

# EXPERIMENTAL ANALYSIS AND STUDY ON REMOVAL OF PHOSPHATE FROM WASTEWATER WITH REFERENCE TO MUTHA RIVER OF PUNE CITY IN MAHARASHTRA BY ACTIVATED CARBON OBTAINED FROM RICE HUSK

Prof. S. M. Gawande, Ms. Prachi K. Shelke<sup>2</sup>, Ms. Neha A. Dhoke<sup>3</sup>, Ms. Madhura D. Lengre<sup>4</sup>,  
Ms. Diksha A. Dere<sup>5</sup>

<sup>1</sup> Prof.S.M.Gawande

Professor, Department of civil Engineering, Anantrao Pawar College of Engineering & Research,  
Pune (411009), India.

<sup>2</sup>Ms. Prachi Shelke, <sup>3</sup>Ms. Neha Dhoke, <sup>4</sup>Ms. Madhura Lengre, <sup>5</sup>Ms. Diksha Dere  
UG Students, Department of Civil Engineering, Anantrao Pawar College of Engineering & Research,  
Pune (411009),India

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**Abstract** - In today's scenario due to rapidly growing population there is tremendous increase in the generation of the wastewater which not only creating nuisance to human health but also to the environment in various ways phosphorus is the one of the essential nutrient in waste water which occurs as phosphate. But excessive discharge of phosphorus from industrial or domestic waste disturbs aquatic balance and it reduces the level of oxygen in waste water. The leading effect caused due to excessive phosphate is 'Eutrophication'. There are various physical, chemical and biological techniques invented to remove phosphate from waste water. Now a day more attention is given to utilization of naturally available materials for treatment of waters various naturally available materials such as fly ash fruit juice residue, sugarcane baggage, rice husk are used which are cheaper than chemical treatments. Introduction of rice husk in treatment of phosphorus solves the problem of disposal of rice husk and reduces cost of treatment. The activated rice husk ash is used as an adsorbent. According to various studies rice husk provides cost effective and efficient method of phosphate removal.

**Key Words:** Eutrophication, EBPR, ARHA, Activated carbon, BOD, COD, DO.

## 1. INTRODUCTION

The earth planet is having about 79% of water. Water is essential for all living organisms for their growth and survival. Due to development in industry sector people's standard of living and the commercial sectors huge amount of waste water is generated which

may sometimes discharge directly into the water bodies without adequate treatments. This creates great nuisance to aquatic life and human health. The waste water contains various contaminants like heavy metals, sulphate, nitrates, phosphate, suspended solids etc. The permissible limits are set by various government agencies for each parameter.

The site for experimentation at river "Mutha". The river is located in Pune district in western Maharashtra. It arises in western ghats and flows eastward until it merges with the Mula river in Pune. There are 12 industrial estates and IT parks developed by Maharashtra Industrial Development Corporation (MIDC). Small scale industries are also located at various places such as Hadapsar, Lonavala etc. Compared to total number of registered industries in the state, 10.09% of industries are located in Pune district alone. Their waste has to be discharged. Although, not all the industries violate the limits of discharging waste in the river, only a small percentage of industries create a problem and add to pollution in Mula-Mutha. Apart from this, human waste, daily sewage, plastics and other toxic substances worsen the situation more which requires urgent treatment solutions.

Phosphorus is the one of the essential and limiting nutrient entirely exists as phosphate in ecosystem. There are three types of phosphates namely, orthophosphate, polyphosphate and organic phosphate. The point sources of phosphate include municipal and industrial waste water and non point sources includes domestic waste, agricultural sources, detergents etc.

Phosphate is an essential nutrient which is necessary for growth of plants and animals. The amount of phosphate in water is desirable to certain extent. If it exceeds the permissible limits then it creates a serious threat to aquatic plants and animals. One of the leading issues caused by excessive phosphate is eutrophication, which is nothing but the excessive algae growth in water. Various methods of treatment are developed for removal of phosphate. Recently EBPR process is known to have maximum phosphate removal efficiency. More attention is given to remove phosphate by chemically modifying natural materials and using them as adsorbents.

Rice husk is one of material which is available in enough quantity in rice growing countries. The annual generation of rice husk in India is 18-22 million tons.<sup>[1]</sup> The rice husk production in major cities in maharashtra is given below:

**Table No. 1 giving rice production quantity in Maharashtra**

Sr. no.	Name of district	Qty. of rice Produced (kg/ha)
1	Pune	1307
2	Satara	1391
3	Raigad	2294
4	Thane	1683
5	solapur	1226

Rice husk production is about 20-22% of total rice production. Rice husk ash is prepared rice husk which contains activated carbon and it contains good adsorptive properties to remove various contaminants

from waste water. Rice husk ash is siliceous material having more percentage of silica. It is not only cost effective but also very efficient in removing phosphate from waste water. rice husk ash prepared from rice husk

**Table No. 2 giving sources and applications of activated carbon**

Sr No.	source of activated carbon	Applications
1	Rice husk ash	Phosphate removal from waste water
2	Sugarcane baggase ash	Chlorine removal from waste water
3	water hyasinth	Treatment of domestic waste water.

The project study deals with the application of activated rice husk ash for removal of phosphate from waste water by varying dosage of ARHA adsorbent.



**Fig- 1: rice husk collected at laboratory**



**Fig – 2:** Rice husk ash prepared at laboratory

## 2. OBJECTIVES

- 1) To study the waste water characteristics with special reference to phosphorus.
- 2) To analyze the concentration of phosphate content in waste water within study area.
- 3) To find and correlate the effects of phosphate on aquatic environment.
- 4) To conduct laboratory tests for detection and analysis of contaminants.
- 5) To evaluate the Obtained results from field and laboratory.

## 3. LITERATURE REVIEW

In 2016, **SUMAN MOR.et.al**<sup>[1]</sup> expressed the use of agricultural waste in the removal technology of phosphate from waste water which provides an efficient solution to waste water treatment as well as agricultural waste management various types of naturally available waste such as rice husk, sugarcane baggase, fly ash, red mud, wheat residue are used as adsorbents for removal of phosphate from waste water. The study elaborates the effect of rice husk ash as an adsorbent for the removal of phosphate. The method of preparation of adsorbents is explained in this paper. The method is quite simple and cost effective. From this paper it is concluded that the rice husk is largely available product and the results increases that if we modify the rice husk ash with chemical treatment then it can remove phosphate up to 89% maximum at the pH of 6 using 2g/L dose for 120 min.

In 2015, **AMOL A. BHUSARI.et.al**<sup>[2]</sup> illustrated the efficiency of rice husk ash residue for treatment of waste water. The study explained that rice husk is abundantly available in many countries which include India. The rice husk ash consists of higher percentage of silica. The use of rice husk ash in waste water treatment reduces the problem of bulky disposal of husk. The study gives the feasibility of rice husk ash to alternate adsorbents. The adsorbent is prepared using standard procedure and the column study

was carried out. from this paper it is concluded that rice husk can be used as an alternative to activated carbon. After research it is recommended that rice husk is the better alternative to activated carbon and it may also be effective in removing heavy metals.

In 2015, **SUFIA HENA.et.al**<sup>[3]</sup> explained the use of sugarcane baggase as an adsorbent for the removal of phosphate from waste water. The study illustrates the preparation of an adsorbent from sugarcane baggase by the ETM (epichlorohydrin triethylamine method). The main objective of this study is to study the phosphate sorption capacities of modified sugarcane baggase for such prepare batch experiments were performed to study the effect of modified sugarcane baggase dosage pH and temperature is found to be n the removal of phosphate.

In 2014, **ABOOALFAZL AZHDARPOOR.et.al**<sup>[4]</sup> explained the working anaerobic/aerobic modified sequencing batch reactor for removal of phosphate from municipal waste water. In this study, efficiency of removal of Total Phosphate (TD) chemical oxygen demand (COD) is determined by using SBR reactor. The sequencing batch reactor consists of a 4 phases for duration of 3 to 8 hours to meet the best condition for maximum removal efficiency of COD and TD. The reactor is made up of plexi a glass sheet which includes anaerobic and aerobic parts respectively. Anaerobic part is located at the starting point of treatment followed by aerobic part. Aerobic condition is achieved by providing aquarium pump. Volume of reactor in process is 5 to 7 ml and total volume reactor is 9 L. From this paper it is concluded that the total removal efficiency at all phases of COD 80 to 95%. The method is very flexible for varying input of chemical oxygen demand.

In 2014, **RAVINDRAKUMAR GAUTUM.et.al**<sup>[5]</sup> gave an over view of various methods of phosphorus removal and recovery. He suggested that use of bio sorbents for the adsorption of phosphate is good alternative for costly physical and chemical treatments. Various biological treatments which are considered as low cost alternative for physical and chemical treatment in which bacteria algae and fungi helps in biodegradation of phosphate. Enhanced biological phosphorus removal process is increased significantly which provides several advantages like ecology, less sludge production, low investment etc. these method may not be feasible if there is great variation in temperature and chemical composition of waste water. Chemical and physical treatments for phosphate removal include oxidation, filtration, electro-dialysis, chemisorptions etc. These methods are affected by cost factor.

In this paper various low cost adsorbents are introduced such as waste material from agriculture like hull ash, wheat husk, rice husk, fruit residue, groundnut husk etc., industrial

waste includes fly ash, glass furnace slag, etc. From this paper it is concluded that the optimum utilization of low cost adsorbents by providing high surface area are proven as successful treatment for removal of phosphate as these methods are economically sustainable.

In 2012, **DR. C. R. RAMAKRISHNAIAH.et.al**<sup>[6]</sup> expressed the application of low cost adsorbents for removal of phosphate from waste water. The efforts are made to achieve 100% removal efficiency through adsorption process. The study was carried out by using different types of adsorbents namely alum sludge, ground granulated blast furnace slag (GGBS), Class 'C' fly ash and coal ash. The optimum dosage, pH and reaction time was determined. Batch experiments were carried out to measure efficiency of phosphate removal by adding their dosages to 1000ml synthetic phosphate solution. Then the mixture is shaken and filtered. The method used for determination of phosphate is vanado-molybdo phosphoric acid method. From this paper it is concluded that the pH of 5 and dosage 10 g/100 ml is found to be optimized condition for alum sludge, class 'C' fly ash and GGBS, for coal ash, the optimized condition is at pH at 7 and dosage of 7.5 g 100 ml. As the adsorbent dosage is increased, it increases the percentage removal.

In 2012, **DR. EHSAN NASEEF**<sup>[7]</sup>, stated the method of chemical precipitation for removal of phosphate from industrial waste water which is then convert the soluble phosphate to other compound. So that it can be utilized in fertilizer industry. For such method, a phosphate stock solution is prepared and then various precipitating agents of required concentration are prepared. The precipitating agents are calcium oxide, ferrous sulphate, aluminium sulphate etc. The analytical determination of phosphate is carried out with the help of UV-Spectrophotometer. From this project work it is concluded that for iron sulphate the best removal efficiency is 80% at pH of 8.5-10, for aluminium sulphate is 85% for pH of 4 and for calcium oxide the removal efficiency is 90% at pH 8.5-10. The experiments were carried out at room temperature only and he mixing at two salts shows no effect on increase in percentage removal of phosphate.

In 2004, **LUZE DE-BASHAN.et.a**<sup>[8]</sup>, this research evaluates the various progressive advances in the research work of phosphate removal from waste water in addition with its recovery and future use as a fertilizer. The research work analysed the current status of phosphorus removing methods. The main process for phosphate to be removed is the precipitation of phosphorus with metal salts like alum, lime, iron. After some years new inventions were proposed for such method. Another method explained is cultivation of micro-organisms in waste water for biological removal of phosphate. The species used for biological treatment are non specific and enriched from the sludge by incubation

condition same as that of provided for the process of EBPR. One of the low cost and low-technology process is introduced i.e. constructed wetlands to control the environment impacts. Generally, it is a pond constructed which is planted with aquatic or terrestrial plants the roots of plants and substrate in which plants grow work as a giant filter to remove all kinds of impurities struvite precipitation one of the phosphate recovery method. From this paper it is concluded that the focal issue is not reducing or removing phosphorus the phosphate should be recovered as it is essential and limiting nutrient.

**D.G. KANASE.et.al**<sup>[9]</sup> identified the various physical, chemical characteristic of waste water of major rivers in Pune city. Pune city is covered with three major rivers named as Mula, Mutha and Pavana which are source of drinking water for Pune city and nearby areas. The samples were collected from 8 different locations and the various parameters like pH, alkalinity, total hardness, calcium, magnesium, nitrate, sulphate and phosphate were analysed. During the study it was investigated that in many places untreated sewage is discharged into river which contributed in pollution of river Mula, Mutha and Pavana. Hence, the water of these rivers became unsafe for human use and there is urgent requirement of preventive actions. From this study it is revealed that the main reason of pollution of Mutha river is population density and discharge of domestic waste into river. Industrial waste contributes also partly.

**GUIDE MANUAL WATER AND WASTE WATER ANALYSIS, (CPCB)**<sup>[10]</sup> phosphorus occurs in natural waters and waste water almost solely in forms of various types of phosphates. The various forms of phosphates find their way into waste water effluents and polluted water of variety sources. Present of phosphate in water and waste water analysis has a great significance. The present of phosphate in large quantities in fresh water indicates pollution through sewage and industrial waste.

Stannous chloride method: in acidic conditions orthophosphate reacts with ammonium molybdate to form molybdophosphoric acid. It is further reduced to molybdenum blue by adding reducing agent such as stannous chloride and ascorbic acid. The blue colour developed after addition of ammonium molybdate is measured at 690 nm or 890 nm with 10-12 min. The concentration is calculated from standard graph. The intensity of blue colour complex is measured which is directly proportional concentration of phosphate in sample.

#### 4. MATERIALS AND METHODS

The samples of waste water were collected from selected site on the basis of grab sampling. The samples were taken at regular intervals. Then the phosphate absorption in waste water is analyzed in the laboratory with the help of UV-Spectrophotometer. Calibration graph is prepared to



evaluate the phosphate concentration in waste water. Along with phosphate different parameters like Ph, BOD, COD and DO were calculated for each sample. Then the maximum concentration of phosphate is determined for designing the phosphate removal procedure. Stock solution is prepared by dissolving 4.39gm of potassium di-hydrogen phosphate ( $\text{KH}_2\text{PO}_4$ ) in 1000 ml of distilled water<sup>[1]</sup>. Then maximum concentration of phosphate in waste water from site is determined. The synthetic sample is then prepared in laboratory of desired concentration. Chemically modified Rice husk ash is used as an adsorbent for the removal of phosphate from waste water. For activation HCL is used in the proportion of 1:1<sup>[1]</sup>. The efficiency of activated rice husk ash is calculated by varying the adsorbent dosage at constant pH and temperature.

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