INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

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SPECIAL ISSUE FOR INTERNATIONAL LEVEL CONFERENCE "ADVANCES IN SCIENCE, TECHNOLOGY & MANAGEMENT" (IC-ASTM)

VULNERABILITY EVALUATION AND MANAGEMENT TECHNIQUES FOR CRITICAL BRIDGES TOWARDS EXPLOSION

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Accepted Date: 05/09/2017; Published Date: 10/10/2017

Abstract: An important aspect of designing bridges for security in an economically feasible way is to have in place plans for evaluating the criticality of any one structure on the transportation network. Thus, in deciding how to allocate resources, bridges considered more essential to the transportation infrastructure, or those thought to be at higher risk for a terrorist attack, should be given priority in the implementation of protective measures over other, less critical bridges. This paper describes methods of carrying out threat and vulnerability analyses and risk assessments. Once the risks to a given bridge have been assessed, measures may need to be taken to mitigate these risks if they are deemed unacceptable. These measures generally attempt to prevent an attack by increasing surveillance or limiting access, but they can also include actions to limit the effects of blast loads or procedures to aid in rescue and recovery. Usually, deterrence and prevention measures will provide the least expensive solution to mitigate risk initially. Therefore, a risk manager should consider implementing these measures for short-term risks before hardening a structure is specified. Deterrence and prevention, however, may not always provide the most cost-effective solution for long-term risks when considering lifetime costs, such as maintenance, replacement, personnel, and surveillance costs.

Keywords: Bridges, Terrorist Attack

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PAPER-QR CODE

How to Cite This Article:

Sunil J. Payghan, IJPRET, 2017; Volume 6 (2): 100-106

INTRODUCTION

India is gifted with a diverse agricultural climate, which is extremely boosting for cultivating a large number of crops such as fruits, vegetables, ornamental, aromatic plants, medicinal herbs, spices and plantation corps. India is second largest producer of fruits and vegetables all over the globe. A huge amount of biomass is formed every year during cultivation, harvesting, processing and consumption of agricultural products. This biomass can be utilized for different applications like a low cost biosorbent, feedstock for producing biochemical and biofuels and substrate for the production of enzymes and metabolites [1, 2].

Banana (Musaceae) is a tropical fruit harvested all over the year. Banana is world's second major harvested fruit contributing about 16% of total fruit production. India contributes about 27% of biosphere's banana production. The average weight of fruit is about 125 g. Banana peel (BP) founds about 30-40% (w/w) of fresh banana. The main elements of BP are cellulose, hemicellulose, pectin, chlorophyll, and other low molecular weight compounds [3-7]. In 2012, approximately 101,992,743 tons of bananas were harvested throughout the world (FAO, 2013).

This huge amount of waste produced has given rise to the new problem of solid-waste management and its safe disposal. Landfills have been the collective method of BP waste disposal, but in some cases, open burning is preferred. However, these methods of BP disposal cause serious environmental problems. From an environmental viewpoint, it is essential to reuse BP. This would help decrease the load on ecosystem and contribute to the world economy.

These paper reports physicochemical and surface characteristics of BP. Characterizations were done using gravimetric, titrimetric, potentiometric, and instrumental techniques. This exercise helps in getting the insight of BP and serves as baseline information to propose their potential application as an adsorbent.

Chacterization of BP:

Proximate and ultimate analysis of BP was done and properties like point of zero charge, surface pH, surface charges, BET surface area were determined. FP were further characterized by techniques such as SEM and FTIR.

The analysis of dry BP shows that it contains of moisture (9.65%), ash (5.01%), volatile matter (85.26), C (40.24%), H (6.14%), N (1.38%) and S (0.098%). The proximate analysis approves high energy potential of BP (Carbon: 40%; LOI: 94 %;). The XRF analysis reveals that BP contains Al, Cl, Na, Si, and traces of some metal elements. The high loss on ignition of BP specifies that the volatile matter is present in huge amounts. Ripe BP contains upto crude protein; 8%; ether extract:6.2%;soluble sugars: 13.8% and total phenolic compounds: 4.8% [8].

zero-charge point (pHpzc) is a very valuable parameter in adsorption studies. It gives an idea about the interactions of adsorbent surface with the adsorbate. The pHpzc of BP corresponds to pH value of 5.36 of solution. Also, the concentrations of basic sites (4.9 mmol g-1) are more than acidic sites (0.75 mmol g-1). Along with this the surface pH of BP was found to be 6.68. Due to this, the BP can be classified as an adsorbent with a basic character. Additionally, the surface area was determined by BET method. Its value was 0.65 m^2g^{-1} [8].

From SEM image (Figure 1) it was clear that the particles of BP are irregular in shape and its surface shows a micro-rough texture. There may be pores are present which are significantly minor than can be observed in a typical SEM and that such micropores/mesopores might responsible for the surface area available for adsorption [8].

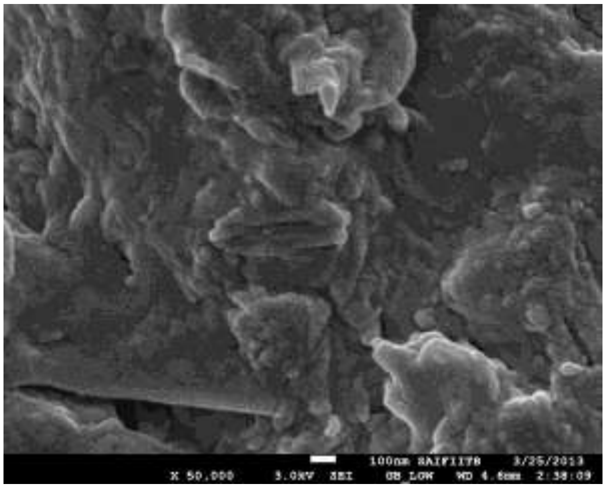

Figure1: SEM of BP

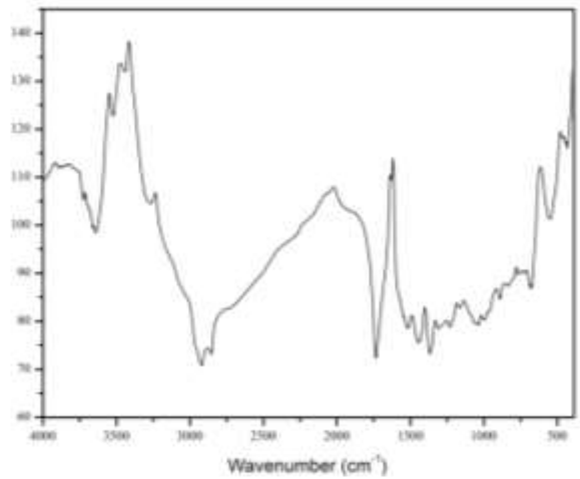

Figure2: FTIR of BP

FTIR spectrum was carried out to identify the functional groups present on BP surface. FTIR (Figure 2) spectrum broadly confirms presence of amines, amino acids, phenol, alcohol, alkanes, alkyl halide, carboxylic acid, aromatic in BP.

According to these findings BP can be a low-cost adsorbent to uptake acid molecule from aqueous solution [9].

BP as an Adsorbent:

We envisaged the possible use of BP as a biosorbent after carrying out various physicochemical characterization studies. The surface properties of BPs specifies that BP have more basic sites, low BET surface area, and different functional groups are present with rough and porous surface. This combination of properties makes it suitable as a biosorbent. For example, adsorption of heavy metals, dyes, and organic pollutants from aqueous solutions on BP had shown promising results. Due to this purpose, BP can be used in its natural or modified form, or as activated carbon [7, 10]. The detailed literature available for BP as an adsorbent is listed in Table 1.

Table 1: BP as an adsorbent for removal of heavy metals, dyes, and organic pollutants

Adsorbate	Activation process/agent	Qm (mg/g)	% R	T (min)	pH	Reference
Cr^{3+}	Esterified BP	115.43	95	30	4	[11]
Cr^{6+}	-	131.56	95	30	2	[12]
Cr^{6+}	-	2.73	95	15	6	[13]
Cu^{2+}	-	20.97	98	20	3	[14]

Pb^{2+}		41.44				
Cd	-	20.88	73.15	1440	5	[15]
Cd	Esterified peel	35.52	97	30	8	[16]
Cu	-	0.9±0.2	-	120	-	[17]
	Rapid explosion with supercritical CO2	-		120	5	
	Bioactive compounds extracted using supercritical CO2	0.38 ± 0.05		1200	5	
Methylene blue	-	106.95	93.44	60	4-8	[18]
	0.1 N NaOH	332.23	98.54			
Acid blue 25	0.1 M HCl	89.52	-	-	2	[19]
Phenolic compounds	-	688.9	96	180	7	[20]
Benzoic acid	-	6.62	77.59	720	3.68	[7]
Salicylic acid	-	9.80	61.55	840	3.3	
Citric acid	-	76.13	85.27	360	4.75	[21]
Citric acid	Microwave treated	147.06	88.43	360	4.75	
Cu	-	8.24	81.2	600	6.48	[22]
Pb^{2+}	-	5.71	85.3	-	5	[5]
Cd^{2+}		2.18	89.2		3	
Methyl orange	-	21.0	-	65	6–7	[23]
Methylene blue		20.8				
Rhodamine B		20.6				
Congo red		18.2				
Methyl violet		12.2				
AmidoBlack 10B		6.5				
Pb^{2+}	-	50.45	-	300	5	[24]
	NaOH	469.42				

	HCl	49.77				
	H_3PO_4	71.12				
Cu^{2+}	-	52.36	-	1500	-	[25]
Pb^{2+}		25.91				
Zn^{2+}		21.88				
Ni^{2+}		54.35				
Cd^{2+}		34.13				
Cu^{2+}	Cellulose extracted	140.85				
Pb^{2+}		101.01				
Zn^{2+}		104.17				
Ni^{2+}		133.33				
Cd^{2+}		76.92				
Au^{3+}	-	198.31	17.23	30	2.5	[26]
	Carbonated at 300°C for 4 hours	692.37	60.34			
	Carbonated at at 500°C for 4 hours	801.70	69.86			
	Carbonated at at 700°C for 4 hours	71.19	6.20			
Atrazine	-	-	93.8	1440	-	[4]
Ametryne			95.2			

CONCLUSION:

This paper presents the physicochemical properties of BP in detail with the aim to get an in-depth understanding of BP and its possible reutilization as an adsorbent. The surface pH and pH_{pzc} of BP recommends that BP contain more number of basic groups. The BET surface area of BP is low, but its surface is uneven and lumpy with some pores. The results from FTIR confirm the presence of different functional groups such as amines, amino acids, phenol, carboxylic acid, alkanes, alcohol, and aromatic alkyl halide in BP. This physicochemical characterization enables the reutilization of FVP as a low-cost adsorbent.

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