TREATMENT OF DYE WASTE WATER THROUGH PHOSPHATE MINE-REJECT ADMIXED -ACTIVATED AGRO-WASTE

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Abstract : The toxicity of textile wastewater has been a major problem both in developing as well as in the developed country. The varying requirements of color pigments by textiles necessarily leads to variation in the wastewater quality, so also the increasing unreliability on the treatment-trains. The pollutants in textile wastewater include high-suspended solids, chemical oxygen demand, heat, color, acidity, and other soluble substances. Hence, the substances, which need to be removed from textile wastewater, are mainly COD, BOD, nitrogen, heavy metals and dyestuffs. Although various electrochemical and even biological treatment method are in vogue, yet the cost of the installation as well as operation and associated environmental loading render them rather non-ecofriendly. The present project aims at utilizing principle of adsorptive remediation of textile wastewater using agro-residue, activated by mine-reject, so as to make the process both cost-effective and better eco-friendly (through partial closing the loop).

***IndexTerms* – Adsorption, Wastewater, Textiles, Agro residues**

I. INTRODUCTION

Echo of the development of industrialization (and associated comforts) is often heard in almost synchronously in the domain of pollution (and associated diseases). In fact, many of the major industries (such as Distilleries, Sugar, Tannery, Textile, Paper and pulp, Steel plating, Pharmaceutical, Fertilizer etc.) discharge huge quantities of highly organic and toxic substances into the environment, with concentration of these toxic pollutants, released into the environment, is far beyond the self-cleansing capacity of the environment, may it be air, water or soil. In fact, many researches have been making attempts to find the ways and means to minimize toxic effects of specific pollutants (viz. DDT, phenol, heavy metals, other organic and inorganic compounds etc.) from the industrial effluents. The most common methodologies used for removal of toxic pollutants from wastewater involve sedimentation, coagulation, filtration, ion exchange, foam floatation, solvent extraction, electrolysis, chemical oxidation and precipitation, membrane techniques as well as sorption techniques. Among these various methodologies, adsorption technique has been widely accepted as one of the most efficient as well as cost-effective tools for purification and separation of wastewater, in recent years.

1.1 Method used for treatment and limitation

The advantages of adsorption over other conventional treatment methods are:

- It is relatively safe and easy to operate
- This method can remove both organic as well as inorganic contaminants even at very low concentrations
- Applicable to both batch and continuous experiment
- The possibility of regeneration and reuse of adsorbent
- It is found to cause simultaneous removal of a wide range of pollutants
- Possibility of development of low-cost substitute for commercial adsorbents

However, adsorption is also associated with high expenses in procuring adsorbent and lack of effective end use of spent adsorbents. Hence, in the present method the waste (effluents and mine-rejects) are explored for activating adsorbent, which themselves are agro-waste, therby reducing the cost of preparation, improving environmental-friendliness by utilizing other wastes and improving the scope of end-use (being organic, can be effectively used for combustion).

II. METHODOLOGY

2.1 Experimental Design & Flow

As presented in Fig 3.1, the adsorbents (agro-wastes) were activated with phosphoric acid (reagent grade) and used for adsorption of textile wastewater (with or without addition of mine-rejects and phosphoric acid-rich wastewater, with different proportion). The studies were carried out at different contact time, dosage, conc., pH, etc. to get least cost and optimized colour-treatment of textile wastewater.

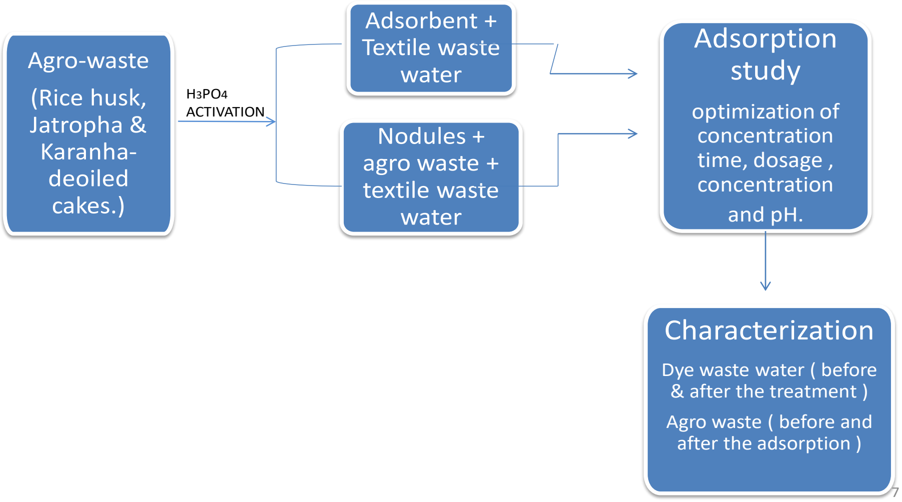

Figure 1 Methodolody

2.2 Preparation of samples and adsorbents

The wastewater from CETP (common effluent treatment plant) of textile industries was collected and stored in refrigerator, inside dark bottle to avoid auto-oxidation, and different stock solutions of different concentration were obtained for study. Both reagent grade phosphoric acid and phosphoric-acid rich effluent from fertilizer industry were also collected and maintained at different dilution for activation of adsorbents. Besides, phosphate mine-rejects were collected for impregnation during activation of the adsorbents.

The adsorbents used for the study are the agro-wastes such as rice husk, as well as the Deoiled cakes from jatropha and Karanja – both used for bio-diesel. The adsorbents were hydro-cleaned using soxhlet extractor, and then sun-dried, crushed, sieved (170 to 200 mesh), oven dried (at 100±°C overnight), desiccated and stored in airtight container, away from sunlight. The adsorbents were activated with different concentration of phosphoric acid with different proportion (of adsorbents) in furnace at 500°C (for 2hours) at nitrogen atmosphere**.**

III. RESULTS AND DISCUSSION

3.1 Effect of Dosage, pH, and Contact Time

When studied for 24 hrs , the dosage of 0.25g Rice husk (at ph7, with 5% H_3PO_4 activation) gives maximum removal of colour (close to 100%), following by 0.4g. but, when the activation was increased to 10% H_3PO_4, dosage of 0.4g Rice husk gives maximum colour removal.

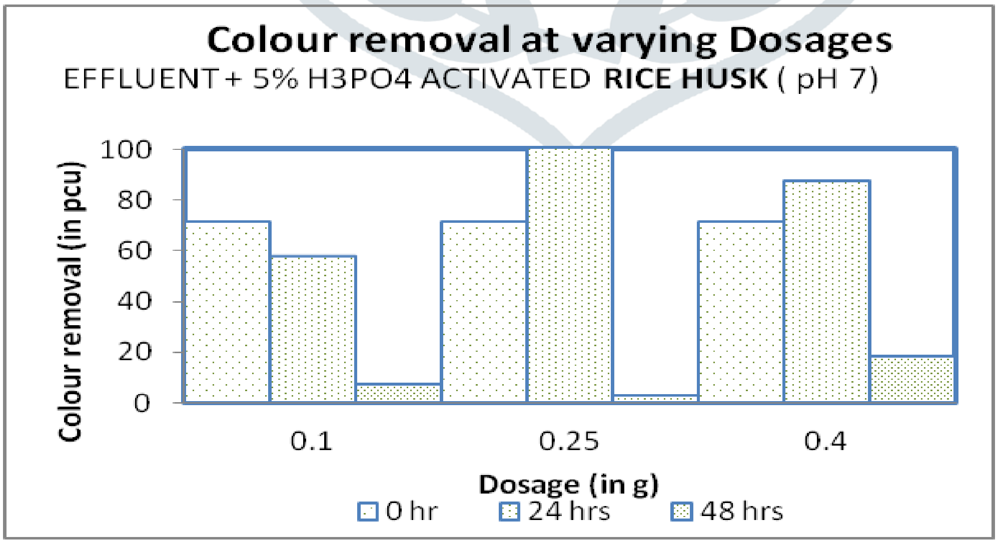

Figure 2 Colour removal at varying dosage and time (pH7) with Rice Husk

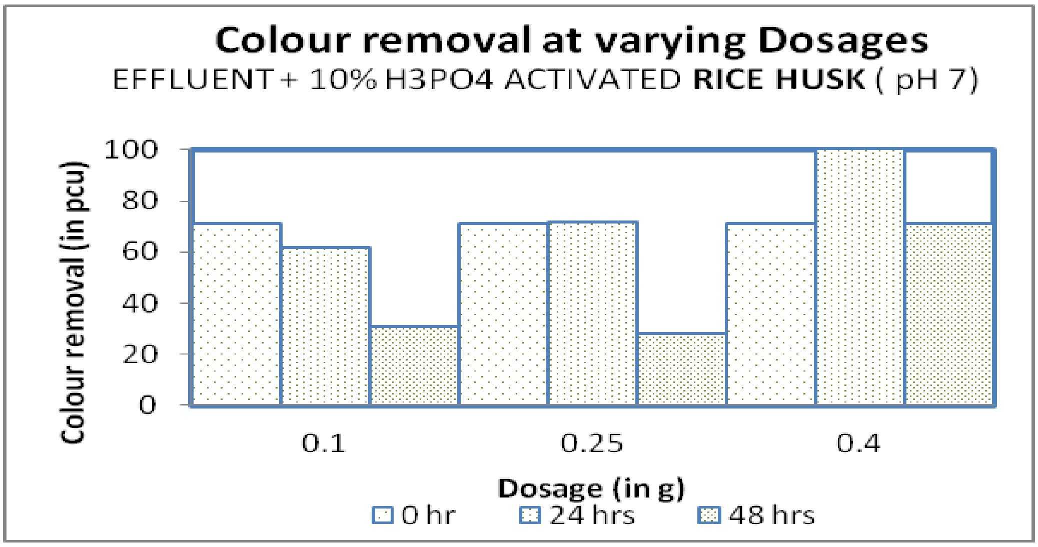

Figure 3 Colour removal at varying dosage and time (pH7) with Rice Husk

3.2 Effect of effluent on colour removal

At pH 2, the dosage of 0.4g Rick husk with 5% H_3PO_4 activated gave maximum colour removal, whereas dosage 0.1g Rice husk with 10% H_3PO_4 activation could remove maximum colour.

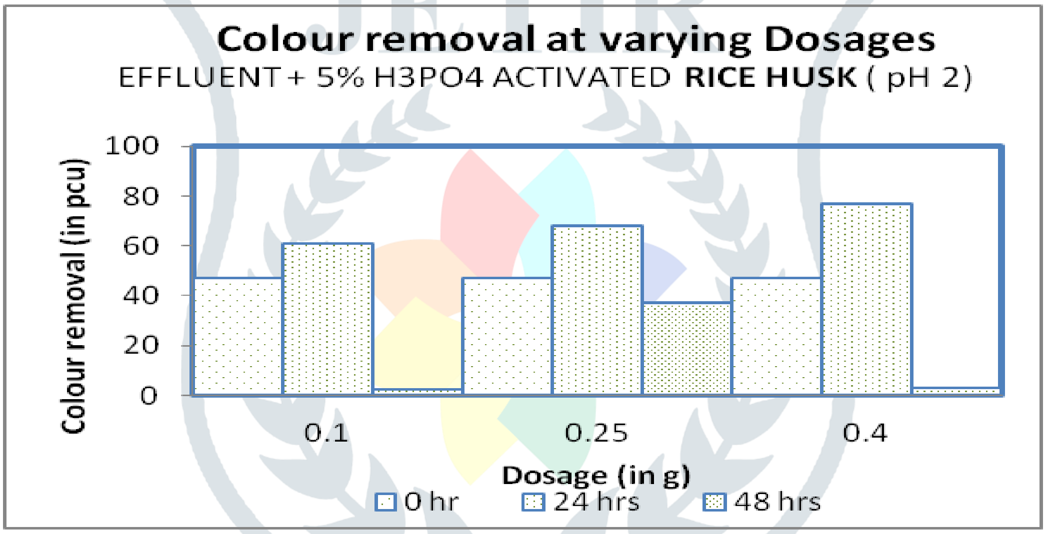

Figure 4 Colour removal at varying dosage (pH2) with Rice Husk

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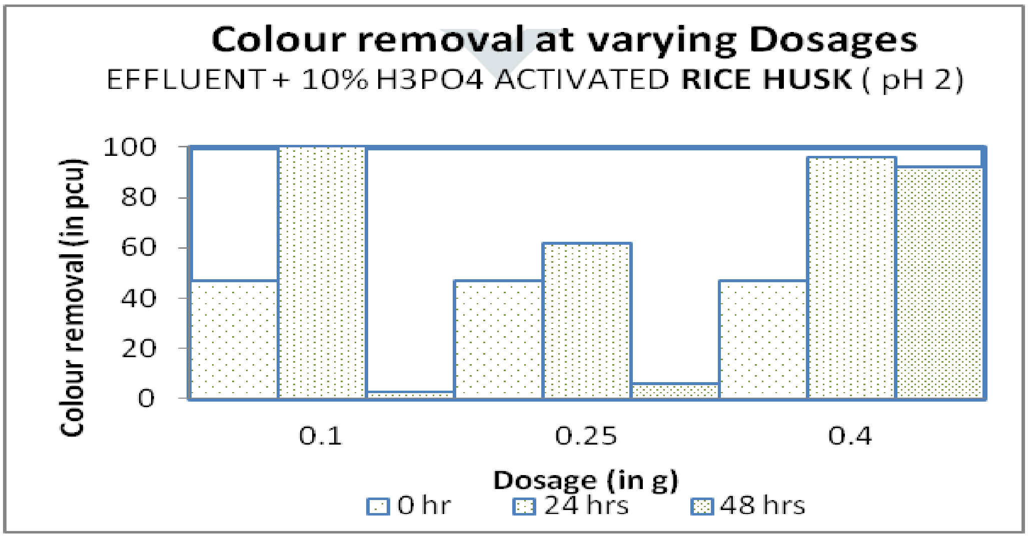

Figure 5 Colour removal at varying dosage (pH2) with Rice Husk

However, for jatropha at pH_7, the dosage of 0.4g Rick husk with 5% H_3PO_4 activated gave maximum colour removal, whereas dosage of 0.1g Rice husk with 10% H_3PO_4 activation could remove maximum colour. At pH_2, the dosage of 0.4g jatropha with 5%, 10% H_3PO_4 activation gave maximum colour removal at 24 hrs and 48hrs.

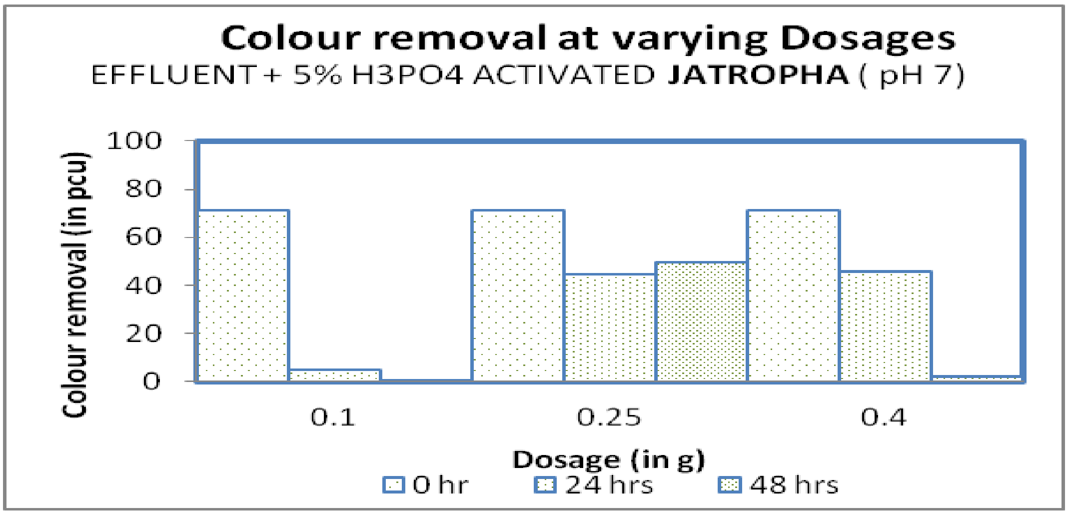

Figure 6 Colour removal at varying dosage (pH7) with Jatropha

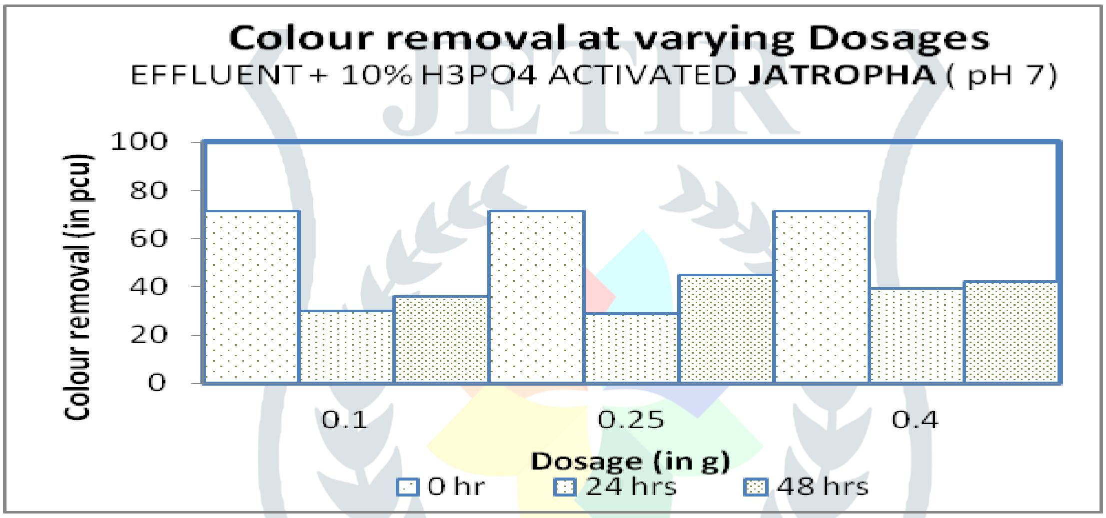

Figure 7 Colour removal at varying dosage (pH7) with Jatropha

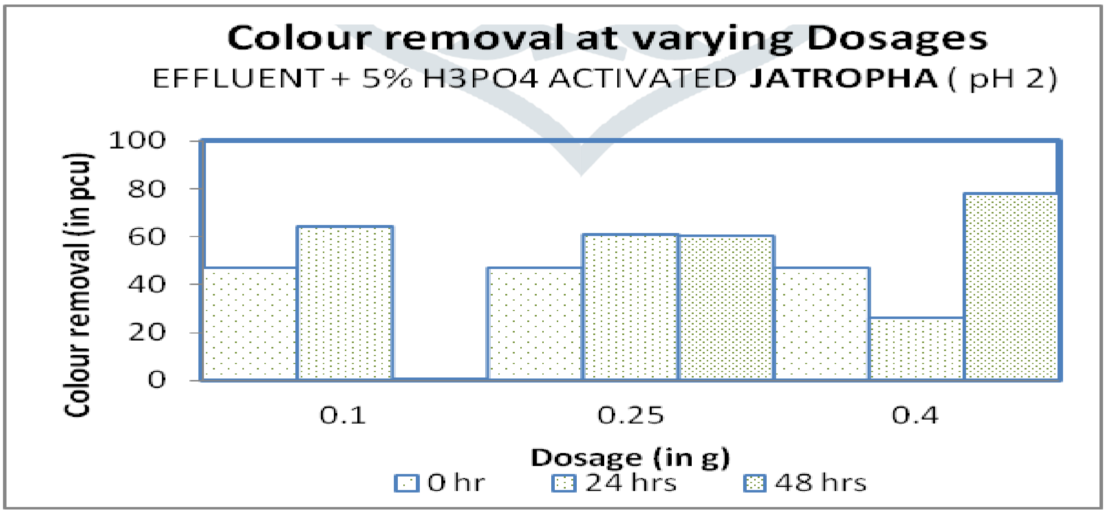

Figure 8 Colour removal at varying dosage (pH2) with Jatropha

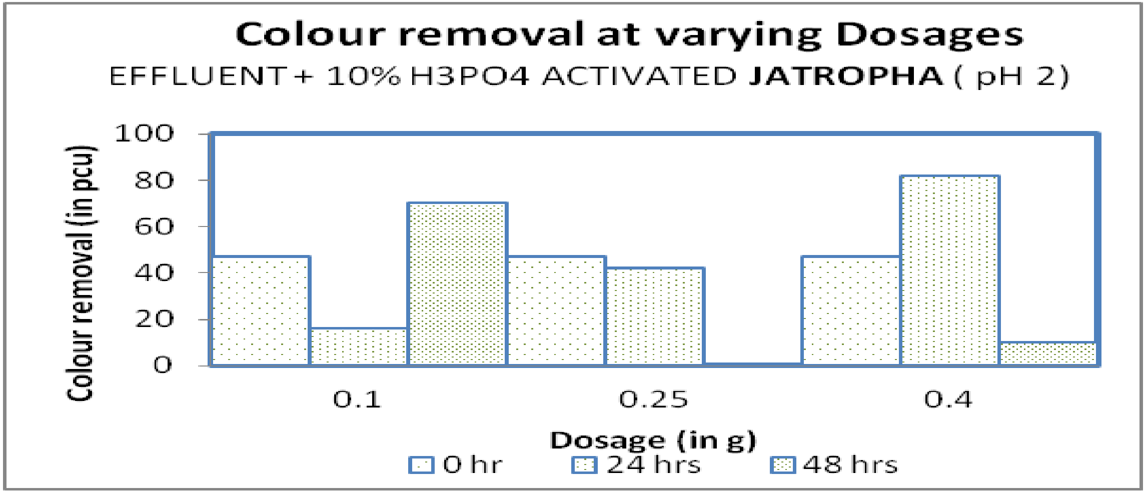

Figure 9 Colour removal at varying dosage (pH2) with Jatropha

4.2 Contribution Of Mine Rejects On Adsorption:

To minimize the cost, the study at ph7 was conducted with minimum cost-activation (i.e., with 5% H3PO4 activation) for different dosages for 48 hours which reveals that in all dosages the removal was at least 80%. The highest (i.e., 95%) was observed in case of 4g dosage of mine reject admixture.

Table 1 Contribution of Mine Rejects on Adsorption

S.No	pH	DOSAGE (gm)	Time (hrs)	COLOR REMOVAL (%)	TREATMENT (Mine reject + 5% H_3PO_4) gm
1	7	0.1	48	80	0.1
2	7	0.25	48	80	0.1
3	7	0.4	48	80	0.1
4	7	0.1	48	90	0.25
5	7	0.25	48	80	0.25
6	7	0.4	48	85	0.25
7	7	0.1	48	90	0.4
8	7	0.25	48	95	0.4
9	7	0.4	48	90	0.4

Table 2 Colour Removal at Varying Dosage of Rice Husk

S.No	pH	DOSAGE (gm)	Time (hrs)	COLOR REMOVAL (%)	TREATMENT (Effluent + 5% and 10% H_3PO_4) gm
1	7	0.1	48	90	Effluent + 5% H_3PO_4
2	7	0.1	48	56	Effluent + 10% H_3PO_4
3	7	0.25	48	95.7	Effluent + 5% H_3PO_4
4	7	0.25	48	60	Effluent + 10% H_3PO_4
5	7	0.4	48	74	Effluent + 5% H_3PO_4

Table 3 Colour Removal at Varying Dosage of Karanja

S.No	pH	DOSAGE (gm)	Time (hrs)	COLOR REMOVAL (%)	TREATMENT
1	7	0.1	24	92	Effluent + 5% H_3PO_4
2	7	0.25	24	36	Effluent + 5% H_3PO_4
3	7	0.4	24	35	Effluent + 5% H_3PO_4
4	7	0.1	24	57	Effluent + 10% H_3PO_4
5	7	0.25	24	59	Effluent + 10% H_3PO_4
6	7	0.4	24	45	Effluent + 10% H_3PO_4
7	7	0.1	24	7	Effluent + 20% H_3PO_4
8	7	0.25	24	-	Effluent + 20% H_3PO_4
9	7	0.4	24	-	Effluent + 20% H_3PO_4

Table 4 : Colour Removal at Varying Dosage of Jatropha (pH7)

S.No	pH	DOSAGE (gm)	Time (hrs)	COLOR REMOVAL (%)	TREATMENT
1	7	0.1	48	98	Effluent + 5% H_3PO_4
2	7	0.25	48	29	Effluent + 5% H_3PO_4
3	7	0.4	48	97	Effluent + 5% H_3PO_4
4	7	0.1	48	49	Effluent + 10% H_3PO_4
5	7	0.25	48	36	Effluent +10% H_3PO_4
6	7	0.4	48	40	Effluent + 10% H_3PO_4
7	7	0.1	48	2	Effluent + 20% H_3PO_4
8	7	0.25	-	-	Effluent + 20% H_3PO_4
9	7	0.4	-	0	Effluent +20% H_3PO_4

Table 5 Colour Removal at Varying Dosage of Jatropha (pH2)

S.No	pH	DOSAGE	HR	COLOUR REMOVAL	TREATMENT
1	2	0.1	48	98	Effluent + 5% H_3PO_4
2	2	0.25	-	-	Effluent + 5% H_3PO_4
3	2	0.4	-	-	Effluent + 5% H_3PO_4
4	2	0.1	48	-	Effluent + 10% H_3PO_4
5	2	0.25	48	97	Effluent + 10% H_3PO_4
6	2	0.4	48	78	Effluent + 10% H_3PO_4
7	2	0.1	48	-	Effluent + 20% H_3PO_4
8	2	0.25	48	97	Effluent + 20% H_3PO_4
9	2	0.4	48	38	Effluent + 20% H_3PO_4

4.4 Design of Optimized Adsorption, Adsorbate System

For production of least cost absorption system, the H_3PO_4 activation (which is most expensive) was completely modified and keeping mine rejects in a minimum quantity (i.e., 0.25g), various dosage was attempted and the maximum colour removal was obtained (90%) at a dosage of 0.1g of adsorbent and 80% at 0.15g dosage.

On comparing pH2 and pH7, pH7 gives better result. 0.1g of jatropha gives better result on comparing various dosage like 0.1g, 0.25g, and 0.4g of jatropha. While comparing 24hr and 48 hr readings, 24hr readings gives better result while using both mine rejects and agro waste in the experiment. When studied for 24 hrs , the dosage of 0.25g Rice husk (at ph7, with 5% H_3PO_4 activation) gives maximum removal of colour (close to 100%), following by 0.4g. but, when the activation was increased to 10% H_3PO_4, dosage of 0.4g Rice husk gives maximum colour removal. At pH2, the dosage of 0.4g Rick husk with 5% H_3PO_4 activated gave maximum colour removal, whereas dosage of 0.1g Rice husk with 10% H_3PO_4 activation could remove maximum colour. However, for jatropha at pH7, the dosage of 0.4g Rick husk with 5% H_3PO_4 activated gave maximum colour removal, whereas dosage of 0.1g Rice husk with 10% H3PO4 activation could remove maximum colour. At pH2, the dosage of 0.4g jatropha with 5%, 10% H3PO4 activation gave maximum colour removal at 24 hrs and 48hrs.

Table 6 Design of Optimized Adsorption, Adsorbate System with mine rejects

S.No	pH	DOSAGE (gm)	MINE REJECTION (gm)	Time (hrs)	COLOUR REMOVAL (%)
1	7	2	0.25	24	40
2	7	1.5	0.25	24	80
3	7	0.1	0.25	24	90
4	7	0.5	0.25	24	70

IV. CONCLUSION

Thus, the above evaluations of the substitution of phosphoric acid activation with mine rejects containing phosphate reveals that the treatment of dye effluents takes place at different initial concentrations of the effluent and with different dosages of adsorbents. Therefore, textile wastewater treatment could be possible and with the use of mine rejects as an alternate for phosphoric acid activation. Although it may have some limitations, such as availability and extraction percentage of crude elements, which leads to further study.

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