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Adsorption Kinetic and Isotherm of Solution Pair of Methylene Blue and Crystal Violet by Algae-Silica-Magnetite Hybrid Adsorbent on *Porphyridium* sp. Algae

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INTRODUCTION

The adsorption method can be used as an effective method to control the discharge of MB and CV into waters, because this method it is simple, relatively inexpensive, and does not generate byproducts that are harmful to the environment (Buhani et al., 2017)

methylene blue (MB) and crystal violet (CV) which it is a basic substance with good solubility but mutagenic, toxic, and difficult to degrade (Umpierres et al., 2017)

violet

PS

PSM

industrial plant

waste water

UV-Vis

IR

SEM-EDX

river

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1. *Preparation of PSM adsorbent*
2. Characterization of PS and PSM adsorbent
   a. infrared (IR) spectrometer
   b. Scanning Electron Microscopy with Energy Dispersive X-Ray (SEM-EDX)
3. *Adsorption Experiments*

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1. Preparation of PSM adsorbent

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1. Preparation of PSM adsorbent

A solution added to B solution accompanied stirring up to gel forming

filtered gel with filter paper

be kept quiet for 24 hours

washed with Aquadest: 96% ethanol (60:40) to pH ≈ 7

Oven with T = 40°C for 3 hours

be grunted with mortar and pestle up to smooth

grinding up to 200 mesh

PSM powder

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2. Characterization of PS and PSM adsorbent

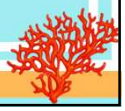
PS

PSM

IR

SEM-EDX

The synthesis resulted in a material PS and PSM that was characterized by an IR and SEM-EDX



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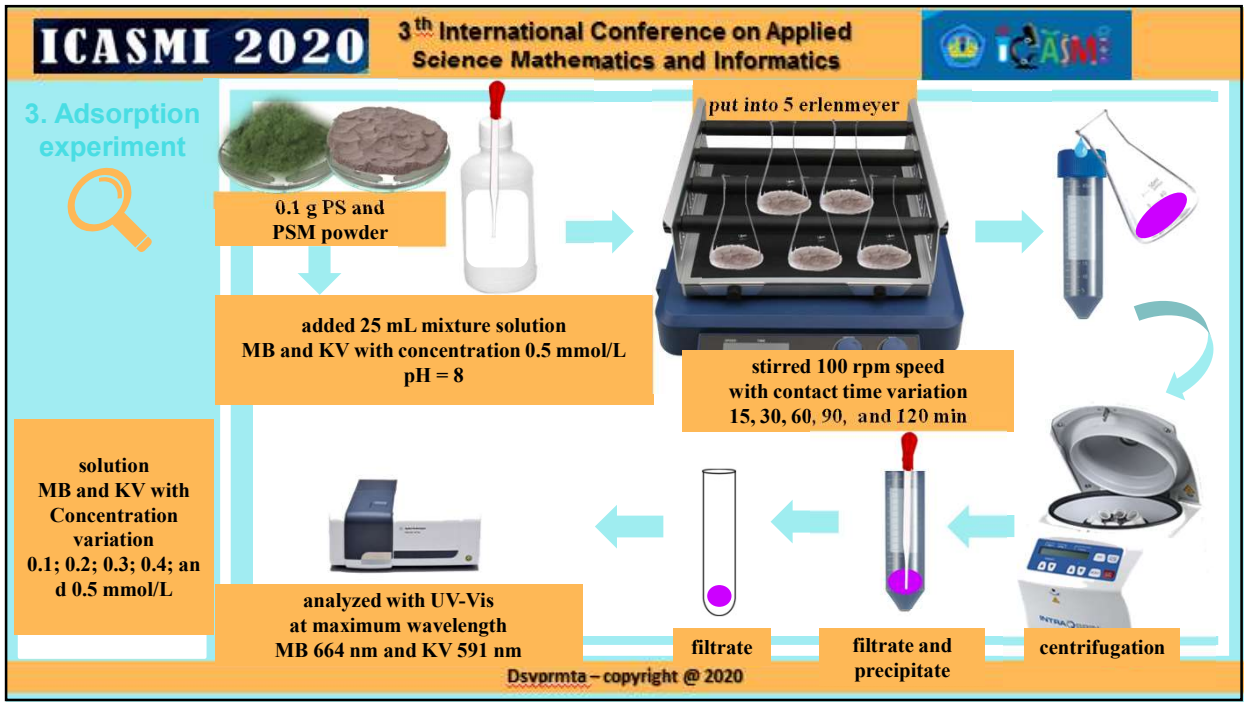
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3. Adsorption experiment
0.1 g PS and PSM powder
put into 5 erlenmeyer
added 25 mL mixture solution MB and KV with concentration 0.5 mmol/L pH = 8
stirred 100 rpm speed with contact time variation 15, 30, 60, 90, and 120 min
centrifugation
filtrate and precipitate
filtrate
analyzed with UV-Vis at maximum wavelength MB 664 nm and KV 591 nm
solution MB and KV with Concentration variation 0.1; 0.2; 0.3; 0.4; and 0.5 mmol/L
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Results
a
b
c
Figure 1. Synthesis results (a) PS (b) magnetite, and (c) PSM
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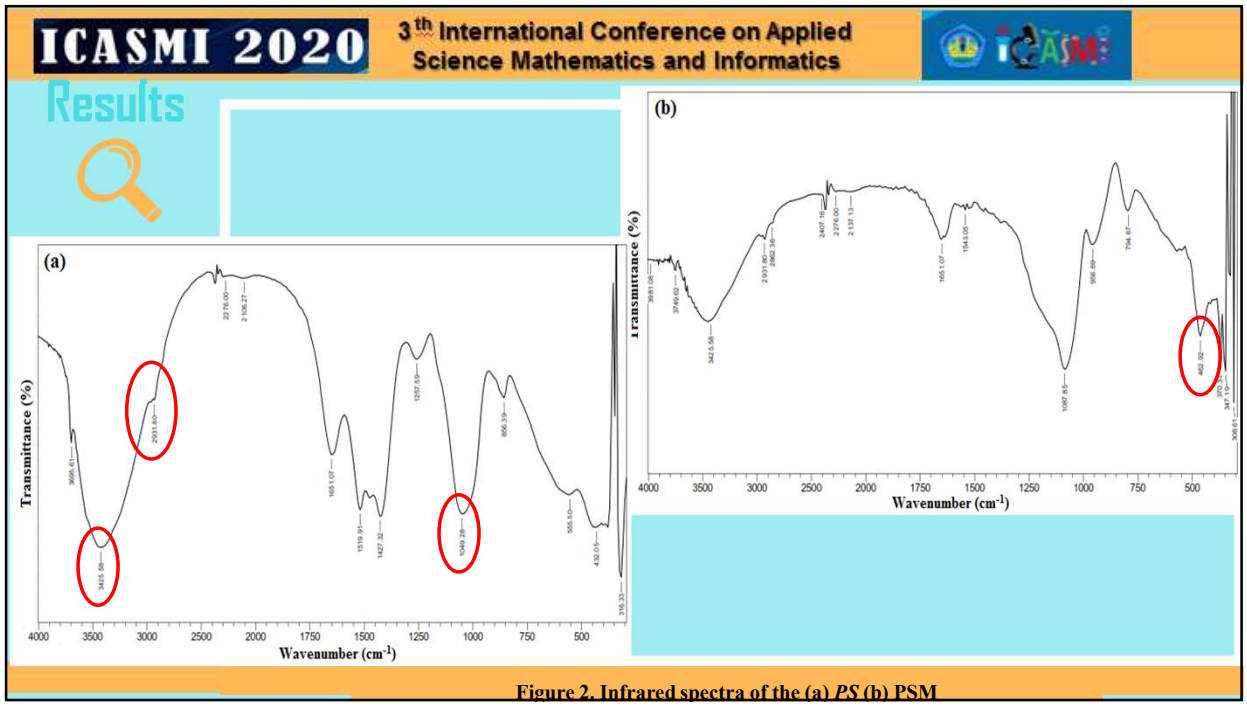

Figure 2. Infrared spectra of the (a) *PS* (b) PSM

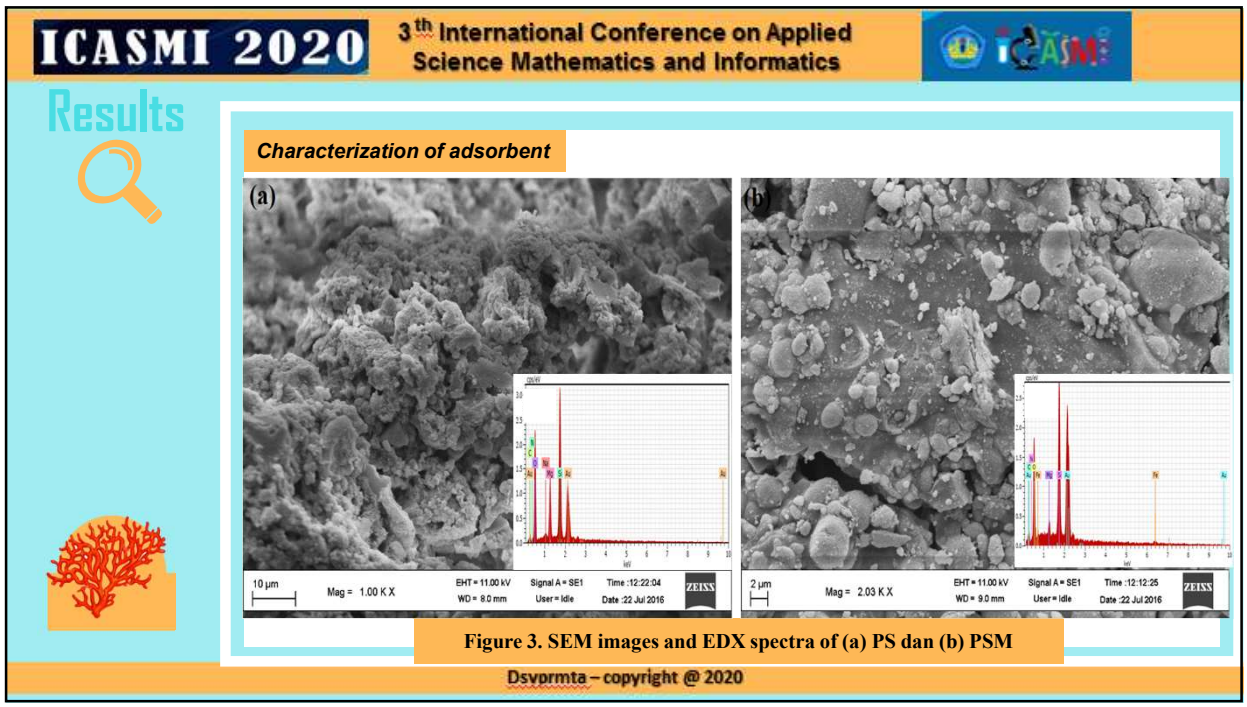

Figure 3. SEM images and EDX spectra of (a) PS dan (b) PSM

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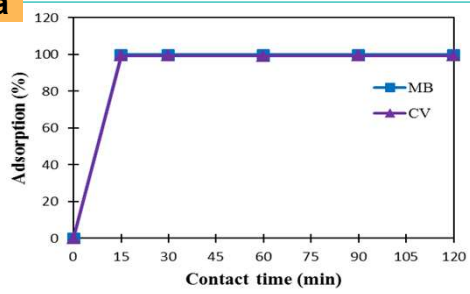
Adsorption experiment

a



b

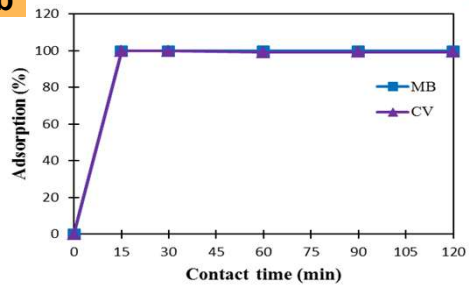


Figure 4. Influences of contact time on adsorption solution pair of MB and CV by (a) PS and (b) PSM

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Adsorption kinetics

Adsorbent		Kinetics Model			
		Pseudo-first-order		Pseudo-second-order	
		K_1 (min^{-1})	R^2	K_2 (g mg^{-1} min)	R^2
PS	CV	0.019	0.309	5.455	0.984
	MB	0.018	0.309	1.392	0.994
PSM	CV	0.019	0.311	2.331	0.965
	MB	0.018	0.309	0.501	0.989

Figure 5. Pseudo-first-order and pseudo-second-order parameters for the adsorption of solution pair of MB and CV by (a) PS and (b) PSM.

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Adsorption experiment

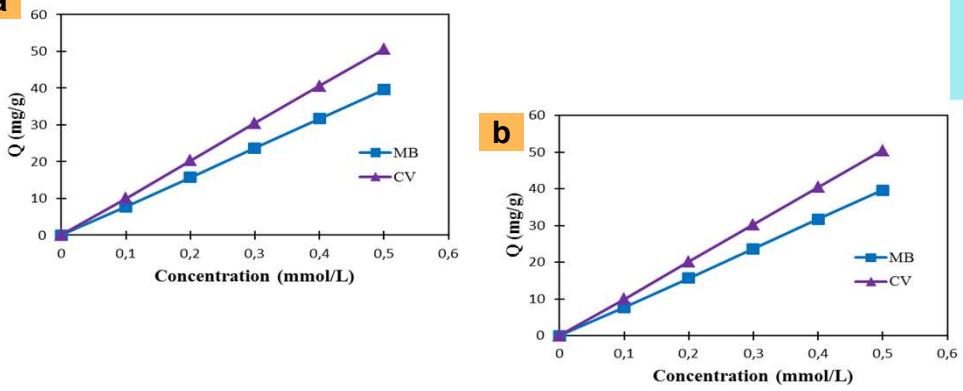

Figure 6. Influences of solutions concentration on adsorption of MB and CV by (a) PS and (b) PSM.

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Adsorption isotherm

Adsorbent		Isotherm Model					
		Langmuir			Freundlich		
		n_m (mg/g)	K_L (L/mg)	R^2	n	K_F (mg/g) $(L/mg)^{1/n}$	R^2
PS	CV	112.359	0.323	0.618	1.419	27.283	0.820
	MB	2.066	0.722	0.627	0.104	2.755	0.829
PSM	CV	13.642	0.381	0.612	0.836	15.111	0.933
	MB	4.887	1.298	0.494	0.239	20.118	0.502

Figure 7. Langmuir and Freundlich parameters for the adsorption of solution pair of MB and CV by (a) PS and (b) PSM.

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Conclusion

1. Characterization of PSM material shows some active groups acting as active sites for binding MB and CV.
2. In the PSM Materials, it is also proven that there are more complex bond interactions.
3. Thus, PSM is an effective adsorbent for MB and CV in solution, so it can be applied to the processing of wastewater containing dyestuffs.