Characterization of *Tridax Procumbens* as adsorbent

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***Abstract*-Purification techniques are used to reduce or remove the amount of toxic pollutants found in waste water. Adsorption process is considered to be most suitable and widely used techniques because of its simple operation and availability of wide range of efficient and economical adsorbents. In present study undertake, the characterization of Tridax Procumbens as adsorption is investigated. Hydrochloric acid solution is used to study the adsorption process of Tridax Procumbens towards it using Fourier Transform Infrared Spectroscopy (FTIR) and Elemental Analyser. A low-cost adsorbent was prepared from the stems, leaves and flowers of widespread weed Tridax Procumbens. Adsorption was carried out for 24 hours before being analyzed. From the result, it reveals that Tridax Procumbens is excellent adsorbent towards Hydrochloric acid.**

***Keywords*-Tridax Procumbens, adsorption, Hydrochloric acid, characteristics**

I. INTRODUCTION

The presence of heavy metals in the environment causes adverse impacts on flora and fauna on the earth. Trough many metallic elements are essential for nutritional and physiological requirements in living organisms, their overabundance can cause toxicity, symptoms or even death [7]. Several purification techniques are used to reduce or remove the amount of toxic pollutants found in waste water. Numerous approaches have been studied for the development of more effective methods in removing metal pollution. Conventional methods for heavy metal removal, including reverse osmosis, electrodialysis and ionic exchange are frequently expensive when applied for removal of metal ions in low concentrations. Efficient methods with acceptable costs are necessary to reduce the concentration of heavy metals in the environment to acceptable levels [6].

Therefore, efficient tool to remove metal pollution from industrial effluents is adsorption by low cost adsorbents which is simple and cost effective. adsorption process is one of the safest, easiest, and more cost-effective methods for heavy metal removal from industrial effluents [8]. Besides, this process is already established as a simple operation and an easy-handling process [9]. Furthermore, adsorption process is considered to be most suitable and is found to be more practicable over other techniques as well as widely used technique because of its simple operation and availability of wide range of efficient and economical adsorbents. In addition, adsorption is a wastewater purification technique for removing a wide range of compounds from industrial wastewater. Adsorption takes place when molecules in a liquid bind themselves to the surface of a solid substance. The term 'adsorption' refers as a mass transfer process by which a substance is transferred from the liquid phase to the surface of a solid and becomes bound by physical and/or chemical interactions [1].

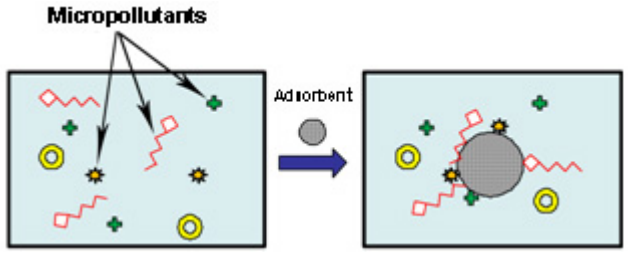

Fig. 1: Adsorption process

Adsorbent define as material that has the ability to extract certain substances from gases, liquids, or solids by causing them to adhere to its surface without changing the physical properties of the adsorbent. Adsorbents have a very high internal surface area that permits adsorption. Available adsorbents used in industry usually are Activated Carbon, Natural Clay Mineral, Silica gel and *Tridax Procumbens*. However, *Tridax Procumbens* will be used in this research project to study the characterization in waste water treatment process since it is less cost needed,.easily to get, which is over abundance and plants can flower and produce fruit all year around. In the current study undertake, the characterization of *Tridax Procumbens* as adsorption is investigated. Hydrochloric acid solution is used to study the adsorption process of *Tridax Procumbens* towards it.

In the recent past, much research interest is being devoted to evoke adsorption potentialities of the waste materials of flora and fauna origin either in their native state or chemically modified form in controlling the hazardous polluting ions in waste waters. These methods are proving to be potential alternatives to the classical and traditional methods of pollution prevention and are stimulating continuous and expanding research in this field [4]. From the Journal of ChemTech Research, *"Leaves and Barks of Some Plants as Bio-Adsorbents in the Control of Methylene Blue Dye from Waste Waters",* leaves and barks of *Tridax Procumbens* plant have been examined for their adsorption abilities towards Methylene Blue using simulated polluted waters. In this present study, the acid treatment on *Tridax Procumbens* leaves, flowers and stems is investigated. The objectives was to study the characteristics of *Tridax Procumbens* with the treatment of hydrochloric acid using Elemental Analyzer and Fourier Transform Infrared Spectroscopy (FTIR).

Tridax procumbens (Fig. 2) is a species of widespread weed flowering plant in the daisy family and is best known as a pest plant. It is able to adapt and grows in tropical, subtropical and mild temperate regions worldwide. Moreover, it possesses medicinal uses especially for diabetic treatment. In the present communication, the studies on the removal of Ni(II) and Hg(II) from synthetic waste water using activated biocarbon derived from *Tridax Procumbens* was reported. *Tridax procumbens* is responsible to form activated biocarbon used for adsorption since it has great percentage of carbon. Activated biocarbon prepared from Tridax procumbens leaves usually are used to remove toxic heavy metals and dyes from industrial waste water [5].

Fig. 2: *Tridax Procumbens*

The pollution of water surface and underground water sources usually are lead from emission of heavy metals into the environment caused by the mining operation [2]. However, source of heavy metals that penetrate into the water system can derived from natural and anthropogenic. Table 1.0 summarizes the variety of sources of heavy metal that exist in the environment [3] and the limits on the types and the concentration of heavy metals that may be present in the discharged wastewater can be referred to the Maximum Contaminant Level (MCL) Standards established by the [1].

Table 1: Various sources of metal in environment

Heavy Metal	Sources	Toxicities
Arsenic	Pesticides, fungicides.	Skin manifestation, vascular disease.
Cadmium	Welding, electroplating.	Kidney damage, renal disorder.
Zinc	Refineries, brass manufacture.	Depression, increased thirst.
Lead	Paint, pesticide, smoking.	fetal brain, kidneys diseases.
Mercury	batteries, paper industry.	Rheumatoid arthritis, Kidneys diseases.

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II. METHODOLOGY

A. Materials

The plant *Tridax Procumbens* was collected at around UiTM Shah Alam and cleaned with distilled water. Stem, flower and leave parts of the plant were grind and blended into ash powder, dried in under sunlight until the water content evaporated. Further it is dried in hot air oven at 40ºC for 2 hours. The dried materials were used for the treatment with hydrochloric acid solution.

B. Experimental Design

3.5 grams of *Tridax Procumbens* ash powder was weighed and put in 50 mL of hydrochloric acid solution. It is kept for 24 hours to let the adsorption process to occur. After 24 hours passed by, the ash powder with hydrochloric acid were filtered with filter paper. The filtered ash powder after treatment with hydrochloric acid was let to dry before being examined under FTIR and elemental analyzer. FTIR and elemental analyzer spectrum were recorded and the data obtained is analysed.

III. RESULTS AND DISCUSSIONS

FTIR: The FTIR spectrum of *Tridax Procumbens* ash powder is shown in Fig. 3, while Fig. 4 shows FTIR spectrum of *Tridax Procumbens* after treatment with HCl. It can be seen that after treatment with HCl, the spectra obtained more sharpen and produce more peaks.

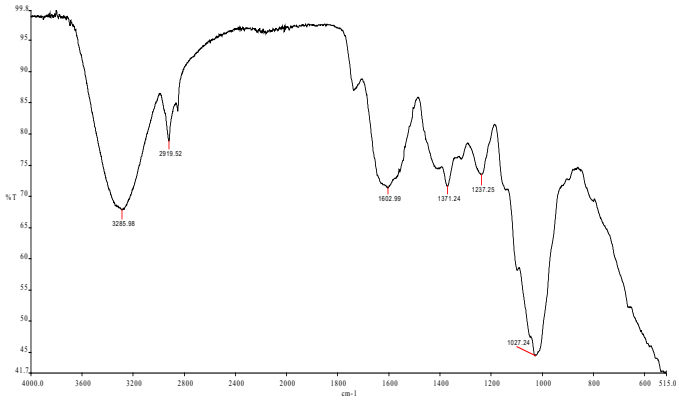

Fig. 3: FTIR spectrum of *Tridax Procumbens*

Table 2: Type of bond presented in *Tridax Procumbens*

FTIR spectrum result (cm^{-1})	*Type of bond*	*Wavenumber (cm^{-1})*	*Intensity*
3285	*C – H*	*3300 – 2700*	*Medium*
	N – H	*3500 – 3300*	*Medium, strong*
2919.52	*C – H*	*3300 – 2700*	*Medium*
1602.99	*C = N*	*1650 – 1550*	*Medium*
	C = C	*1680 – 1600*	*Medium*
1237.25	*C – O*	*1250 – 1050*	*Strong*
1027.24	*C – N*	*1230 – 1020*	*Medium*

The FTIR spectra of *Tridax Procumbens* shows peaks in the regions of 2700 cm^{-1} – 3500 cm^{-1}, 1550 cm^{-1} – 1680 cm^{-1} and 1020 cm^{-1} – 1250 cm^{-1}. The peaks at 2700 cm^{-1} – 3300 cm^{-1} indicated the presence of (C-H) alkane. However, at peak 1050 cm^{-1} – 1250 cm^{-1}, characteristic band of oxygen bonded C-O group that due to the adsorbent properties for the negative charge at oxygen element for the adsorption process in the treatment with HCl, which to attract the negative charge element. To compare with the spectra obtained in Fig. 4., more elements were present where more bonds produced due to the reaction occurred [10].

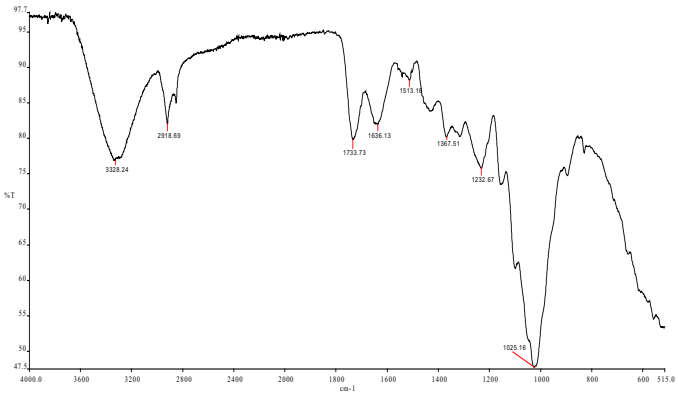

Fig. 4: FTIR spectrum of *Tridax Procumbens* after treatment with HCl

Table 3: Type of bond presented in *Tridax Procumbens* after treatment with HCl

FTIR spectrum result (cm^{-1})	Type of bond	Wavenumber (cm^{-1})	Intensity
3328.24	N – H	3500 – 3300	Medium, strong
	O – H (alcohol)	3650 – 3200	Strong, broad
2918.69	C – H	3300 – 2700	Medium
	O – H (carboxylic acid)	3300 – 2500	Strong, very broad
1733.73	C = O	1780 – 1650	Strong
1636.13	C = N	1650 – 1550	Medium
1232.67	C – O	1250 – 1050	Strong
1025.16	C – N	1230 – 1020	Medium

the broad band at 3328 cm^{-1} is a characteristic of the stretching vibration of hydrogen bonded hydroxyl groups of an adsorbent. The band at 2918.69 cm^{-1} refers to the presence of an aliphatic C-H stretching. The spectrum shows a pronounced band at 1733.73 cm^{-1}, that can be assigned to the C=O stretching vibration in the structure of the activated carbon. The band at 1250 cm^{-1} to 1050 cm^{-1} is usually found with oxidized carbons and has been assigned to C-O stretching in hydrochloric acid. The FTIR spectroscopy result indicates that the prepared adsorbent with active carbon is rich in surface functional groups. Peaks in the region of wave numbers 1025.16 cm^{-1} could be attributed to N-containing bioligands.

Elemental Analyzer: Elemental Analyser setup uses dynamic flash combustion to analyse the following elements with an accuracy of 0.3% absolute: carbon, hydrogen and nitrogen (default) and, if requested, sulphur. Elemental analysis is an experiment that determines the amount (typically a percent mass) of an element in a compound. This type of analysis is especially useful for organic compounds (compounds containing carbon-carbon bonds). Fig. 7 will show clearly the percentage trend on elemental analyzer spectrum obtained before and after *Tridax Procumbens* been treated with hydrochloric acid. The comparison was analysed from Fig. 5 and Fig. 6. It adsorbs H, C and N when it is exist as divalent cation [10].

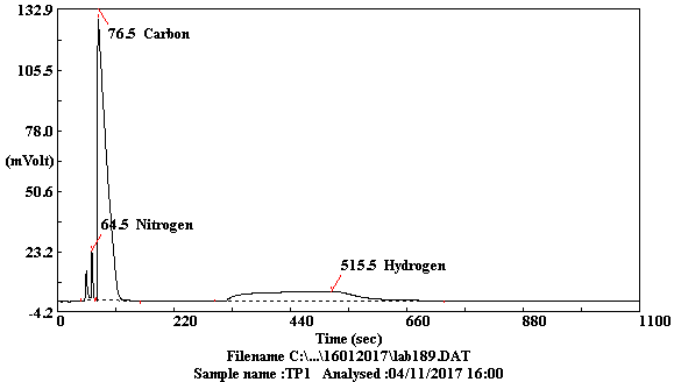

Fig. 5: Elemental Analyzer spectrum of *Tridax Procumbens*

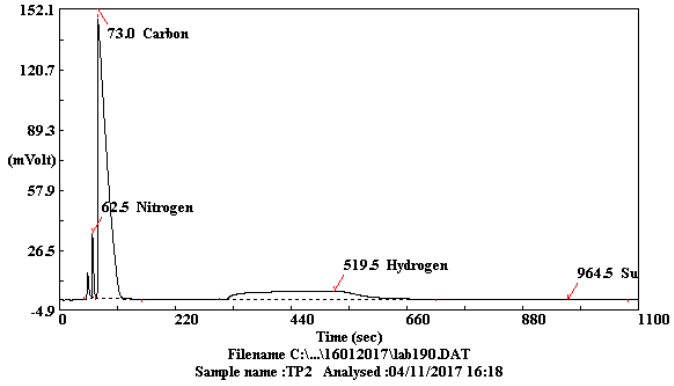

Fig. 6: Elemental analyzer spectrum of *Tridax Procumbens* after treatment with HCl

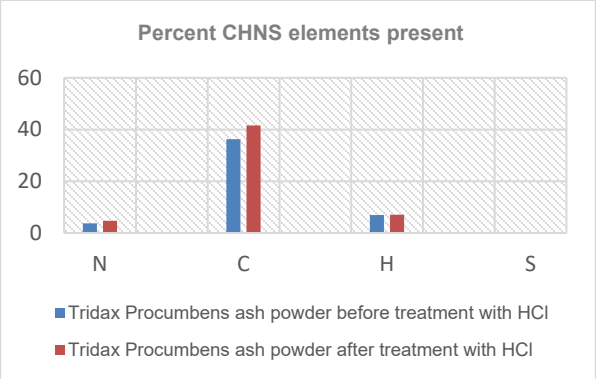

Fig. 7: Comparison before and after treatment with HCl

The analysis can be made that after adsorption of HCl towards adsorbent, the percentage of nitrogen, carbon and hydrogen elements increased but not too much for hydrogen. However, Sulphur element percentage still not present even before or after the treatment with HCl.

IV. CONCLUSION

The characterization of *Tridax Procumbens* as adsorbent by using FTIR and elemental analyzer was studied according to experimental conducted. Based on the results, the following conclusions can be drawn. Carbon element is an efficient for adsorption process. In the current study, activated carbon was prepared from *Tridax procumbens* by adsorption method using HCl. No impurity peaks were observed other than carbon in the FTIR spectrum. Besides, only carbon, hydrogen and nitrogen element present in elemental analyzer analysis. There is no sulphur content.

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