Use of Biosurfactants in the Removal of Dye from Aqueous Solution

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Abstract

Biosurfactants can be used in environmental clean-up by biodegradation and detoxification of industrial effluents. There are used four surfactant pillared clays (TAZA, RAZA,FAZA and AZA) individually by batch process for dye removal and blending with 1, 5, 10, 15 and 20% bentonite for maximum decolourisation of dyeing wastewater by column process. The sorption goes on increasing as their concentration decreases from 20.0 to 0.1 mg/l. In the batch and column processes the order of dye removal capacities for these chemical adsorbents was found to be TAZA > RAZA > FAZA > AZA, and adsorbability order of dyes was MB > MG > CV. Thus the removal by column process was about 20% less than batch process.

Keywords - *Biosurfactants, Dyes: Crystal Violet (CV), Malachite Green (MG), Methylene Blue (MB), Biosurfactant and Waste water*

Introduction

Water pollutants are being discharged by the various industries, pulp and paper mills, carpet industries etc. These industries use dyes for colouring their materials and use huge amount of water foe the washing and cleaning purposes. Most of dyes are toxic in nature, their high concentration causes many water born diseases and increase the BOD of the receiving water[1,2]. The use of biosurfactants in the removal of dye was found to be an eco-friendly approach and also an alternate to conventional complex remediation systems. Due to their diversity, biosurfactants are considered as a potential candidate for the environmental clean-up pollutants[3]. Biosurfactants can be used in

environmental clean-up by biodegradation and detoxification of industrial effluents evaluated process for dye removal individually and then after blending (mixing) with 1, 5, 10, 15 and 20% bentonite for maximum decolourisation of dyeing wastewater by column process.

Experimental

Material and Methods

Dye Solution :

Four solution of 0.1, 1, 10 and 20 mg/l concentrations of each of the proposed dyes crystal violet (CV), malachite green (MG) and methylene blue (MB) were prepared by dissolving commercial grade dyes in distilled water was obtained fromQualigens Fine Chemicals, Mumbai, MG was obtained from Qualigens Fine Chemicals, Mumbai and MB was procured from CDH (P) Ltd., New Delhi.

Preparation of Biosurfactant Pillared Clays

Bentonite clay, cetyltrimethyl ammonium bromide (CTAB) and the above two biosurfactants (rhamnolipids typically produced by pseudomonas sp. And trihaloseproduced by Nocardia sp.) were used without further purification.Surfactant pillared clays were prepared by stirring sodium – exchanged clay (6 g) in 0.2 molar solution of the corresponding surfactants for 100 hrs. at 70oC. The solution was filtered, was repeatedly with distilled water and dried overnight in an oven at 110oC. Surfactant pillared clays were coded as RAZA (used rhamnolipids) and TAZA (used trihalose) fractionated Al-pillered (code name AZA) and Fe-Al-pillered (code name FAZA) clays were also be prepared 4,5. The pillered clays were characterizes for different X-ray diffraction (XRD) data using RigakuCorporation D/max – III A diffracto meter with Cu Karadiation (35 KV, 25 Ma) and IR data with a Perkin-Elmer R x 1 FTIR spectrometer using KBr Pellets of samples.

Blending of Biosurfactants with Bentonite and Dye removal capacities of different blends

Four surfactant pillered were evaluated individually and then after blending with 1,5,10,15&20 % bentonite.The composition of different blends were investigated and optimized to enhance decolourisation.

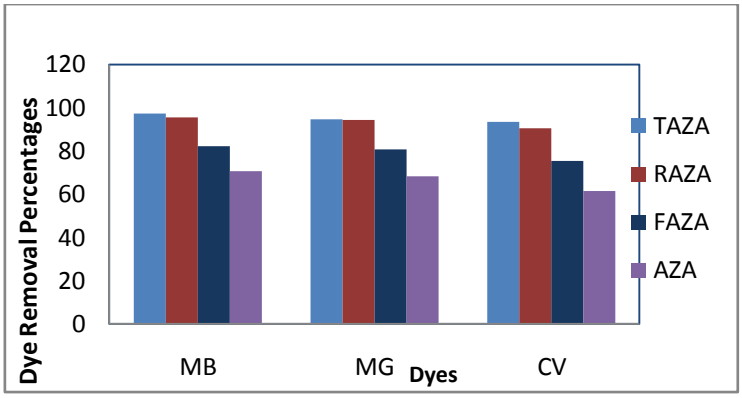
Result and Discussion

Sorbents were analysed and result are depicted in Table.

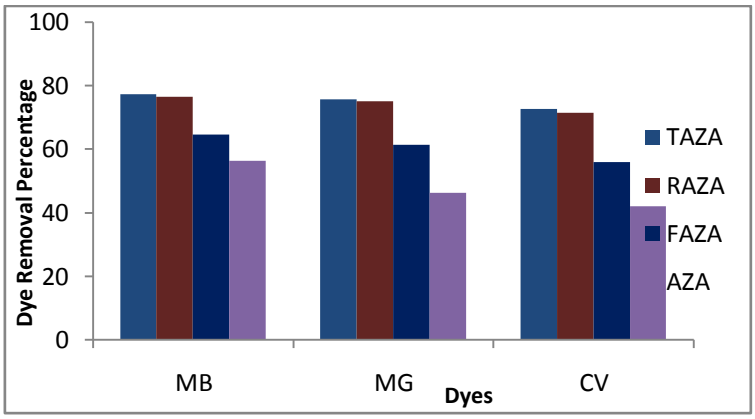
Table – Characteristics of bentonite blended pillared clays.

S. N.	Paramrters	TAZA	RAZA	FAZA	AZA
1	Moisture	3.82	4.96	5.67	3.22
2	Ash	14.56	9.85	5.68	7.36
3	Carbon	59.89	68.32	26.9	33.73
4	Calcium	2.35	1.39	4.41	3.31
5	Magnesium	1.03	1.02	3.07	2.04
6	pH	7.32	7.61	7.35	7.24
7	Conductivity (µs/m)	0.52	0.6	0.79	0.63
8	Specific Gravity	1.7	1.64	2.19	2.14
9	Surface area (m2/g)	356	307	288	218
10	CEC (meq/g)	0.7	0.9	1.63	0.72
11	Porosity (ml/g)	2.01	1.92	0.89	0.69

The sorption of dyes goes on increasing as their concentration decreases from20 to 0.1 mg/l. The sorbents TAZA, RAZA, FAZA and AZA could remove 97.1, 95.6, 82.3 and 70.5% MB and 93.3, 90.4, 75.3 and 61.6% CV respectively at 10 mg/l dye concentration, sorbent dose 5 g/l, pH 6.0, contact time 5h, temperature 25oc and rpm 150 in the batch process. This is shown in graph.



They could remove 77.2, 76.5, 64.5 and 56.2% MB and 72.5, 71.4, 55.8 and 41.9% CV respectively at 10 mg/l dye concentration, bed height (BH) 60 cm, pH 6.0, flow rate 10 ml/min and temperature 25oc by column process. This is shown in graph.



Conclusion

In the batch and column processes the order of the dye removal capacities for the bentonite blended pillared clays was found to be TAZA>RAZA>FAZA>AZA and adsorbability order of dyes was MB>MG>CV. This is probably due to several factors such as molecular size, molecular polarity, pH,cadmium respectivity and retentivity, sorbent properties and environmental conditions. The leaching order should be reverse of the sorption order. The sorption of dyes increased as their concentration decreased from 20.0 to 0.1 mg/l. Thus the removal in column process was about 20% less than batch process. Leaching increases as the flow rate increases.

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