

**Dr. D. Y PATIL PRATISHTHAN'S COLLEGE OF
ENGINEERING SALOKHENAGER, KOLHAPUR**



DEPARTMENT OF CIVIL ENGINEERING

A PROJECT REPORT ON

“REMOVAL OF HEXAVALENT CHROMIUM, POTASSIUM AND
NITRATE FROM WASTE WATER BY SELECTIVE FILTER MEDIA”

SUBMITTED TO THE SHIVAJI UNIVERSITY, KOLHAPUR
IN PARTIAL FULFILLMENT OF THE DIGREE

BATCHLER OF ENGINEERING IN CIVIL ENGINEERING

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Under the Guidance of

Prof. M. P. Shinde A.

Y. 2023-24



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**DEPARTMENT OF CIVIL ENGINEERING
CERTIFICATE**

This is to certify that the project report entitled
“REMOVAL OF HEXAVALENT CHROMIUM, POTASSIUM AND
NITRATE FROM WASTE WATER BY SELECTIVE FILTER MEDIA”
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Has completed the project work carried out by them under the supervision of Prof. M. P. Shinde and it is submitted towards the partial fulfilment of the requirement of Shivaji University, Kolhapur for the award of Bachelor's Degree of Engineering in Civil Engineering for A. Y. 2023-24.

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The sense of contentment and relation that accompanies the successful completion of the project “REMOVAL OF HEXAVALENT CHROMIUM, POTASSIUM AND NITRATE” would be incomplete without mentioning the names of those people who helped us in accomplishing the project. Those people whose Constant guidance and encouragement resulted in its realization.

We take this opportunity to thank our Campus Director Dr. A. B. Mane for providing a constant support and resources that helped us in completing the task.

We take this opportunity to thank our Principal Dr. S. D. Mane for providing a healthy environment in the college that helped us in concentrating on the task.

We express a deep sense of gratitude to our H.O.D Prof. R.V. Jadhav. We also Thankful to our guide Prof. Monica .P.Shinde for support and guidance.

Place: Dr. D. Y Patil Pratishthan's College Of Engineering Salokhenagar, Kolhapur Date:

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DECLARATION

We, the undersigned, students of B.E. (Civil Engineering) declare that the project work report entitled “**REMOVAL OF HEXAVALENT CHROMIUM, POTASSIUM AND NITRATE**” written and submitted under the guidance of **Prof. Monica .P. Shinde**. The empirical findings in this report are based on the data collected by us. The matter assimilated in this report is not reproduction from any readymade report.

Place: Salokhenagar, Kolhapur

Date:

Abstract

Finding out how well rice husk & its modified form could remove phosphate, nitrate and chromium (VI) from synthetic & swine farm wastewater was the aim of this investigation. Investigation is also conducted into the mechanism of adsorption & the possibility of using rice husk adsorbed with phosphate, nitrate or hexavalent chromium as a nutrient-rich residue. The properties of rice husk is it's constitutes about 20% of the weight of rice and its composition. Some of reasons why Rice Husk Ash is considered as one of the most economical & renewable source.

Rice husk ash has the ability to change into carbon based slow release fertilizer via light processing. Rice husk allow for effective adsorption of pollutants. It resists fungal decomposition. It resist moisture penetration. It decomposes slowly. It renewable. Model is given with bottom Strainer as outlet. The experimental procedure is carried out in batch process. The material used for lab scale experimental setup is acrylic sheet of 5mm thick of dimension 20x60cm. Top 20cmx20cmx60cm.

Media used for simultaneous removal of hexavalent chromium, phosphate nitrate by using rice husk ash. Solution of various concentrations of this pollutants are prepared to check the efficiency of filter area. UV 1900 spectrophotometer used for analysis .Rice husk ash can efficiently remove nitrate, phosphate, hexavalent Chromium pollutants from wastewater.

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INTRODUCTION

Water is the basic need of every life form on Earth. Water helps us to leave a comfortable life on this planet. Our bodies are made up of 70 water. So, Water is important compound for us Human being as well as animals are use water for so many purposes. We use water for drinking, cooking, bathing & cleaning. Without water, life is impossible on the planet.

Water is everything to a human being Water has three states: Solid, liquid & Gas. The solid form of water is ice. But, now a day's water is polluted due to various activities of humans. Water pollution is environmental issue caused by harmful substances. into water bodies, such as rivers, lakes & oceans. Sources of water pollution are industrial waste, agricultural runoff, sewage & littering.

It poses risks or harmful to aquatic life, ecosystems & human health. Industrial wastewater is toxic, reactive, carcinogenic or ignitable. Industrial wastewater having a large amount of hazardous chemicals. Also groundwater is polluted by various chemicals. used in farm. The pollutants seen in wastewater was nitrogen, nitrate, chromium, potassium, heavy metals, chlorine, and acids.

1.1 Characteristics of chromium:

- Chromium denoted by symbol-Cr & having atomic no.24.
- It is a brittle, hard metal.
- The level of chromium in air & water is generally low.- In drinking water the level of chromium is usually low as well, but contaminated well water may contain the dangerous chromium (IV); hexavalent chromium.
- High corrosion resistance.
- High melting point.
- High intensity colored compounds.
- Possible oxidation states +3 & +6 observed in chromium compounds.

1.2 Sources of pollutants in water and waste water.

Pollutants	Sources
1]Nitrate	a) Non agricultural (30 to 50.00% taken up by the plant) b) Agricultural Fertilizers (By putting nitrogen based fertilizers on the farming land) c) Manure storage (storage of animal dung in farm)
2]Potassium	a) Weathering of rocks. b) Wastewater disposal c) Industrial wastewater
3]Chromium	a) Leaching from topsoil & rocks. b) Industrial wastewater. c) Chemical manufacturing Industry.

1.3 Health Effects of nitrate; chromium & potassium:

Pollutants	Health Effects
1] Nitrate	a) Cancer Causing b) Chronic disorders in human beings c) Damage nerves, liver & bones. d) Cause methemoglobinemia. (Blood disorder).
2] Chromium	a) Increases the risk of lung, nasal, & sinus cancer. b) Skin allergies. c) Reproductive & developmental problems. d) Bronchial Asthma. e) Changes in weight and Low energy
3] Potassium	a) Irregular heartbeat b) Chest pain c) A weakening pulse. d) Kidney diseases or failure. e) Muscle Weakness.

1.4 Treatment options removal of chromium, nitrate and potassium:-

❖Chromium	❖Nitrate	❖Potassium
1. Adsorption.	1. Boiling	1. Adsorption
2. Chemical precipitation.	2. Filtration	2. Ion exchange.
3. Membrane process.	3. Disinfection	3. Electrolysis
4. Redoxadsorption.	4. Water softening.	4. Reverse osmosis.
5. Ion exchange.	5. Distillation	
	6. Reverse osmosis.	
	7. ion exchange	

- **Adsorption:** - Adsorption is the adhering of substances from gases or liquids onto the interface of two phases, mainly onto solids.
- **Ion exchange:** - Ion exchange is a chemical process reaction in which free mobile ions of a solid, the ion exchanger, are exchanged for different ions of similar charge in solution.
- **Distillation:** - It is the process of separating the components of a liquid mixture through selective evaporation & condensation.
- **Reverse Osmosis:** - It is a water purification process that uses semi-permeable membrane to separate water molecules from other substances.
- **Chemical precipitation :-** It is the most common technology used in removing dissolved (ionic) metals from solutions

1.5 Necessity of the study:

Understand the effective methods adopted to remove the pollutants in wastewater. Because the pollutants are very harmful to human as well as animals. They are dangerous for environment also. For understanding the basic properties characteristics & functions of the pollutants. Adopted economical or low cost method to remove pollutants from water as well as wastewater. The choosing of method which is flexible, easily processing in nature. Adopting ecofriendly the method which is give high results. choosing proper material for removing pollutants.

1.6 scope of the study :

The following is the scope of suggested study:-

- 1) To study the properties of the nitrate, chromium, potassium & filter media.
- 2) To prepare artificial wastewater solutions of nitrate, potassium, chromium (VI) of varying concentrations as sample.
- 3) To grow experimental setup using low-cost filter materials for nitrate, chromium (VI) & potassium. removal.
- 4) To check the efficiency of Nitrate, chromium (VI) potassium removal for different filter media.

Literature Review

- S.S.Kerura & Sneha Bandekar, Manjunath & Hanagadkar (2020) Santosh S. Nandid, G-M. Ratinamala, Prasad G. Hegde Bes are studied on se "Removal of hexavalent chromium - Industry treated water & wastewater" This paper attempts to removing hexavalent, through laboratory experiments by effective cost. They focuses on recovering the heavy metals & usage of treated water. Adsorption is one of the simple technique used for heavy metals treatment. The adsorption kinetics helps understand the reduction of Cr (VI) from streams.
- Daniel Schwantes, (2015) studied on "Nitrate Adsorption. using sugar cane: Bagass Physiochemically changed". Studies involving chemical & physical modification in adsorbing materials which is performed for adsorption of nitrate. The absorbents made by physical chemical modification with heating of sugar cane bagass at a temperatures ranging until 480°C in oven. It have adsorbed quality. In 30-minutes. Higher removal % of nitrate is lower initial concentrations. The adsorption is at 25°C. 30 minutes is short space time indicate the maximum adsorbed amount occurred according to study.
& pH results is also satisfactory according to that study. No₃ removal is 100%.

For Phosphate
Nitrate
Nitrite

83.8%
>45.0%
65%

- Dessalew. Berihun (2017) studied on of Removal of chromium from Industrial Wastewater by adsorption. Using Coffee Husk": The study involve adsorption capacity of activated carbon for the removal of carbon Cr (VI) from industrial wastewater. The hexavalent chromium adsorption by coffee husk by chemical method. The a-11- functions are pH, adsorbent dose & initial adsorbent concentration, contact time. Results found to be 60min, 80mg/l, 3 mg/l, 2g/l. Hexavalent chromium adsorbed at 98.19 %.
- shankar (2010) adopted Low-cost treatment for attenuation of nitrate from groundwater". Using laboratory scale physical model. The study focuses on low cost

cost treatment for nitrate reduction in groundwater using selective filter media. which is easily available & cheap. In this method different combination of filter beds. 4 et capacity of nitrate removal was checked for 3-5 hr. the sample collected every 1/2 hr. and analyzing. For nitrate removal.

Combinations	Efficiency
--------------	------------

Fly ash + pebbles	66%
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Charcoal + brick bats	88%
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- Sumra Neem etc al. (2009) studied Adsorption studies of r (VI) on the rice husk ash (Rhq). In this case, the adsorption of Cr(VI) investigate by using batch technique, % adsorption is calculated for Rice. Husk Ash. It focuses on a functions of contact time, pH, adsorbent concentration & temperature. Adsorption explain in terms of Freundlich & Langmuir equations. Rice Husk Ash give major present adsorption of Cr (VI).

OBJECTIVE

The objectives of a project aimed at removing hexavalent chromium, nitrate, and potassium from wastewater may include:

- 1) Developing efficient and cost-effective treatment methods for each contaminant.
Maximizing removal efficiency while minimizing energy and resource consumption.
- 2) Ensuring compliance with regulatory standards for wastewater discharge. Investigating the potential environmental impacts of different treatment approaches.
- 3) Optimizing process parameters such as pH, temperature, and contact time to enhance removal efficiency.
- 4) Evaluating the feasibility of scaling up the treatment process for practical implementation in industrial or municipal wastewater treatment facilities.
- 5) Assessing the long-term stability and performance of the treatment system under varying operating conditions.
- 6) Exploring potential synergies between different treatment methods to achieve simultaneous removal of multiple contaminants.

MATERIALS

The investigation was carried out at the "SHIVAJI UNIVERSITY KOLHAPUR" by instrumental analysis laboratory. The instrument used is UV- VIS 1900 SPECTROPHOTOMETER. The rice husk ash bought from a rice mill. A material go through a physical and chemical activation using a KH_2PO_4 (Potassium Dihydrogen $\text{K}_2\text{Cr}_2\text{O}_7$ (Potassium Dichromate) and KNO_3 (Potassium Nitrate) Use 600 micron sieve for the preparation of rice husk ash.



EXPERIMENTAL SETUP:

1. The model is given with bottom stainer as outlet.
2. The experimental procedure is carried out in batch process
3. The material used for lab scale experimental setup is acrylic Sheet of 5mm thick. of dimension 20×60, TOP - 20×20×60cm
4. Media used for removal of hexavalent chromium & potassium, rice husk ash
5. Prepared with potassium di-hydrogen phosphate (KH_2PO_4), potassium dichromate $\text{K}_2\text{Cr}_2\text{O}_7$
6. For the Study simulated water of hexavalent chromium & potassium
7. Solution of a various concentrations of this pollutant are prepared to check the efficiency of filter area.



METHODOLOGY

The present research was started in an attempt to develop a practical, user friendly, inexpensive and environmentally friendly technique. The most popular techniques for removing Cr (VI) ions from aqueous solution include adsorption.

PROCEDURE:

1) Why Rice Husk Ash :

By literature review or by analysing the research papers related to removing pollutants from wastewater by eco-friendly and inexpensive methods choose rice husk ash for project. Rice Husk Ash have high absorbent capacity to remove chromium (VI), phosphate and nitrate etc. various pollutants. Rice Husk Ash is easily available material from rice mill as well as farms. It is available easily at village level. Rice Husk Ash has ability to effective adsorption of pollutants. It resist moisture penetration.

2) PREPARATION OF RICE HUSK ASH :

- a) Sieve rice husk ash by using 600 micron sieve.
- b) Clean filter media by distilled water.
- c) Filling the rice husk ash in 3 batches into filter media.
- d) Wash rice husk ash until impurities has been cleared and get cleared water.

3) PREPARATION OF SOLUTION :

For project do not use direct wastewater which having pollutants such as chromium (VI), nitrate & phosphate. First prepared solutions as per its limits as follows:

Pollutants	Limit	solutions
Chromium	2mg/lit	K ₂ Cr ₂ O ₇ + Distilled Water
Nitrate	20mg/lit	KNO ₃ + Distilled Water
Phosphate	20mg /lit	KR ₂ PO ₄ + Distilled Water

These solutions are prepared for 10 litre water as per limit & for every sequencing batch process is used for analysis. Samples are collected from outlet at every 30 min time interval.

Collected sample are store into the INCUBATOR at 5 degree Celsius temperature.

**4) SPECTROPHOTOMETER READING : (UV 1900
SPECTROPHOTOMETER)**

Read absorbance against water set at zero absorbance. Use wavelength of 540nm for nitrate, 371nm for chromium and 840nm for phosphate obtain sample concentration directly from the standard curve.

REPORT

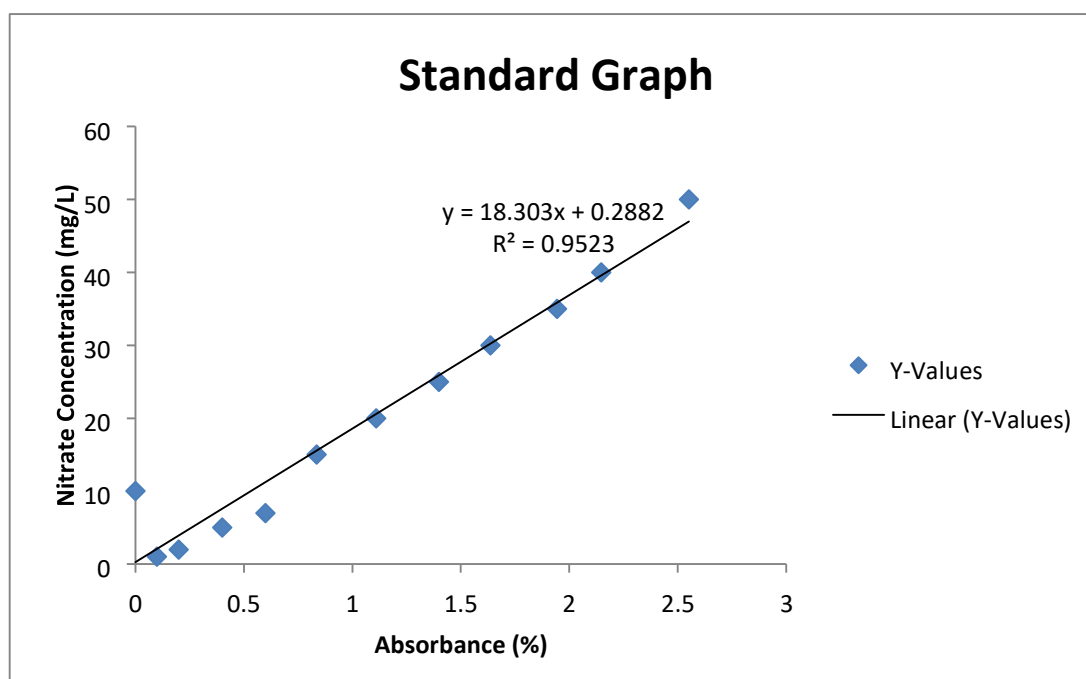
Cost Estimation :

Description	Expenses(Rs)
Model(The material used for lab scale experimental setup is acrylic Sheet of 5mm thick. of dimension 20×60, TOP - 20×20×60cm)	4000
Distilled Water	1080
Potassium Dichromate(K ₂ Cr ₂ O ₇)	1080
Potassium dihydrogen Orthophosphate Anhydrous(KH ₂ PO ₄)	462
Potassium Nitrate(KNO ₃)	884
Bottles	150
Total	8000

RESULT

STANDARD GRAPH:

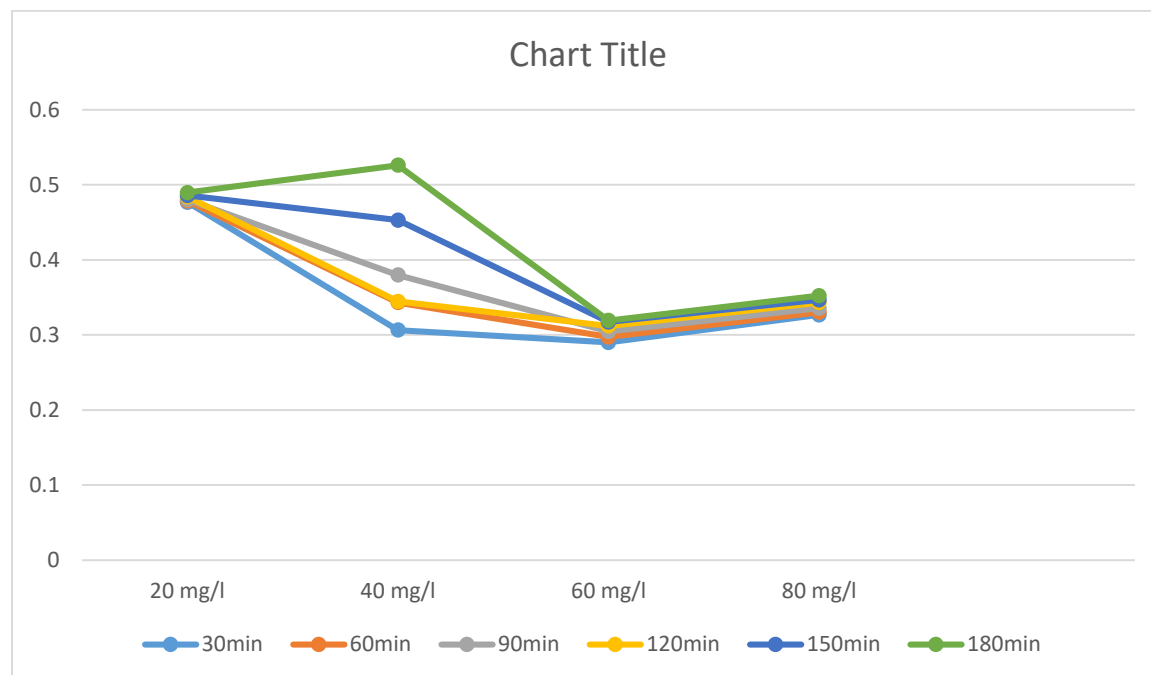
Absorbance	Concentration (mg/l)
0.038	1
0.1125	2
0.2691	5
0.385	7
0.5658	10
0.8361	15
1.1104	20
1.3995	25
1.6368	30
1.9432	35
2.1464	40
2.5513	50



The above graph gives the nitrate concentration in feed as function of absorbance. The graph obtained is straight line with the equation of line. This graph is used for the further results which are taken on the filter column.

NITRATE

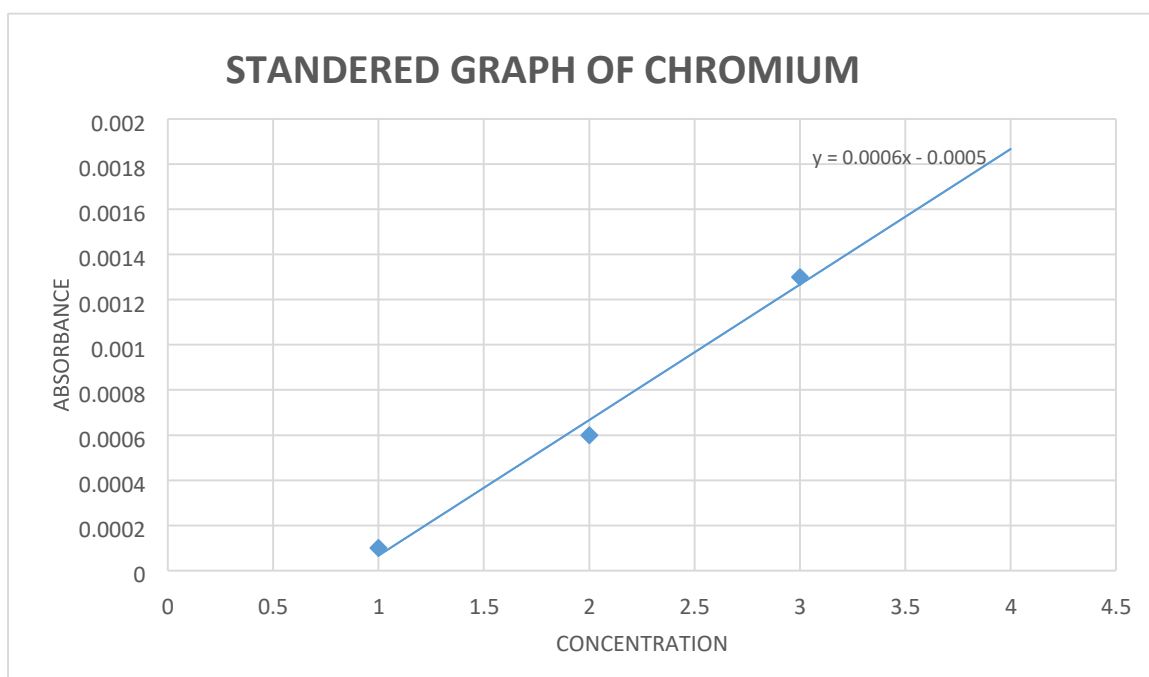
CONCENTRATION	30min	60min	90min	120min	150min	180min
20 mg/l	0.4767	0.4786	0.4803	0.4840	0.4858	0.4895
40 mg/l	0.3065	0.3431	0.3797	0.3446	0.4529	0.5261
60 mg/l	0.2900	0.2973	0.3046	0.3119	0.3174	0.3193
80 mg/l	0.3266	0.3302	0.3357	0.3431	0.3467	0.3522

NITRATE**FIGURE-1**

The maximum absorbed percentage is observed at 80mg/l concentration of nitrate which is 99.57% and minimum for 20mg/l that is 97.58%.

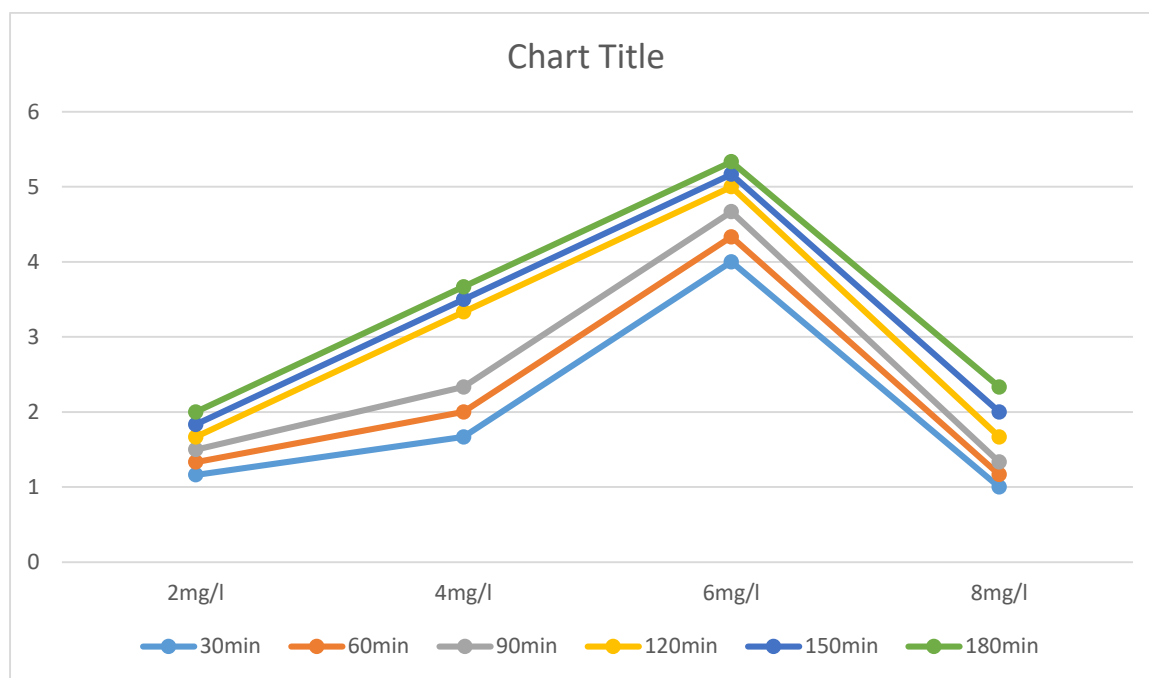
STANDERD GRAPH OF CHROMIUM

CONCENTRATION	ABSORBANCE
0.1mg/l	0.0001
0.2mg/l	0.0006
0.4mg/l	0.0013
0.6mg/l	0.0019



The above graph gives the chromium concentration in feed as function of absorbance. The graph obtained is straight line with the equation of line. This graph is used for the further results which are taken on the filter column.

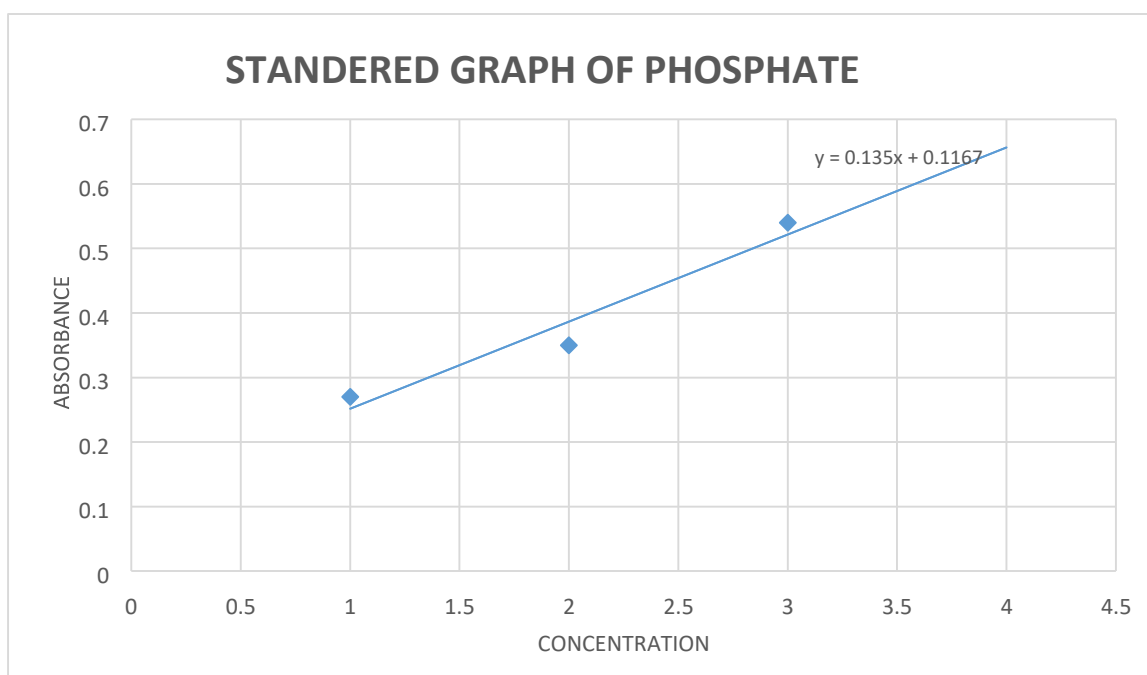
CONCENTRATION	30min	60min	90min	120min	150min	180min
2mg/l	1.1627	1.3333	1.5	1.6667	1.8333	2.00
4mg/l	1.6667	2.00	2.3333	3.3333	3.500	3.6667
6mg/l	4.00	4.3333	4.6667	5.00	5.1667	5.3333
8mg/l	1.00	1.1667	1.3333	1.6667	2.00	2.3333

**FIGURE-2**

The maximum absorbed percentage is observed at 80mg/l concentration of Cr(VI) which is 80.25% and minimum for 40mg/l that is 31.25%.

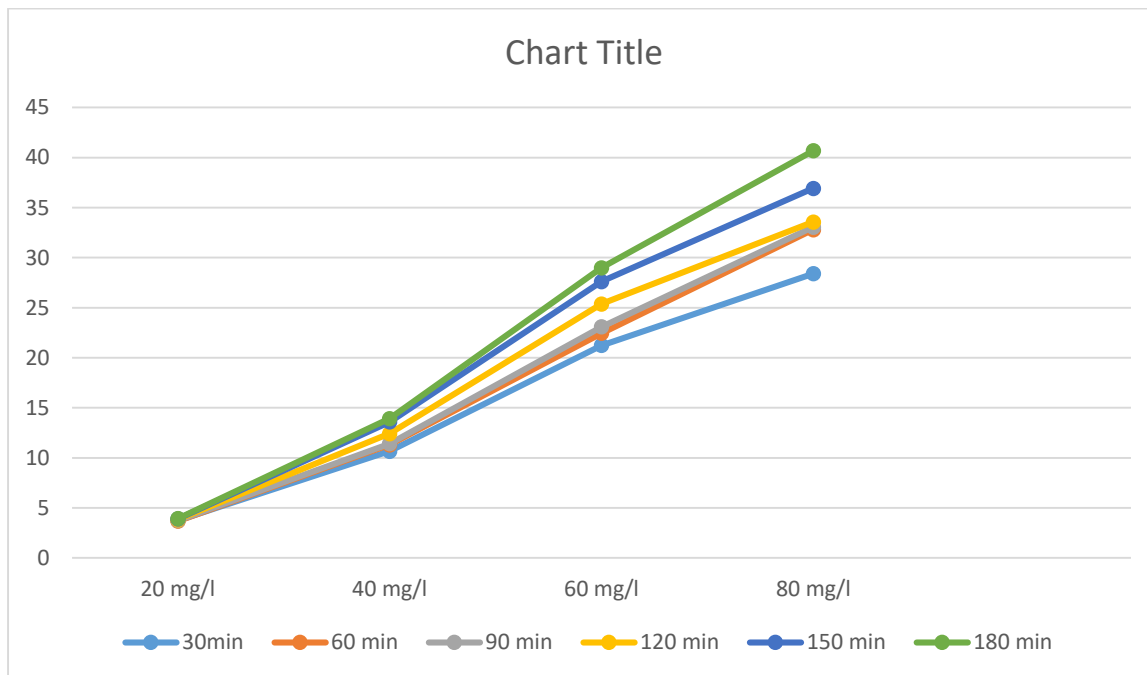
STANDARD GRAPG OF PHOSPHATE

Concentration	Absorbance
5mg/l	0.27
10mg/l	0.35
15mg/l	0.54
20 mg/l	0.648



The above graph gives the phosphate concentration in feed as function of absorbance. The graph obtained is straight line with the equation of line. This graph is used for the further results which are taken on the filter column.

Concentration	30min	60 min	90 min	120 min	150 min	180 min
20 mg/l	3.7533	3.6795	3.7533	3.8272	3.9010	3.9379
40 mg/l	10.67	11.3119	11.4298	12.4263	13.6072	13.9394
60 mg/l	21.2468	22.4647	23.0921	25.3803	27.6315	28.9970
80 mg/l	28.4065	32.7984	33.0567	33.5734	36.9318	40.6962

**FIGURE-3**

The maximum absorbed percentage is observed at 20mg/l concentration of nitrate which is 80.95% and minimum absorbed percentage is observed at 80mg/l concentration of phosphate which is 57.19% .

CONCLUSION

The present study focuses on the cost effective eco -friendly technique of the removal of the very harmful pollutants in water and wastewater. The filter media used in the experimental setup gives the different removal efficiencies for different concentrations of Cr (VI), nitrate and phosphate. So the final conclusion for the study is as follows:

- 1) The FIG.1 shows that the maximum absorbed percentage is observed at 80mg/l concentration of nitrate which is 99.57% and minimum for 20mg/l that is 97.58%.
- 2) The FIG.2 shows that the maximum absorbed percentage is observed at 80mg/l concentration of Cr(VI) which is 80.25% and minimum for 40mg/l that is 31.25%.
- 3) The FIG.3 shows that maximum absorbed percentage is observed at 20mg/l concentration of nitrate which is 80.95% and minimum absorbed percentage is observed at 80mg/l concentration of phosphate which is 57.19% .

FUTURE SCOPE

- 1) The project aims to improve treatment methods for better efficiency & lower costs.
- 2) It may involve exploring like new technologies nanotechnology or advanced oxidation processes.
- 3) Integrating renewable energy for sectionbil sustainability.
- 4) Additionally, there is potential to research ways to rence treated wastewater & develop smaller, de centralized treatment systems for communities

REFERENCES

- S.S.Kerura & Sneha Bandekar, Manjunath & Hanagadkar (2020) Santosh S. Nandid, G-M. Ratinamala, Prasad G. Hegde Bes are studied on se "Removal of hexavalent chromium - Industry treated water & wastewater"
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- shankar (2010) adopted Low-cost treatment for attenuation of nitrate from groundwater". Using laboratory scale physical model.
- Sumra Neem etc al. (2009) studied Adsorption studies of r (VI) on the rice husk ash (Rhq).

IMAGES





