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Processed Waste To Process Waste

[I]Manasi V. Ghamande, [II]Sacchidanand S. Gogawale, [III]Dr. Sanjeevani Gogawale
[I,II]Dept. of Engineering Sciences and Humanities, VIT, SP Pune, University, India
[III]Management consultant, Zen International systems, India

Abstract
This paper describes method for developing a simple, modular, cost effective, environment friendly innovative gadget for removing heavy metal ions, foul smell and color, from the effluents of industrial waste and /or domestic waste / groundwater by treating it, using activated carbon. The simple method to develop activated carbon is also experimented and evolved fusing a Samuchit envirotech char coal unit suitably modified. Now the controlled conversion of dry wood/ leaves, to activated carbon, without producing CO_2*, for salvaging garden waste, is also achieved. The garden waste is a nuisance and if burnt creates air pollution. This garden waste could not be salvaged simply by composting and/ using it as manure so effectively, creating health and environment hazards. The other by products developed in controlled conversion of garden waste to activated carbon are charcoal, manure, and Agarbatti raw material, which have its own application. In short the project is a product for Garbage to gold conversion; it uses activated carbon for removing effluents from industrial waste and groundwater by treating it for recycling. In brief it uses processed waste to process waste, or it can be considered as garbage to gold converter. The contamination and related treatment and results are further processed in Cloud so can be accessed from any where to plot the trends for further improvements, using computer and IT support.*

Keywords
Activated carbon, cost effective devise, Garbage, modular, Water treatment, cloud technology

I. Introduction
The water treatment is being important day by day because of the water sources are getting contaminated, of let with increasing misuse and contamination due to garbage other wastage being drained in drinking water sources. Water being one of the prime important needs, the water treatment is equally important. For a common man the drinking water purification options like Use of RO, Demineralization, ozonisation or UV treatment is difficult. For day today use the biological hazards are taken care of by Boiling, the physical hazards and chemical hazards are still a concern. The simple cost effective solution for water treatment that can be used for day to day application, also for households, yet a cost effective that everyone can afford was to be developed in a group.
We the team members have gone through the various literatures published on water treatment, and participated in SMART city drive initiative, to get a clue of Use of activated carbon was found. With our guide we worked the details for assembly and testing. We interacted with various NABL approved laboratories to confirm the gadget we would make can be validated through them for the before and after results to prove the treatment efficiency.

II. Concept
The plating, in small scale is a cottage industry similar to Plating of Brass utensils, called Kalhee. The metals used for plating are drained out left in soil, that gets absorbed during rain in ground sources , or as the process is simple, and user may not be even aware of the negative impacts and small scale may not call for having environmental approvals and controls . Such unaware contribution may cause ground water source contamination, some of the Industrial effluent treatment is also not equipped for heavy metal treatments so treated/ untreated waste may have heavy metal contaminants, which is a serious health hazard and needs attention.
Similarly the battery charging waste water, are also drained. The Ni, Cd, Pb are the heavy metals are having extreme negative impacts on human health and environments so some method to purify the same is essential.

III. Theory
Activated carbon, also called activated charcoal, activated coal, carbo activatus or an “AC filter”, is a form of carbon processed to have. small, low-volume pores that increase the surface area available for adsorption or chemical reactions . *Activated is sometimes substituted* with *active.* Due to its high degree of micro porosity, just one gram of activated carbon has a surface area in excess of 500 m2, as determined by gas adsorption. An activation level sufficient for useful application may be attained solely from high surface area; however, further chemical treatment often enhances adsorption properties. Activated carbon is usually derived from charcoal and, increasingly, high-porosity bio char. Activated carbon is used in gas purification, decaffeination, gold purification , metal extraction, water purification, medicine, sewage treatment, air filters in gas masks and respirators, filters in compressed air, and many other applications. One major industrial application involves use of activated carbon in the metal finishing field. It is very widely employed for purification of electroplating solutions. For example, it is a main purification technique for removing organic impurities from bright nickel plating solutions. A variety of organic chemicals are added to plating solutions for improving their deposit qualities and for enhancing properties like brightness, smoothness, ductility, etc. Due to passage of direct current and electrolyticlution, their excessive build up can adversely affect the plating quality and physical properties of deposited metal. Activated carbon treatment removes such impurities and restores plating performance to the desired level. In 2007, UGent (Ghent University, Belgium) began research in water treatment after festivals. A full scale activated carbon installation was built at the Dranouter music festival in 2008, with plans to utilize the technology to treat water at this festival for the next 20 years. Activated carbon is also used for the measurement of radon concentration in air. Activated carbon is used to treat poisonings and overdoses following oral ingestion. It is not effective for a number of poisonings including strong acids or alkali, cyanide, iron, lithium, arsenic, methanol, ethanol or ethylene glycol. Tablets or capsules of activated carbon are used in many countries as an over-the-counter drug to treat diarrhea, indigestion, and flatulence. Activated carbon is commonly used on the laboratory scale to

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purify solutions of organic molecules containing unwanted colour organic impurities .

IV. The factors affecting the adsorption

1. Iodine number

Many carbons preferentially adsorb small molecules. Iodine number is the most fundamental parameter used to characterize activated carbon performance. It is a measure of activity level (higher number indicates higher degree of activation), often reported in mg/g (typical range 500–1200 mg/g).

2. Apparent density

The solid or skeletal density of activated carbons will typically range between 2.0 and 2.1 g/cm3 (125–130lbs./cubic foot). However, a large part of an activated carbon sample will consist of air space between particles, and the actual or apparent density will therefore be lower, typically 0.4 to 0.5 g/cm3 (25–31 lbs./cubic foot). Higher density provides greater volume activity and normally indicates better-quality activated carbon

3. Dechlorination

Some carbons are evaluated based on the dechlorination half-life length, which measures the chlorine-removal efficiency of activated carbon. The dechlorination half value length is the depth of carbon required to reduce the chlorine level of a flowing stream from 5 ppm to 3.5 ppm. A lower half-value length indicates superior performance.

4. Molasses

Some carbons are more adept at adsorbing large molecules. Molasses number or molasses efficiency is a measure of the mesopore content of the activated carbon (greater than 20 Å, or larger than 2 nm) by adsorption of molasses from solution. A high molasses number indicates a high adsorption of big molecules (range 95–600). Caramel dp (decolorizing performance) is similar to molasses number. Molasses efficiency is reported as a percentage (range 40%–185%) and parallels molasses number (600 = 185%, 425 = 85%). The European molasses number (range 525–110) is inversely related to the North American molasses number. Molasses Number is a measure of the degree of decolorization of a standard molasses solution that has been diluted and standardized against standardized activated carbon. Due to the size of colour bodies, the molasses number represents the potential pore volume available for larger adsorbing species. As all of the pore volume may not be available for adsorption in a particular waste water application, and as some of the adsorbate may enter smaller pores, it is not a good measure of the worth of a particular activated carbon for a specific application. Frequently, this parameter is useful in evaluating a series of active carbons for their rates of adsorption. Given two active carbons with similar pore volumes for adsorption, the one having the higher molasses number will usually have larger feeder pores resulting in more efficient transfer of adsorbate into the adsorption space.

5. Hardness/abrasion number

It is a measure of the activated carbon's resistance to attrition. It is an important indicator of activated carbon to maintain its physical integrity and withstand frictional forces imposed by backwashing, etc. There are large differences in the hardness of activated carbons, depending on the raw material and activity level.

6. Ash content

Ash reduces the overall activity of activated carbon and it reduces the efficiency of reactivation. The metal oxides (Fe_2O_3) can leach out of activated carbon resulting in discoloration. Acid/water-soluble ash content is more significant than total ash content. Soluble ash content can be very important for aquarists, as ferric oxide can promote algal growths. A carbon with low soluble ash content should be used for marine, freshwater fish and reef tanks to avoid heavy metal poisoning and excess plant/algal growth.

7. Particle size distribution

The finer the particle size of an activated carbon, the better the access to the surface area and the faster the rate of adsorption kinetics. In vapour phase systems this needs to be considered against pressure drop, which will affect energy cost. Careful consideration of particle size distribution can provide significant operating benefits.

Typical process used for water treatment –

8. Demineralisation

Distillation removes all minerals from water, and the membrane methods of reverse osmosis and nano-filtration remove most of all minerals. These results in dematerialized water which is not considered ideal drinking water. The World Health Organization has investigated the health effects of dematerialized water since 1980. Experiments in humans found that dematerialized water increased diuresis and the elimination of electrolytes, with decreased blood serum potassium concentration. Magnesium, calcium, and other minerals in water can help to protect against nutritional deficiency. Dematerialized water may also increase the risk from toxic metals because it more readily leaches materials from piping like lead and cadmium, which is prevented by dissolved minerals such as calcium and magnesium. Low-mineral water has been implicated in specific cases of lead poisoning in infants, when lead from pipes leached at especially high rates into the water. Recommendations for magnesium have been put at a minimum of 10 mg/L with 20–30 mg/L optimum; for calcium a 20 mg/L minimum and a 40–80 mg/L optimum, and a total water hardness (adding magnesium and calcium) of 2 to 4 m mol/L

The water treatment is being important day by day because of the water sources are getting contaminated, by allowing hazardous waste to be drained with our any treatment due to lack of awareness or lack of method to treat it. Water also develop foul small and different colour and due to garbage other wastage being drained, uncontrolled that may contaminate in drinking water sources.

Water being one of the prime important needs, the water treatment is equally important. For a common man the drinking water purification options like Use of RO, Demineralization, ozonisation or UV treatment is difficult and not affordable.

For day today use the biological hazards are taken care of by Boiling, the physical hazards can be filtered out, but chemical hazards are still a concern.

So our team aimed to find out, a simple cost effective solution for water treatment that can be used for day to day application, also for households, which can also be re-generated and easily maintained and used. The team members have gone through the various literatures published on water treatment, and participated in SMART city drive initiative, and interacted with various experts and professionals along with the national and international conventions to develop the gadget, and we wish to further refine it and patent it.

V. Detail of Design

Activated carbon is carbon produced from carbonaceous source materials such as nutshells, coconut husk, peat, wood, coir, lignite, coal, and petroleum pitch. It can be produced by one of the following processes:

1. Physical reactivation

A. Carbonization

B. Activation/Oxidation

5.2. Chemical activation

The source material is developed into activated carbons using hot gases.

Air is then introduced to burn out the gasses, creating a graded, screened and de-dusted form of activated carbon. This is generally done by using one or a combination of the following processes

Physical reactivation

A. Carbonization - pyrolyzed at temperatures in the range 600–900 °C, usually in inert atmosphere

B. Activation/Oxidation -exposed to oxidizing atmospheres (oxygen or steam) at temperatures above 250 °C, usually in the temperature range of 600–1200 °C.

Chemical activation – With acid, strong base, or a salt, carbonized at 450–900 °C

We used activated carbon by controlled heating of Coconut shell, Husk, Orange peels, straws, dry grass, Coconut lining threads etc. in activating chamber in the range of 699-1200, using well designed burning –carbonizing chamber designed by Samuchit Enviro tech. The comparative study of all types is done. The Different powder gave different results. A detailed study for the various types and factors affecting the adsorption was carried out.

5.3 Powdered activated carbon (R 1, PAC) are made in particulate form as powders or fine granules less than 1.0 mm in size with an average diameter between 0.15 and 0.25mm. Activated carbon (R 1)is defined as the activated carbon particles retained on a 50-mesh sieve (0.297 mm).

5.4 Granulated carbons are used for water treatment, deodorization and separation of components of flow system and is also used in rapid mix basins.

5.5. Extruded activated carbon (EAC) - (PAC) with a binder, which are fused together and extruded into a cylindrical shaped activated carbon block with diameters from 0.8 to 130 mm.

5.6 Bead activated carbon is made from petroleum pitch and supplied in diameters from approximately 0.35 to 0.80mm. With low pressure drop, high mechanical strength, low dust content, with a smaller grain size.

5.7 Porous carbons containing several types of inorganic impregnate such as iodine, silver, cations such as Al, Mn, Zn, Fe, Li, and Ca have also been prepared for specific application. Due to its antimicrobial and antiseptic properties, silver loaded activated carbon is used as an adsorbent for purification of domestic water. Drinking water can be obtained from natural water by treating the natural water with a mixture of activated carbon and Al $(OH)_3$, a flocculating agent. Impregnated carbons are also used for the adsorption of Hydrogen Sulfide (H^2S) and thiols. Absorption rates for H^2S as high as 50% by weight have been reported.

5.8 Polymer coated carbon - is used for Hemoper-fusion

Important properties for selection - A gram of activated carbon can have a surface area in excess of 500 m2, with 1500 m2 being readily achievable.

Carbon aero gels, while more expensive, have even higher surface areas, and are used in special applications.

Under an electron microscope, the high surface-area structures of activated carbon are revealed. Individual particles are intensely convoluted and display various kinds of porosity; there may be many areas where flat surfaces of graphite-like material run parallel to each other, separated by only a few nano meters or so. These micro pores provide superb conditions for adsorption to occur, since adsorbing material can interact with many surfaces simultaneously.

Tests of adsorption behaviour are usually done with nitrogen gas at 77 K under high vacuum, but in everyday terms activated carbon is perfectly capable of producing the equivalent, by adsorption from its environment, liquid water from steam at 100 °C (212 °F) and a pressure of 1/10,000 of an atmosphere.

James Dewar, the scientist after whom the Dewar (vacuum flask) is named, spent much time studying activated carbon and published a paper regarding its adsorption capacity with regard to gases. In this paper, he discovered that cooling the carbon to liquid nitrogen temperatures allowed it to adsorb significant quantities of numerous air gases, among others, that could then be recollected by simply allowing the carbon to warm again and that coconut based carbon was superior for the effect. He uses oxygen as an example, wherein the activated carbon would typically adsorb the atmospheric concentration (21%) under standard conditions, but release over 80% oxygen if the carbon was first cooled to low temperatures. Physically, activated carbon binds materials by van der Waals force or London dispersion force. Activated carbon does not bind well to certain chemicals, including alcohols, diols, strong acids and bases, metals and most in organics, such as lithium, sodium, iron, lead, arsenic, fluorine, and boric acid. Activated carbon adsorbs iodine very well. The iodine capacity, mg/g, (ASTM D28 Standard Method test) may be used as an indication of total surface area.

Carbon monoxide is not well adsorbed by activated carbon. This should be of particular concern to those using the material in filters for respirators, fume hoods or other gas control systems as the gas is undetectable to the human senses, toxic to metabolism and neuro toxic. Substantial lists of the common industrial and agricultural gases adsorbed by activated carbon can be found online. Activated carbon can be used as a substrate for the application of various chemicals to improve the adsorptive capacity for some inorganic (and problematic organic) compounds such as hydrogen sulphide (H_2S), ammonia (NH_3), formaldehyde (HCOH), mercury (Hg) and radioactive iodine-131(131I). This property is known as chemisorption.

After study of all types we decided to study the effect of the carbon based filter using coconut husk derived activated carbon.

VI. Details of the material used

The simple filter of cotton,

Deposited with activated carbon,

Two Matka (earthen pots for water cooling) One of them with & one without tap, Water collection Pot,

Test equipments,

Water from Drainage,

$CrCl_2$,

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Lead,

VII. Details of Assembly

The first pot was put on second pot. The junction was separated with filter, so the water dripping from the first pot gets treated by filtering and adsorption and pure cool water is available for drinking.

The carbon at lab was used effectively to get it tested a flask & titration tubes were used, however, to convert it into a gadget that can be used by all was a problem.

We brain stormed on it and realized a drop by drop arrangement is also possible if we use simple Mataka , the separation of the two with a filter would be easily done if we use the cotton filter with carbon deposit .

When a modular cost effective simple construction was done, The second problem was to identify and device a simple modular, cost effective , domestic application, or a gadget that can be easily constructed and validated.

The testing for NABL approved lab and availability for Lead AS analysis was a problem. But with help of our guide and support from VSI, and Vipanan extending the support we could get our gadget validated.

VIII. Figures And Tables

8.1. Table showing the calculation of reduction after treatment

	Conc. Of Lead ion In ppm
BEFORE	8.207
AFTER	3.779
DIFFERENCE	4.428
% Reduction	4.428/8.207×100 = 54%
Result	54%

Table8.2 -The guidelines for drinking water

Parameter	World Health Organization	European Union
Chromium	50μg/l	50 μg/l
Lead	50μg/l	10 μg/l
Nickel	50μg/l	20 μg/l

Fig. 8.1 The time response

Fig.8. 2. The adsorption % display on ASM

Fig.8. 3 The de colorization photo

The photos clearly show the effective treatment done by the simple gadget.

IX. Conclusion

This simple devise will facilitate all specially villagers, cost effective simple treatment and also salvage the waste, which is otherwise a problem.

So the simple processing of waste would lead to process the waste, contaminants in water that are hazardous to health

X. Acknowledgements

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Author Profile

Mrs. Ghamande Manasi – M.Sc. Assistant Professor in Chemistry, with VIT, for past 25 years, currently, pursuing Ph.D. program in Chemistry at Nagpur University, Registration under process. Participated in various seminars, training, conferences and related research activities. Cambridge International Certificate for Teachers and Trainers. Written 3 books.

Mr. Sacchidanand S. Gogawale- cell 09421080334, Pune, India, Keen interest in Research and currently perusing B.Tech Instrumentation and control, Interested in Process design and improvement drives. He is associated in various drives with YUNGA and My DRR with UN. He has developed multiple simple gadgets for social support on critical issues like water, waste, environment, and technology. He has achieved multiple awards for improvement drives.

Dr. Sanjeevani – Cell – 9422522322, Expert Faculty in leading institutes like VAMNICOM, HNIMR, SIMCA, AIIESG etc. Management consultant and judge, with 30 years of International exposure and Pune University approved, Professor, Ph.D guide, and Director. She acts as judge in various panels for QIMPRO, VEDZEN and similar leading institutes.