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THE USE OF CARBONIZATION TO REDUCE OF MERCURY IN THE AQUATIC ECOSYSTEM (MARTYR MONUMENT) BAGHDAD

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Abstract

Samples were collected from the Martyr Monument near the city land Sinbad in Baghdad city to follow element Hg by activated carbon technology of *Typha domingensis* plant to reduce Hg concentration. Work included access to geographical data during November 2018 and the selection samples "Water from Pond, water well and *Typha domingensis*. A statistically significant relationship was achieved in increasing concentrations with proximity and distance from source of pollution depending on plant and location, Especially in the location near the Sindbad land and the location near the well, which is the source of water for the pond at the present time, where it was found that there is an increase in concentrations in this sites. A good environmental was found to focus mercury in the environment of the ecosystems in this region as an important of evaluating the biological elements and their relationship to activated carbon as a natural processor depending on the high surface area and porosity formed during carbonate conditions that affect the development of porous structures, results showed the water well have a superior percentage of ability to accumulate ions mercury. Results of activate carbon carbonization gave the highest efficiency to provides greater activity and normally indicates better quality activated carbon to improve the filtration rate by natural purification of elements, results showed Hg and a activated carbon before (25.33, 17.43, 7.92) ppm in respectively after (12.45, 0.11, 0.01) Ash ppm respectively (water well, water pond, *Typha domingensis* plant).

Key words: Martyr Monument Pond, Mercury (Hg), Carbonization, *Typha domingensis*.

Introduction

Mercury is considered a highly toxic nonessential element that negatively influences all wildlife due to its ability to access long distance from the source of pollution by the atmospheric transport (Grandjean, *et al.,* 2010). Mercury exists in an environment as a three main chemicals form 'Elemental Mercury (Hg^0), Inorganic mercury (Hg^+) and mercury salts (Hg^{+2}). The primary risk of mercury exposure in terrestrial, vertebrates including humans, agricultural products, industrial and military activities have led to widespread contamination of the environment (Alexander, 1999 and Doty, 2008). Human activity is a primary source of Hg contamination and with drastic health consequences resulting from its uptake through the food chain. It has been documented that zinc smelting plants result in some of the greatest anthropogenic contributors to Hg emission (Nriagu and Pacyna, 1988) with Hg concentrations in zinc varying between 0.1 and 0.3 ppm being released into top soil and downstream processes through mining activities (Mukherjee, *et al.,* 2000). The mechanism mercury is not fully to understand due to the rate of mercury methylation is believed to depend on many environmental factors (Choi, *et al.,* 1994 and Jackson, 1998), environmental chemists have investigated the mechanism of Hg generation and its occurrence in the environment for several decades such as (Jackson, 1998 and Hintelmann, *et al.,* 2000), and the persistent and highly toxic form of Hg, is assimilated by living organisms by food intake bioaccumulates in individuals and biomagnifies within food webs from lower to higher trophic levels (Avramescu, *et al.,* 2011). Water pollution by metals in some area is practically inevitable due to natural process (Weathering of rocks) and anthropogenic activities such as industrial, agricultural and domestic effluents,

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Pic. 1: The Martyr's Monument. Archnet org, 2005.

increasing human activities enter huge amounts of pollutants into the aquatic ecosystems (Abdel-Baki, *et al.,* 2011). But the elements magnification and accumulation in the environment are highly important, growing population, urbanization, industrialization and a growth in agricultural activity further complicates the problem (Giguere, *et al.,* 2004 and Gupta, *et al.,* 2009). Because trace metals do not degrade in water, they deposit into the sediments or incorporated in organisms and particles exist in the water column (Linnik and Zubenko, 2000) and cause water pollution (Malik, *et al.,* 2010). Mercury affects the living organisms such as aquatic plants, bacteria, fish and invertebrates, aquatic plants are sensitive to mercury at the low level (1mg/L) due to the ability of mercury to accumulate in tissues of plants and transport it by aquatic Food web (Choy, *et al.,* 2010). Once deposited in aquatic ecosystems, inorganic Hg is subject to biotic reaction (methylation) carried out by microorganisms (Fitzgerald, *et al.,* 2007). Mercury methylation in the marine environment may be attributed to both biotic and a biotic processes (Cossa, *et al.,* 2009).

Monument is located in al Rusafa side of Baghdad on the East side of the Tigris river near the Army Canal which separates Al-Sadr city from the rest of Baghdad, is considered a flat aqueous industrial. Which was established in 1983 and was designed by Iraqi architect Saman Asaad Kamal and the dome designed by Iraqi artist Ismail Fattah al-Turk and symbolizes martyr's sacrifice for his country.

The Martyr Monument has 4 ponds located at latitude 33.3386 and longitude: 44.3939 (Jafar, 2013 and Google earth, 2014). Imagery shows the Martyr's Monument (Pic 1) shows that the pool surrounds the monument with a small distance to the south and a large distance to the north, bordered by Palestine Street to the west and the City of Games and the Army Channel in the east. The approximate area of the entire pool about 10 km^2. The approximate depth of the pond is about 3 meters. The pond is designed to beautify the site of the martyr's Monument. Artificial water in which the pump is pumped, are given Water to the pond through a tube diameter (30 cm). According to the maps of the municipality of Al Ghadir, the water is supplied by the raw water network that flows from the main network (Zayouna area, Route 24), originally from Abu Nwaas pumping station. The pond currently seems to have an input of water because of the drying and maintenance works of the army channel, which makes the pond in its current state a closed pond (a closed environmental system).

Activated carbon used widely for this purpose due to the large surface an area available for the adsorption and chemical reactions because a high internal surface area and porosity formed during carbonization conditions influenced the development of pore structures (Sricharoenchaikal, *et al.,* 2007). Different materials characterized by their extraordinary large surface areas and developed porosity, surface oxygen functional groups easily introduced to the activated carbon by different methods including dry and wet oxidizing agents. Dry oxidation involves a reaction with hot oxidizing CO_2 at temperatures about 600^0C, A primary source is from the organic material with high carbon content such as wood, peat, shells, plants. But activated carbon can granular produced by grinding adding a suitable binder to give it the hardness recomposing and crushing to the correct size. This method can apply in more areas such as water purification, wastewater treatment, discoloration, removal of toxic organics, groundwater remediation, and elements ions (Rahmani, *et al.,* 2009) there has been an increasing interest in the production of activated carbon from agricultural by-products and industrial waste (Rahman *et al.*, 2006), many studied concern to use this method to treatment of pollution such as cocoa pod husk (Sricharoenchaikal *et al.*, 2007), periwinkle shell (Atuyor and Badmus, 2008), walnut shell, peach stone, physic nut waste, coconut shells, palm kernel shells, and bamboo stem wastes (El-Sheikh, *et al.,* 2003 and Razada, *et al.,* 2005). Others include olive stone, sugarcane bagasse, pecan shells, palm seed, apple pulp (Kenneth, *et al.,* 2002), rubber seeds, and molasses, resins, and dried sewage sludge paper mill sludge, old newspapers (Ahmedna, *et al.,* 1997 and Puziy, *et al.,* 2002), and waste tires (Thomas and Thomas, 1997).

Natural purification of water in liquid form depends on chemical absorption and adsorption by soil particles and organic matter, living organism uptake of nutrients, and living organism decomposition processes in soil and water environments. Heavy metal initial concentration is apparently affecting the biosorption process (Ho, *et al.,* 1999). It seems to be crucial for identifying the maximum saturation potential of the biosorbent materials that the work should be conducted at the higher concentrations of heavy metals in aqueous solution (Qaiser, *et al*., 2009 and Witek-Krowiak, *et al.,* 2011). Activated carbon is obtained through the controlled burning with a low level of oxygen of porous materials such as corn cobs, wood, coconut husks and rice husks due to its negative characteristics, resistance to degradation, the great volume occupied, low nutritive properties and high level of ash (Harmina, *et al*., 1997). This research used easy innovative treatment techniques and focused attention on the use of biological materials for active carbon of a plant *Typha domingensis* to reduce Mercury (Hg) and try to remove and recovery due to good performance and low cost of this completing element and used a filtration material before and after carbonization.

Materials and Method

Description and samples collection of the study area

In Martyr Monument two basic stations were chosen of water pond nearby land Sindbad and one sample a nearby to the water well (current source of feeding pond) and basic species of aquatic plants were chosen *Typha domingensis* (Class: Angiosperm, Family: Typhaceae) (Linnaeus, 1758). *Typha domingensis* were collected in same sites were collected water. first step was cleaned put in polyethylene bags then rinsed thoroughly with deionized water and dried in the outdoor in room temperature for (3-5) days and grind well with a ceramic mortar and use a manual sieve 2 mm to get rid of impurities and be ready before analysis, second part in same sites It was burned in 600 until it became ash.

The water samples were collected from two sites (water pond, water well) the surface water (about 30 cm below the surface) in each community, using 48 litter containers. Water samples (sub-surface) were collected by means of a Van Dorn water sampler and then immediately filtered through 0.45µ Millipore filters. The filtrates were placed in glass containers and were divided into two parts for pre-treatment and post-treatment. Standard methods by (Pearson and Havill, 1988). (24 before and 24 after) one sample three replicate total water 48.

Carbonization preparation

After washed plants with distilled water to remove dirt, dust and impurities from the surfaces from leaflets in 15 minutes in 60^0C with burning and high temperature. The resulting black mixture was left to cool and then used an investigation (Gimba, *et al.,* 2001).

2.3: Laboratory Analysis

Mechanical working of Milestone's Direct Mercury Analyzer (DMA-80):

Directly analysis to any sample solid or liquid at the same time without need to preparation of sample liquid or solid sampleinto metal boat or quartz and then transfer sample from DMA-80 to the analytical balance need five minutes for one sample, no need acid digestion. The sample boats loaded on to instrument auto sampler, first dried then thermally decomposed in furnace oxygen. Mercury and combustion products released from the sample and carried to the catalyst section furnace, where sulfur oxides and nitrogen. Mercury (Hg) is flown by the transfer or gas into path of the spectrophotometer where it is quantitatively measured. All systems of information a kept on a Windows-based computer and software, providing simple and intuitive, Sample parameters including method profile, furnace temperatures, absorbance signals. The results and calibrations are saved; information is easily transferred by using a USB memory to Laptop Laboratory (USEPA, 2006).

Method validation wa**s** used as certificate reference material CRM as in Table 2-3 (Gaithersburg, MD, USA, 2013) was utilized to assess the accuracy of the method. Developed spike recoveries were performed on this material as well as samples according to Ataro *et al*., (2008) and Nascimento *et al*., (2008). This principle was used for all sample analysis. This typically contains an automatic sampler, quartz furnace, cobalt-manganese oxide catalyst, gold-coated sand amalgamator and an

Table 1: Method validation was used as certificate reference material CRM.

Wavelength	Step	Time	CRM and SRM	Type
Gas Flow (L min-1)	150	12 min	IAEA-140TM	Plants
Nebulizer 0.8	100	10 min	0	blank
Replicates 5	175-200	One time to each	SRM-1974b	water
Replicate 5	1-5	15 min	CRM 202	Activated carbon
Probe in sample (n)	100	10	0	blank

atomic absorption detection cell with three different path lengths (120,165 and 4mm). The method for solid sample analysis consists of placing a known amount of milled sample in a nickel or quartz boat (Sample holder). The sample is introduced in the quartz furnace, where it is heated up to 200°C (drying temperature) for 600-1000 C, Maximum temperature allowed by the software of equipment about 105 which set a limit mercury volatilization and reduction of Oxygen O_2 (99.99%) (CEM Corporation, Matthews, NC and USA, 2013).

Statistical method

The analysis of variance (ANOVA) using a complete randomized design (CRD) was employed to test the differences between the eight date palm residues and A. tortillas in all the measured properties using the SAS statistical package Cox (2006). Least significant difference at 5% level of probability (LSD 0.05) used to detect the differences among the means of all the measured properties. Correlation analysis was carried out to find out the relationship between the heating value and each of the chemical constituents and ultimate and proximate analysis of the date palm residues (Cox, 2006).

Results and Discussion

Results showed the presence of Mercury concentration in water samples and plants but differ from one to other depending on the ability to absorb this element that means used it as a positive indicator of pollution in study areas in this area. Through statistical analysis scored a significance between element in water pond and water well and plant in a percentage of the corresponding (36%, 29 %, 17%), respectively, this is consistent with some of the researchers Mercury for plants *Ceratophyllum demersum* between (2.01–8.3 ppm) in Ajmi and zeki, (2015). Also in local studied Ati (2017) found Hg in *Phragmites australis* between (2.3-1.9 ppm). The concentration of elements varies from station, especially near well and second site because it is the closest to the 'Sindibad land 'which is frequented by people on holidays and occasions, in which diesel generators are produced, through which the dust can transfer as it is deposited on the surface of the nearby, Figures as following show different concentrations relative in plants to the five sites. From table (3-2) showed the values can be observed P value < 0.05 a significant relationship was achieved in increasing concentrations with proximity and distance from source of pollution.

Statistical analyses were used to evaluate Mercury which variables correlated in plant and estimate with water as amenability that a an important environmental pollution in the region. It is the plant play an important role in circulating nutrients and trace metals in aquatic ecosystems (Pip and Stepaniuk, 1992). They spread all over the world, and due to their high capacity in uptake of nutrients and other pollutants from water are proper for wastewater treatment, and can reduce pollution loadings in the aquatic environment. Uptake of inorganic complexes by aquatic plants is because of their higher surface area compared to their volume and high membrane sorption and permanent contacts to solutions in media. This plant can be applied for monitoring of pollutants and the investigation of ecosystem quality of water bodies (Brankovic, *et al.,* 2010), and found to be biomonitoring of the environment and can be applied as a bioindicator in ecosystems (Bonanno and Lo Guidice, 2009), and is suitable for wastewater and landfill discharge treatment (Prevely, *et al.,* 1995). Considering the growth rate and biomass and the growth season for each of them, it is suggested to apply both of these in a constructed wetland for better treatment of pollution. Perhaps the answers to the most of our industrialized world's problems can be found somewhere in nature. Water as a good indicator of Mercury contamination, which can store large amounts of this metal as interactions with the plant, an important factor for a cleaner environment and be a site of its many conversions (Ajmi, 2015). According to present experimental results, this concentration was positive regarding in the biogenic metals.

Table 2: The concentration of mercury with values standard deviation.

Factors *domingensis*	Hg *Typha* pond	Hg water	Hg water well
Max.- Min	3.06-0.04	3.12-1.93	5.92-1.44
Mean	2.03	2.65	3.39
SD	0.938	0.822	0.921
LSD	0.141	0.199	0.21
P < 0.05	0.003	0.029	0.031

LSD: Least significant difference, SD: Standard Deviation

Results gave the highest efficiency to provides greater activity and normally indicates better quality activated carbon to improve the filtration rate by natural purification of elements, results showed mean a carbon in Table 3 (Hg) after treatment ash (0.03, 1.65, 2.39) ppm Respectively plant, water pond, water well, the ratio of removal of these elements by carbonization depending on the efficiency of the factor selected in the study Table 3 showed concentration Mercury after carbonization. Ash content of carbon is the residue that remains when the carbonaceous portion where the ash content increases with absorption to a peak of 88% and sharply decreased to 25% (Gumus and Okpeku, 2015), This corresponds to the results of the current study as it was found that the removal rate exceeded 91% for the *Typha domingensis* ash with other factors variables. The porosity developed in the activated carbon is due to the impregnation of the doping agents (Lee and Lim, 2003 and Zang, *et al.,* 2005), this is because the chemical reactions caused by hydrolysis of the doping agents weaken the structure of the carbonized shell and release volatile matter which is responsible for adsorption and the porosity of capacity of the carbon, all samples achieved the lowest proportion of elements after treatment. that's maybe due to chemistry of carbonization is immensely complex, it involves too many chemical reactions, some occurring simultaneously with the necessity of minimizing the emissions of CO_2, is a favorable point for the use of biomass since when this is burned, CO_2 is released into the atmosphere (Suzuki, *et al.,* 2006 and Yue, *et al.,* 2006), the plants absorption gas CO_2 during their photosynthesis. Test of equality of variance showed equal variance (p>0.05).

Table 3: The concentration of mercury after treatment with activated carbon plant.

Factors *domingensis*	Ash Hg *Typha* pond	Hg water	Hg water well
Max.- Min	0.06-0.01	1.12-1.93	1.92-1.94
Mean	0.03	1.65	2.39
SD	0.03	0.22	0.21
LSD	0.04	0.19	0.11
P<0.05	0.001	0.02	0.01

Conclusions

According to our results, it will not be possible to know in detail of carbonization an attempt has been made in this work to study depending on the minimum and optimum carbonization temperature and time. For economic reasons and to avoid further pollution of the environment with the used adsorbent different plant. Regeneration study was carried out on both the prepared natural it was found out that the adsorbent could be actually be regenerated refresh environmental factor without any chemical interaction. The chemistry of carbonization is immensely complex, it involves too many chemical reactions, some occurring simultaneously. The environmental question, with the necessity of minimizing the global emissions of CO_2, is a favorable point for the use of biomass, since when this is burned, CO_2 is released into the atmosphere; however, the plants absorb this gas during their photosynthesis.

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