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RIDDANCE OF AMMONIA AND PHOSPHATE FROM KELAVARAPALLI DAM BY ESP FLY ASH AS ABSORBENT USING ABSORPTION TECHNIQUE

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ABSTRACT

Water, an 'Elixir for life'. The quality of water is vital concern for mankind since it is directly linked with human welfare. Safe drinking water is essential to all living beings, even though it provides no caloric or nutrient values. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack accesses to adequate sanitation. A study on the contamination in Kelavarapalli dam (Krishnagiri district, Tamilnadu) water is discussed with the removal of ammonia and phosphate using Electrostatic precipitator (ESP) fly ash. The dam water contains excess amount of ammonia and phosphate leads to environmental components affecting aquatic and human life.

An attempt has made to remove the contaminants using Electrostatic precipitator fly ash, collected from Mettur Thermal Power plant using adsorption techniques. The removal of Nitrates, Phosphates and other nutrients yield promising results on the quality of water within the permissible limits of Indian Standards and WHO standards. The phosphate removal efficiency has increased to 100 % with an increase of detention period of one hour at 2000 mg use of ESP fly, for the initial concentration of phosphate level at 2.56 mg/l. Similarly the Ammonia removal efficiency has increased to 100% with an increase of detention period to three hour at 2000 mg use of ESP fly, for the initial concentration of Ammonia level is at 8.26 mg/l. Besides Phosphate and Ammonia, the water quality parameters were also compared between the raw water and the treated water using ESP Fly ash and found that the turbidity, TDS, pH, Total alkalinity, Total hardness, calcium, magnesium, iron, nitrite, nitrate, chlorine, fluoride, sodium, potassium and sulphate were well within the permissible limit to BIS and WHO standards.

Key words: Ammonia, Phosphate, ESP Fly ash, Water

INTRODUCTION

Water the elixir of life is vital for all living beings, which is nowadays become scares due to contamination at every stage of its usages as well on its runoff through various nature of soil course. Only 2.5% of the earth's water is fresh, and 98.8% of that water is in ice and groundwater. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack accesses to adequate sanitation. Hence, it is necessary to preserve and converse the water either the surface or ground water. Dams are the structures for storing the water during rainy season and utilizing them during the needy time, keeping the quality and quantity intact. However, a reservoir at Kelavarapalli (Krishnagiri district, Tamilnadu) constructed across Ponniar river, which originates from the eastern slopes of Chennakesava Hills, (Karnataka) is exempted by way of deteriorated in keeping the quality of water due to contamination of excess amount of phosphate and ammonia by eutrophication leads to degradation to environmental components affecting aquatic and human life.

Treatment of contaminated water of this nature has several methods viz., aerobic, anaerobic, ozonization, chemical treatment (using lime and liquid carbon-di-oxide process), UV light technique, root zone treatment, and so many other methods. However, no efficient method has so far been arrived on reliable basis. Several attempts by various research scholars were carried out national and international level for the removal of ammonia and nitrates using various techniques. Various studies to remove ammonia in water by adsorption methods have been carried out (AWWA, 1990; Azharet al., 2009; Azharet al., 2010a; Azharet al., 2010; Azharet al., 2011; Azharet al., 2004; Bohart and Adams, 1920; Celiket al., 2001; Ehretet al., 2001). Among the adsorbents for ammonia removal are clay and zeolite (Azharet al., 2011; Aziz et al., 2004; Bohart and Adams, 1920), limestone (Celiket al., 2001), carbon-zeolite composite (Ehretet al., 2001) and silica-carbon-calcium carbonate (Farrah and Preston, 1985).

In this research study, an attempt on treatment of the water of Kelavarapalli dam for the removal of excess ammonia and phosphate using ESP fly ash, a new alternative adsorbent with enhanced adsorption characteristics has been carried out experimentally using bench scale model and the following results were obtained, which shows the results are promising for the better removal efficiency of the pollutants as well the other water quality parameters well within the permissible limits for the BIS and WHO standards.

. The physico chemical analysis of dam water was done and the result is listed below:

Parameter	Appearance	Turbidity (NTU)	TDS	Elec. Conductivity	pH	Total Alkalinity	Total Hardness as $CaCo_3$	Ca	Mg
Raw water	Yellowish	5.6	760	1091	7.31	224	248	58	25
Permissible limits	Colourless	5.0	500	-	7-8.5		200	75	30

Fe	Free ammonia as NH_3	NO_2	NO_3	Cl	Fluoride	Phosphate	Na	K	SO_4
0.1	8.26	1.2	14	152	0.4	2.56	112	16	127
0.1	-	-	45	200	1.0	-	75		200

From the above table, it is clear that the dam water is contaminated with the excess presence of ammonia and phosphate. The sources and effects of ammonia and phosphate were discussed below.

Sources and effects of ammonia in water

Ammonia gas, is extremely soluble in water. It is the natural product of decay of organic nitrogen compounds. Ammonia gets into water as runoff in agricultural where it is applied as fertilizer and industrial effluents and it easily finds its way into underground aquifers. Nitrate is poisoning in infant animals. Although ammonia is an irritant to the respiratory tract, the limited numbers of studies that have been conducted show no long-term ill effects. Ammonia is rich in nitrogen so it makes an excellent fertilizer**.** It reduces the DO level of water, killing fish and other aquatic organisms.

The ammonium does not directly harm the human body in typical pH values (6.5 to 9.5) applied in drinking water treatment. However, it may form nitrite ions under oxidative conditions. Nitrite is a toxic component, because it disables the enzyme lactase in the blood cells, causing hydrogen-peroxide realize. As a result, the hemoglobin is oxidized to meet hemoglobin, which means that the divalent iron in hemoglobin is oxidized to trivalent iron. Iron (II) is suitable for the oxygen transport; however iron (III) is unable to do so, because the iron (III) containing hemoglobin connects to oxygen with stable ionic bond, which makes oxygen transport impossible, and therefore cause hypoxia (blue baby syndrome). Due to the harmful effect of nitrite, the maximum allowable concentration is 0.5 mg/L. Ammonia is an important source of nitrogen for mammals and plants due to its use in the synthesis of amino acids, DNA, RNA and proteins. It is produced endogenously in all mammalian species. Ammonia removal from water and wastewater are important in the alleviation of environmental problems including eutrophication, corrosion and fouling (AWWA, 1990).

Sources and effects of Phosphate

Phosphorus can exist like orthophosphates, polyphosphates, pyrophosphates and organic phosphorus. Orthophosphates are the prevailing form in municipal wastewater (Hultman et al., 2000). Basic sources of contamination of groundwater and surface water with nitrogen and phosphorus are infiltration of rainfall in fertilized agricultural areas and leakage from municipal sewage. Organic phosphates are important in nature and also may result from the breakdown of organic pesticides which contains phosphates. Phosphates stimulate the growth of plankton and water plants that provide food for fish. This may increase the fish population and improve the waterway's quality of life. If too much phosphate is present, algae and water weeds grow rapidly may choke the waterways and use up large amounts of oxygen. The result may be the death of fish and aquatic organisms. Phosphates won't hurt people or animals unless they are present in very high concentrations. Even then, they will probably do little more than interfere with digestion. It is doubtful that humans or animals will encounter enough phosphate in natural waters to cause any health problems.

MATERIALS AND METHODOLOGY:

In this research study, ESP Fly ash a waste material collected from thermal power plants is employed as an absorbant in the treatment of the contaminated dam water. The fly ash produced from the burning of pulverized coal in a coal-fired boiler is a fine grained, powdery, particulate material that is carried out in the flue gas and usually collected from the flue gas by means of electrostatic precipitator. The chemical composition of ESP Fly ash is listed below:

Chemical name	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	K_2O	Na_2O	TiO_2	MnO	P_2O_5	LOI	H_2O
%	69.92	4.01	19.81	2.27	0.88	0.33	0.11	0.02	0.01	0.02	2.16	0.47

Methodology

Adsorption method is chosen to treat the dam water containing high content of ammonia and phosphate. Adsorption is the accumulation of substance at the interface between two phases. The material adsorbed is called as the adsorbate and the adsorbing phase is called as the adsorbent.

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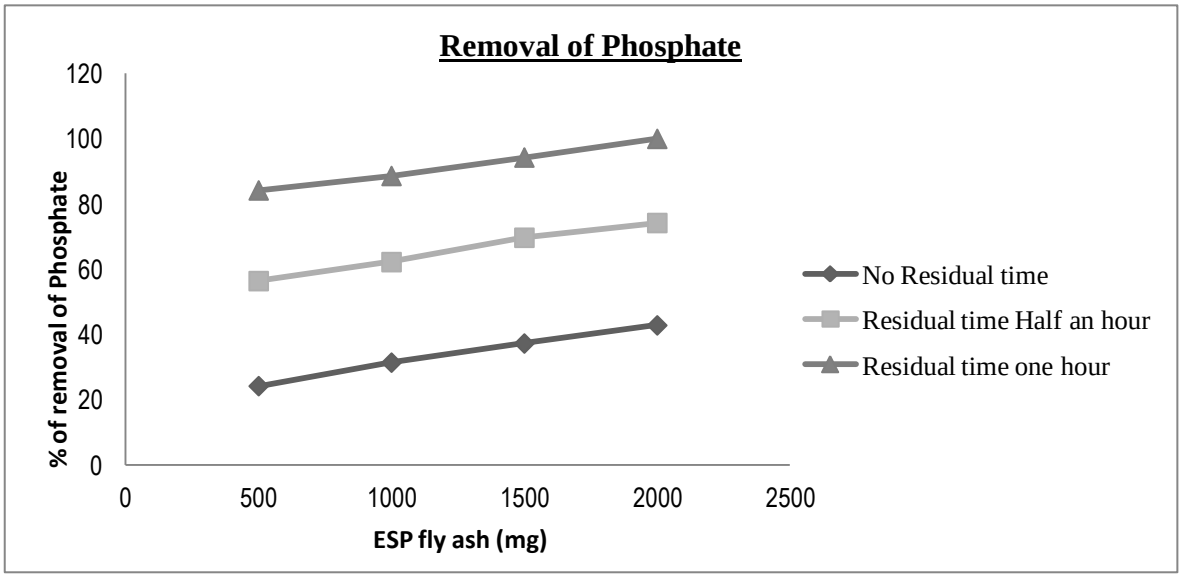
Adsorption is a surface phenomenon. The interface can be between the liquid and a gas, a solid or another liquid. Adsorption is the exchange of material at the interface between two immiscible phases in contact with one another. It may be either physical or chemical process in which a gas, liquid, or solid adheres to the surface of a solid in adsorption of gases by activated carbon.

Preparation of activated ESP fly ash:

The base materials are collected and chopped into fine pieces. They were made to undergo carbonization process, where it has been kept at a temperature of 105ºC in the hot air oven, in order to vaporize out any amount of moisture content present in it. Then these base materials were kept at 650ºC in the muffle furnace. This carbonization process was carried out in inert atmosphere (in the absence of air or oxygen).Then it has been kept as it is in the muffle furnace for the subsidence of the generated temperature. Then the char obtained is divided into parts and were mixed with activating agents like zinc chloride to a requisite space amount to make it a paste. Allowing this mixture to room constitutes to the development of micro porous, which means the activation process. Then the final carbon obtained after the activation process is called as activated carbon. Activated carbon thus obtained was acidic in nature. Therefore its pH was brought down to the normal level by repetitive washing using distilled water in order to avoid any secondary reaction which is likely to take place further color removal process. Experiments were conducted by batch mode in beakers and the results are given below. (Table 1 & 2)

RESULTS & DISCUSSION

Table 1 & 2 shows the results removal of ammonia and phosphate from Kelavarapalli dam by using activated ESP fly ash.



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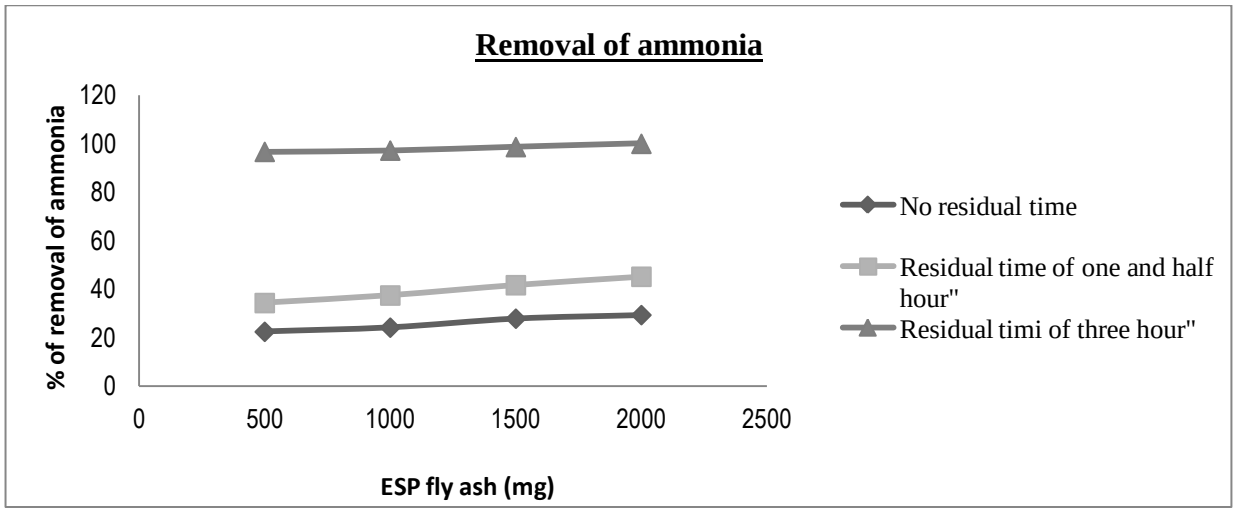

Fig 2.Removal of ammonia

The graphical representation shows the removal of ammonia and phosphate with various residual time using ESP Fly ash for dam water. It is very clear that the removal of phosphate and ammonia with different residual time (i.e. one hour for phosphate and three hour for ammonia) were more effective.

Table 3 The physico-chemical characteristics of the treated water is listed below:

Parameter	Appearance	Turbidity (NTU)	TDS	Elec. Conduct	pH	Total Alkalinity	Total Hardness as $CaCo_3$	Ca	Mg
Raw water	Yellowish	5.6	760	1091	7.31	224	248	58	25
Treated water	Colorless& clear	0.1	700	1005	7.29	184	212	46	23

Fe	Free ammonia as NH_3	NO_2	NO_3	Cl	Fluoride	Phosphate	Na	K	SO_4
0.1	8.26	1.2	14	152	0.4	2.56	112	16	127
0	0	0	7	136	0	0	108	12	112

The result listed above is more clear that the quality of water was completely changed and now the quality is adhering to the permissible limits of BIS and WHO standards.

CONCLUSION:

This is evident from the graphs that the ESP fly ash derived from waste material could be found good in treatment of water for the removal of phosphate and ammonia instead of conventional chemical treatment. Table 3 shows that the water can be treated in an effective manner by using ESP Fly ash.

The water after treatment are within the permissible limits as per IS and WHO standards. It is cost effective and easy method of treatment. The used ESP Fly ash after treatment of water can be recycled by utilizing for the preparation of hollow and solid cement blocks and used in construction.

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