# RECOVERY OF PHOSPHOROUS FROM FERTILIZER INDUSTRY WASTEWATER BY ADSORPTION PROCESS USING MAGNETITE

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## ABSTRACT

*Any substance such as manure added to soil to increase its productivity is called Fertilizer. Nitrogenous, Phosphate and potassium fertilizer are the main fertilizers produced and used in India. India is the 3rd largest fertilizer producer in the world. Phosphorous is important and one of the precious resources. Phosphorous is just as important to agriculture as water. But a lack of availability of phosphorous is an emerging problem that threatens our capacity to feed global population. That is why recovery of phosphorous from wastewater becomes necessary. The recovery of phosphorous can be done by ion exchange process also. The recovery of phosphorous was made using one step base leaching and two step base leaching. Recovery of phosphorous can be done by adsorption method using magnetite as adsorbent. The result shows that when we add 5gms of magnetite in 500ml of wastewater sample, 2mg/l or ppm can be recovered.*

**Keyword**: - *Fertilizer industry wastewater, Phosphorous, Recovery process, Adsorption, De-adsorption, Magnetite,*

## 1. INTRODUCTION

Environmental Engineering and Pollution control are the main concerns of these days. Due to increase in population the economical, industrial and technological revolution and change in life style has direct to various types of environmental problems like water pollution, land pollution, air pollution, sound pollution. As Industrialization is backbone for development of India.

Indian fertilizer industry is one industry with immense scopes in future. The fertilizer industry provides employment to the country's population and share about 25% to the GDP. The fertilizer industry started way back in year 1906. There are 57 large scale fertilizer units. All units mainly manufactures phosphate, nitrogenous, complex fertilizers and DAP. India is the 3rd largest fertilizer producer in the world. Fertilizer plays an important role for increasing agricultural production and productivity of land.

Phosphorous is one of the main element uses in fertilizer industry. Phosphorus is a vital element for every plant and animal. Lack of phosphorus in ground can result in limited crop production. Phosphorus is mainly used in agriculture as a fertilizer. The fertilizer industry wastewater effluents have some percentage of chemicals which can be recovered. Huge amount of phosphorous is lost due to lack of its recovery. Thus the main aim of the study is to do Recovery of phosphorous by adsorption method using Magnetite and to reuse the phosphorous.

## 2. MATERIAL AND METHODS

### 2.1 Material

Magnetite is the oldest known magnetic material with the highest magnetic properties of all natural minerals on earth. Its chemical formula is $Fe_3O_4$, but can be also written as $FeO \cdot Fe_2O_3$.
Magnetite is bought from National Chemicals, Vadodara. The cost of Magnetite is 480Rs/500gms.


### 2.2 Chemicals used in Experiments

| SR NO. | NAME | CHEMICAL FORMULA | ASSAY |
|---|---|---|---|
| 1 | Sodium hydroxide pallets | NaOH | ≥ 99 % |

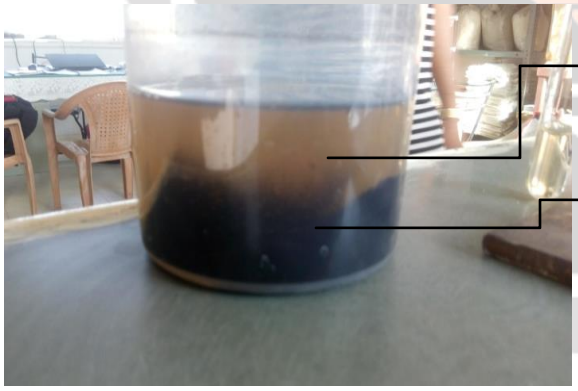
All apparatus, glassware, additional materials (e.g. filters etc.) were present at the laboratory.

### 2.3 Methods

Phosphorus recovery was made in two ways: using one-step base leaching and using two step base leaching. 20%-solution of NaOH was used as a base.
500ml of waste water sample was taken from GSFC ETP outlet. By taking sample of waste water I had checked the PH of sample with the help of PH strip and it came 8.0. But the main factor for recovering of Phosphorous is to have PH of sample 10.0 or more than it. As our PH of sample was 8.0, it was important to increase PH by 10.0 or more for recovery process. For increasing of PH, we have added 20% of NaOH as base solution. By adding NaOH the PH of sample has came to 10.5. After this we have added 5 grams of magnetite in the sample and then stirred it properly in magnetic stirrer at 600rpm. Again checked the PH so that magnetite does not affect the PH value of the sample.
Post this we have to stir the sample for 30 minutes vigorously with the help of magnetic stirrer at 600rpm. The time taken by the magnetite for adsorbing the sample is 30 minutes. After stirring, settle down the sample for 5-10 minutes and then filter it with the help of filter paper. The remaining sample is again to be washed two to three times with distilled water. After doing these, remaining sample is to be mixed with 50ml of 20% NaOH solution and then stir it with vigorously for 10-20 minutes with magnetic stirrer. After stirring settle down the sample and filter it with filter paper. Collect the sample in container and check it in spectrophotometer and the result will be known.

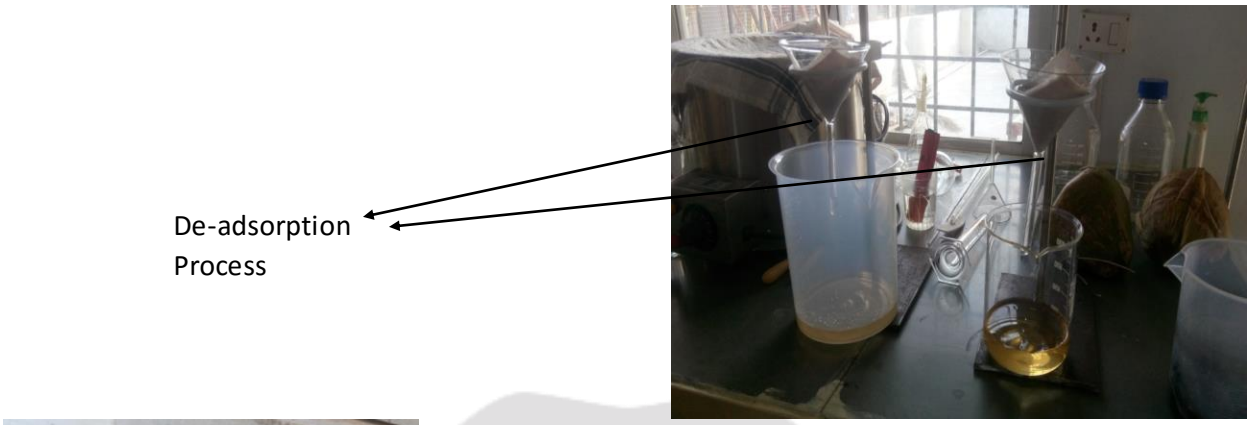
Wastewater Sample

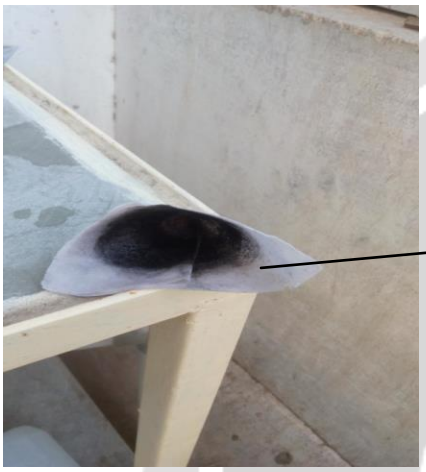
20% NaOH Soln.



Non-adsorbed Wastewater

Adsorbed by Magnetite





## 3. RESULTS AND DISCUSSION

### 3.1 Wastewater characteristics

The characteristics of wastewater were taken from G.S.F.C Ltd ETP Outlet. The various tests were conducted on the wastewater as per procedure laid down in standard methods.

**Table 1**: Characteristics of Fertilizer waste water (Outlet)

| SR NO. | PARAMETERS | RESULTS | TEST METHOD |
|---|---|---|---|
| 1 | Ph | 7.7 | IS 3025(PART 11) 1983, (APHA 22nd Ed.,2012,4500-$H^+$B) |
| 2 | Biochemical oxygen Demand (3days,27 $^0$C) | 110 | IS 3025(PART 44) 1993 |
| 3 | Chemical oxygen Demand (COD) | 235 | IS 3025(PART 58) 2006, (APHA 22nd Ed.,2012,5220-B) |
| 4 | Total Dissolved Solids (TDS) | 2140 | IS 3025(PART 16) 1984, (APHA 22nd Ed.,2012,2540-C) |
| 5 | Suspended Solids (SS) | 44 | IS 3025(PART 17) 1984, (APHA 22nd Ed.,2012,2540-D) |
| 6 | Ammonical Nitrogen | 22 | IS 3025(PART 34) 1988 |
| 7 | Phosphate (PO4) | 16 | IS 3025(Part 31) 1988 |

**Note: -** All Units except pH are in mg/L or ppm.

### 3.2 Adsorption of Phosphorous

For finding optimum adsorption time, volume of wastewater and volume of magnetite are measured in three different combinations. Minimum adsorption time we found is taken as 30 minutes so we have to fix it as described in Table 1.

**Table 1:- Minimum Adsorption time**

| Magnetite Used | Wastewater Volume | Adsorption Time | Phosphorous Recovery | Recovery in % |
|---|---|---|---|---|
| | | 15 min | 1ppm | 6.25% |
| | 500 ml | 30 min | 2ppm | 12.5% |
| | | 45 min | 2ppm | 12.5% |
| 5 gms | | 15 min | 1ppm | 6.25% |
| | 1 L | 30 min | 2ppm | 12.5% |
| | | 45 min | 2ppm | 12.5% |

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| | | | | |
|---|---|---|---|---|
| 10 gms | | 15 min | 1ppm | 6.25% |
| | 1 L | 30 min | 2ppm | 12.5% |
| | | 45 min | 2ppm | 12.5% |

With 16 ppm phosphorous content in wastewater sample, adsorption time taken as 30 minutes, and the recovery of phosphorous done is 2ppm i.e. 12.5%of total phosphorous is recovered. The Table 2 shows the how much amount of magnetite is required for how much amount of wastewater sample is there.

**Table 2:- Magnetite required for wastewater volume**

| **Magnetite Required** | **Volume of Wastewater to pass to get 12.5% recovery** |
|---|---|
| 5 gms | Up to 1.5 liters |
| 10gms | 1.5 liters – 3.5 liters |
| 15 gms | 3.5 liters – 5.5 liters |
| 20 gms | 5.5 liters – 8 liters |
| 25 gms | 8 Liters – 11 liters |
| 30 gms | 11liters – 15 liters |

## 4. CONCLUSION

After doing the experiment, it is concluded that 12.5% of phosphorous is recovered from 16 ppm wastewater sample. In the experiment done magnetite is used in multiple of 5gms and volume of wastewater sample is kept on increasing by 500ml. If the phosphorous content in the sample is high there might be the chances of more recovery or may not be. But if the phosphorous content is low, 12.5% of recovery can be achieved. As it is new field, research work regarding the experiment is not done more and thus there is wide scope of future expansion of the project.

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