewater is mixed with RHA. Second, the liquid is decanted into the vessel via the second pipe made from rice husk. The third pipe is made from sand and passed through the fourth pipe in aqueous solution by photoreaction. The photocatalyst as titanium dioxide under UV light illumination is used. The result showed that the percentage of decreasing of BOD, COD, Cr, Mn, Cu and Hg in the effluent were 97.82, 99.59, 94.90, 89.58, 100 and 100% (red) and 87.23, 93.12, 99.07, 61.59, 100 and 100% (blue).

Keyword: absorbent, dyeing, photocatalytic oxidation

Research Question

When used Titanium dioxide together with the absorbent material (sand and rice husk ash) for dye wastewater treatment, Could water after the treatment reuse?

Hypothesis

Using Titanium dioxide together with absorbent material (sand and rice husk ash) for dye wastewater treatment, can treat the wastewater and remove heavy metals in the dye wastewater.

Investigation Plan

Investigation plan of this research as shows in Figure 1.

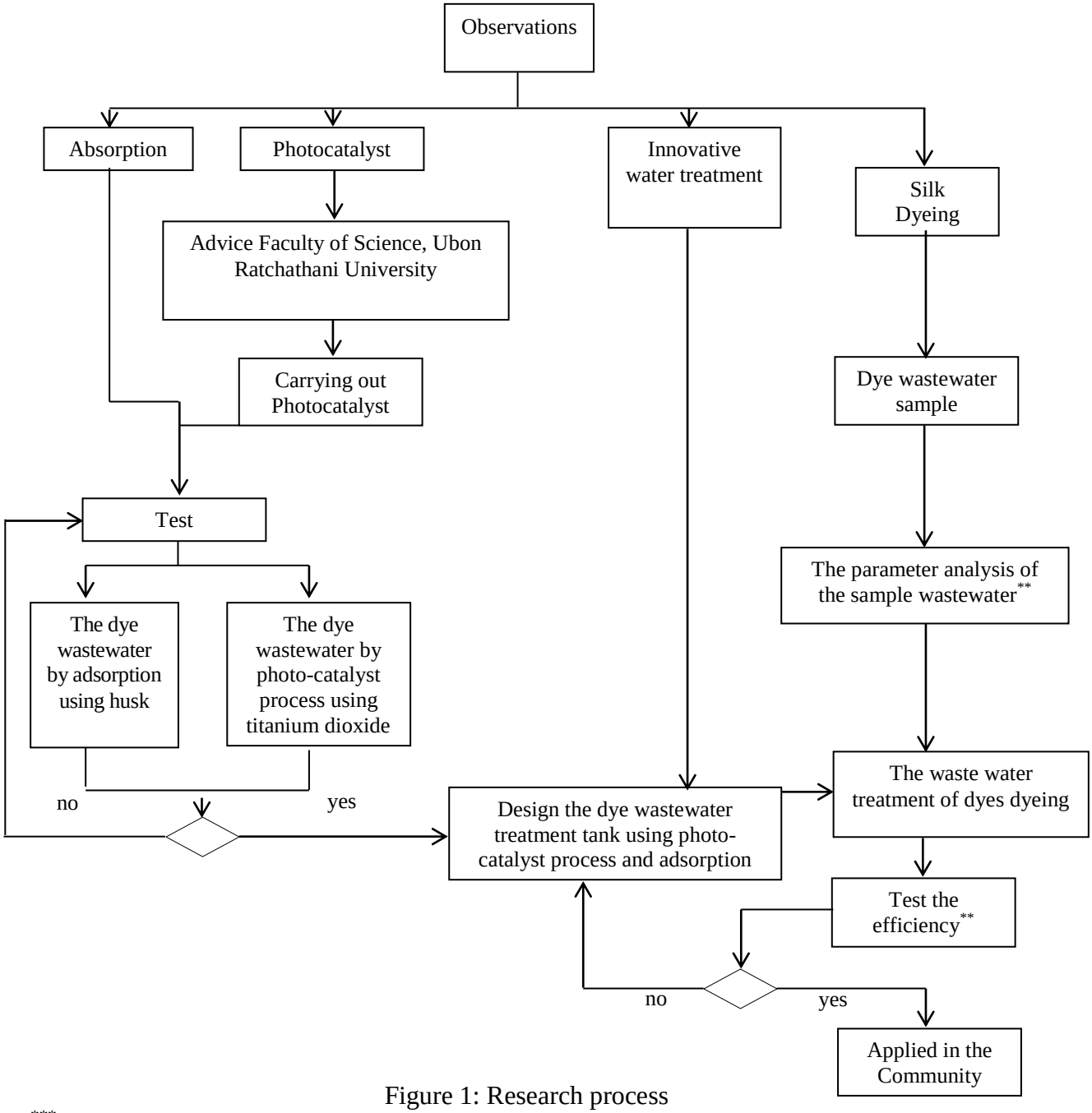


Figure 1: Research process

*** The unit of water quality analysis, Faculty of Science, Ubon Ratchathani University

Research Method

Materials and equipment

1. 20 liter plastic tank
2. PVC pipes of 18 mm.
3. Connecting thread size 18 mm.
4. Elbow PVC Pipe size 18 mm.
5. Wall faucet
6. Valves
7. Adhesive Silicone
8. Black Light Bulb 20 Watt
9. Air pump
10. Rice husk ash
11. Sand
12. Small rocks
13. Titanium dioxide (Commercial grade)
14. BOD and COD test kit
15. pH meter
16. Heavy metals that were used to dissolve in the dye wastewater, which consisted of Chromium (Cr), Lead (Pb), Manganese (Mn), Copper (Cu), and Mercury (Hg).

Methodology

1. Defined the study site. Figure 2 shows the study site.

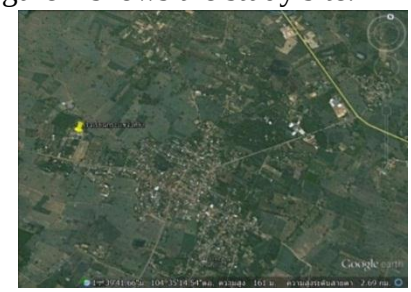


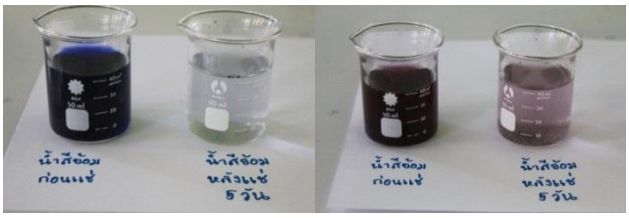
Figure 2: Study site at Krachaeng Sub-district, Kanthalak District, Si Sa Ket Province

2. Sampled dye wastewater and measured the chemical property as follow:
    - Measured pH by using pH meter
    - Measured BOD (Biochemical Oxygen Demand) through Azide modification technique at the unit of water quality analysis, Faculty of Science, Ubon Ratchathani University by using dilution method with percent mixture of 1% and 5 %
    - Measured COD (Chemical Oxygen Demand) using potassium dichromate reflux method at the unit of water quality analysis, Faculty of Science, Ubon Ratchathani University
    - Measured dissolved heavy metals in the dye wastewater by using Atomic Absorption Spectrophotometer (ASS). Heavy metals were Chromium (Cr), Lead (Pb), Manganese (Mn), Copper (Cu), and Mercury (Hg).
3. Measured the dye degradation from wastewater by using rice husk ash as an absorbent. Observed and recorded data.
4. Measured the dye degradation from wastewater by photocatalytic process using titanium dioxide as a photocatalyst. Observed and recorded data.
5. Designed the dye wastewater treatment process by using the photocatalytic process together with absorption.
6. Measured the chemical properties of dye wastewater after treatment . The parameters as shown in No.2.
7. Tested the efficiency of the dye wastewater treatment process by comparing the quality of wastewater before and after treatment.

Data and Data analysis

1. The dye degradation in wastewater by using rice husk ash as an absorbent.

When, the 9,000 ml of dye wastewater treated in the plastic tank which contained 1,000 g of rice husk ash during 3-7 days, the dye wastewater were obviously degraded by observing. However, the dye degradation is not changed after 5-7 days as shows in figure 3.



(A) Blue (B) Red (Dark tamarind seed color)

Figure 3: Comparison of the dye degradation by using rice husk ash as an absorbent

2. The dye degradation in wastewater by using photocatalytic process

Table 1: Results of the dye degradation in wastewater by using photocatalytic process

Test Conditions	**Results**	**Time (Hours)**
250 ml Dye wastewater + TiO_2 (5 g), leave in the sun light	The color of the dye wastewater was not changed, and slowly evaporated with sediment left at the bottom of the beaker	120
250 ml of 50% diluted dye wastewater + TiO_2(5 g), leave in the sun light	The color of the dye wastewater was colorless in blue dye wastewater and slightly clear in red dye wastewater and found the sediment of TiO_2 at the bottom of the beaker	48
250 ml of dye wastewater + TiO_2 (5 g) with 20 watts UV catalyst	Clear and colorless wastewater in both blue and red dye wastewater	3

As table 1 shows the dye degradation in wastewater by using photocatalytic process by using titanium dioxide as the catalyst. The dye wastewater were degraded by using titanium dioxide with 20 watts UV as the catalyst in 3 hours and the 50% diluted dye wastewater with sun light in 48 hours.

3. The design of the dye wastewater treatment process by using photocatalytic process and absorption

The design of the dye wastewater treatment process based on the data as shown in Table 1. The treatment process consisted of 4 components: the 1st treatment tank, contained the rice husk ash, dye wastewater were treated by 120 hours then drained it to the 2nd tank. The 2nd treatment tank, contained with rice husk ash and then wastewater were drained to the 3rd tank which contained with sand, then drained wastewater to the 4th tank, which were treated by using titanium dioxide as a catalyst with sun light photocatalytic process 48 hours, as shown in figure 4.

Figure 4 : The dye wastewater treatment process by using photocatalytic process and absorption

4. The test of efficiency of the dye wastewater treatment process by using photocatalytic process and absorption

Table 2 shows the efficiency of the dye wastewater treatment process by using photocatalytic process and absorption in red and blue dye wastewater. The results showed

that after treatment , all water quality parameters were passed the industrial wastewater quality standard.

Table 2: The efficiency of the dye wastewater treatment process by using photocatalytic process and absorption

Parameter	**Red dye wastewater**			**Blue dye wastewater**			**Standard value**
	Before treatment	**After treatment**	**✓= passed X = not passed**	**Before treatment**	**After treatment**	**✓= passed X = not passed**	
color	Dark red	Clear colorless	✓	Dark blue	Clear colorless	✓	satisfied
pH	7.18	8.34	✓	6.90	7.98	✓	5 – 9
BOD (mg/l)	765	16.68	✓	140	17.88	✓	≤ 20
COD (mg/l)	8,340.67	34.32	✓	755.20	51.98	✓	≤ 40
Cr (mg/l)	0.0961	0.0049	✓	0.389	0.0036	✓	≤ 0.25
Pb (mg/l)	ND	ND	✓	ND	ND	✓	≤ 0.2
Mn (mg/l)	0.1680	0.0175	✓	0.1018	0.0391	✓	≤ 5.0
Cu (mg/l)	0.0192	ND	✓	0.0010	ND	✓	≤ 2.0
Hg (mg/l)	0.000212	ND	✓	0.000884	ND	✓	≤ 0.005

Table 3: Percentage of the decreasing of parameters of the dye wastewater after treatment

Parameter	Percentage of decreasing	
	Red dye wastewater	Blue dye wastewater
BOD (mg/l)	97.82	87.23
COD (mg/l)	99.59	93.12
Cr (mg/l)	94.90	99.07
Mn (mg/l)	89.58	61.59
Cu (mg/l)	100	100
Hg (mg/l)	100	100

As Table 3, The dye wastewater after treatment process by using photocatalytic process and absorption was decreased in BOD, COD , Cr, Mn, Cu, and Hg for 97.82 %, 99.59% , 94.90% , 89.58% , 100% and 100%, respectively in red dye wastewater and 87.23% , 93.12% , 99.07% , 61.59%, 100% and 100% , respectively in blue dye wastewater.

Conclusion

The dye wastewater treatment by using Titanium dioxide together with absorbent material (sand and rice husk ash) can treated the wastewater and heavy metals in the dye wastewater were removed. The results indicated that the photocatalytic process can degrade 50 % color by sun light in 48 hours and UV light illumination (20 watts) in 3 hours. The dye wastewater treatment process consists of 4 parts. First, the dyes wastewater is mixed with rice husk ash for 120 hours. Second, the liquid is drained into the tank via the second tank which contained rice husk ash. Then, passing through the third tank which contained sand and pass through the fourth tank in aqueous solution by photoreaction. Furthermore, it is found that the dye color is so differently, before the oxidation, the waste water was dark, after oxidation, the dye color was clear. There are a few difference of pH between before and after oxidation. The result showed that the percentage of decreasing of BOD, COD, Cr, Mn, Cu and Hg in the effluent were 97.82, 99.59, 94.90, 89.58, 100 and 100% (red) and 87.23, 93.12, 99.07, 61.59, 100 and 100% (blue), respectively. So, the titanium dioxide used as photocatalyst use together with rice husk ash and can be applied to dye wastewater treatment plant.

Discussion of Measurement Limitations

The appropriate quantity of Titanium dioxide which be suitable for dye wastewater treatment by photocatalytic process will be studied.

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