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Improvisation in Sedimentation Process using Magnetic Field in ETP

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Abstract: Among all Earthly Elements, Water has great importance. Globally, we consume around 4 trillion cubic meters of water yearly of which a significant amount of it is thrown untreated into water bodies due to the high cost of the water treatment process. So, we are proposing the idea of using soluble powder having magnetic properties to settle suspended particles in a fraction of a minute.
This process will reduce the cost of filtration of water by minimizing the maintenance of RO filters required, decreasing processes required for filtration of macromolecules.
Keywords: Effluent Treatment Plant, sedimentation process, Water Treatment, Industrial wastewater treatment using a magnet.

I. INTRODUCTION

This article is on water treatment of industrial water waste. Water being an important resource should be conserved. Water treatment is a process that improves the water quality to make it usable again in many ways. The purified water can be used for domestic, industrial water supply can safely return to the environment and many more. Water treatment removes the contaminants and undesirable components by which this water becomes fit for the desired end-user.
Nowadays, many companies use Effluent Treatment Plants to clean industrial water. ETP has a screening process, oil separation, coagulation, sedimentation, activated sludge, carbon absorption, sand filtration, deionization, thermal reduction, air-stripping, RO, and biological treatment. ETP aims to filter microparticles present in industrial water so that industrial water can be reused and this method takes time.

1) *Screening:* Screen with a small uniform opening is used to separate large particles from industrial water.
2) *Oil Separation:* As we know oil has less density than water due to this oil is at the upper surface and water is removed from the lower area.
3) *Coagulation and Flocculation:* Chemical coagulant(alum) is added to water which improves the attraction of fine particles form large particles called flocs and by adding chemical flocculant (polyelectrolyte) enhances the process making large flocs.
4) *Sedimentation:* Large floc settles at a lower level using gravity and also removes suspended solids in its path
5) *Activated Sludge:* It is a process in which treating of sewage or industrial wastewaters is done utilizing air circulation and also by biological floc made out of microorganisms and protozoa
6) *Carbon Absorption:* In this water is constrained through actuated carbon to catch contaminants.[7]
7) *Sand Filtration:* Treatment of the water is realized by the porous nature of a sand layer which traps particles present in water.[8]
8) *Deionization:* Deionisation involves a similar passage of wastewater through the beds of synthetic ion exchange resins, where some undesirable cations or anions of the wastewater get exchanged for sodium or hydrogen ions of the resin.
9) *Thermal Reduction:* Thermal reduction requires burning and consequent oxidation of some toxic and refractive substances, like organic cyanide, which may be present in certain specific industrial wastewaters.
10) *RO:* Reverse osmosis process removes ions, molecules, and large particles from water using a semipermeable membrane.[7]
11) *Biological Treatment:* Biological treatment of industrial wastewaters is fundamental when they contain huge amounts of biodegradable substances. Such biological treatment might be utilized either with or without acclimatization.

In the ETP method, the Sedimentation process accounts for a larger duration as small particles take a long time to settle, so to reduce this time magnet is introduced at the bottom of the tank. The magnet will attract particles to settle faster. With this system, the sedimentation time of particles is decreased by up to 90%.

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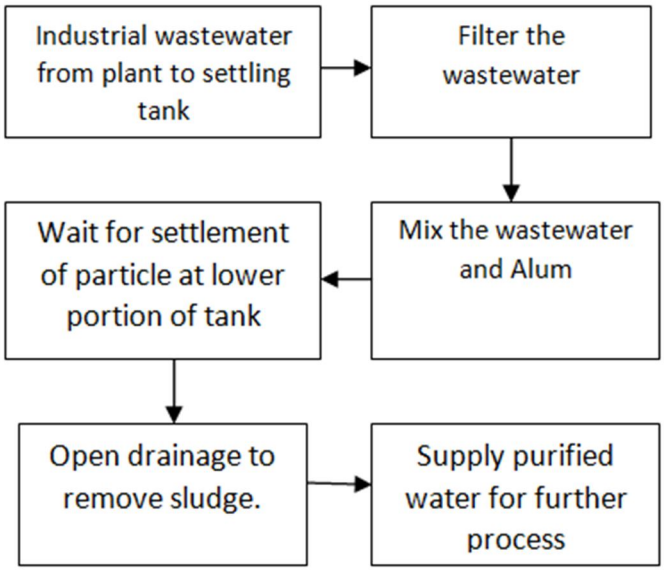
II. EXPERIMENTAL WORK

In the experiment, by using coagulants for sedimentation of small particles present in water after the industrial use. When Alum in crystallized form is added to raw water, it reacts with the bicarbonate alkalinities present in water and forms a gelatinous precipitate. This flocculation process attracts other fine particles and suspended material in raw water, and settles down at the bottom of the container when kept undisturbed due to its heavyweight. The water over this sediment is almost clean other than some fine particles dissolved in it.



We tested sedimentation of suspended particles using alum as a coagulant due to its excellent properties of flocculation. We put 50 gms for 100 liters of water and observed the settlement of particles over time. Noticeably took 1 & ½ hour for the particles to settle at the bottom.

We also tested sedimentation of the same wastewater using polyelectrolyte as an agent (for 100lit of wastewater 30gm polyelectrolyte used). After a long duration of 2-hour results was not satisfying as not much amount of particles have settled.

As we came to know the presence of a high concentration of iron in the wastewater due to the process of deburring/descaling of disc spring. The use of a magnetic field for quick sedimentation was proposed. Magnets were employed at the bottom of the set up to decrease settling time by its magnetic pull.

The advantage of using magnet along with coagulant is that not only the particles settle due to the gravitational force but also the particles which are magnetic in nature are quickly settled and the molecules showing no magnetic susceptibility are combined with the magnetic particles due to flocculation making the overall molecule magnetic by nature. So not only it settles magnetic particles but other non-magnetic molecules too.

An important observation that was observed is that when the amount of solid particles in the form of iron filings, ceramics, and other impurities, in this case, has increased the effectiveness of coagulant decreased. To avoid such limitations, primary screening is a necessity (which can be done using micro filters).

Small scale trial of the sedimentation process in beaker Before performing the main Trail, we got output in 45 seconds:

Fig. 2.1-First Iteration

For experimental purpose, we made a setup during the internship which is described further-
Output water was fed into a sedimentation tank after filtration, where coagulant was added to start the sedimentation process. For the uniform flocculation process, a gear mechanism was used (this assures that all suspended particles come in contact with coagulant).

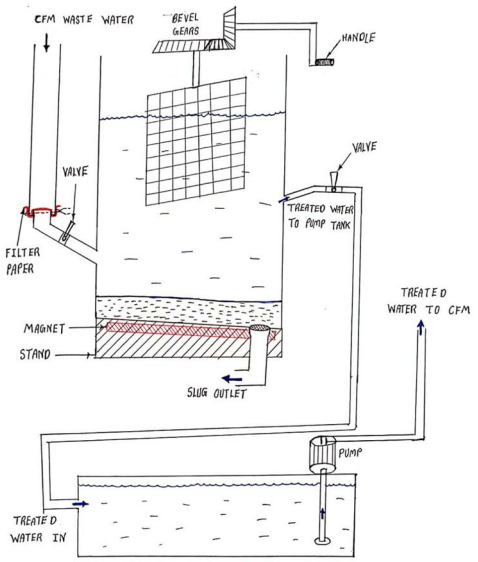


Fig. 2.2 Construction

Magnetic field effectively pulling the particles was visible to the naked eye. The clear water was then passed for further processing and the sludge below the tank was flushed from the bottom valve.

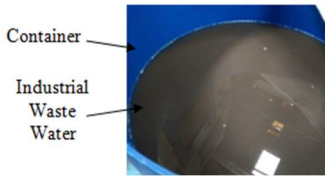


Fig.2.3-Before Treatment of Industrial Wastewater using the above setup

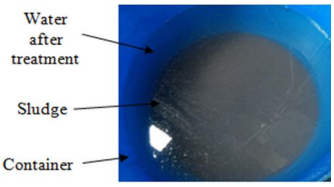


Fig.2.4-After Treatment of Industrial wastewater using the above setup

III. STUDIES & FINDINGS

Experimental data shows that coagulant is effective in sedimenting suspended particles up to a certain extent but the process takes a more extended period to occur.
We came to know that output water contained a large amount of iron compounds. We tried to reduce the settling time by performing the process under the influence of the magnetic field.
Due to this, as per our observations settling time of coagulant was reduced from 2 hours to 5 minutes. This process was promising for the current experiment. Studying various coagulants for the process, we found a need for a coagulant that can combine the benefits of coagulation and magnetic sedimentation by introducing a magnetic metal in the coagulant molecules.
This will lower the sedimentation time and enable the water purification process to increase its treatment capacity.

IV. FUTURE SCOPE

A. ETP Plant

Effluent Plant uses various processes to make industrial wastewater safe for disposal to the environment/ reuse for some secondary purpose. The proposal is to use coagulate which will be magnetic by nature to combine all suspended particles in water and settle it by using a magnetic field. This process will reduce the sedimentation time of sludge and increase capacity along with the plant's efficiency. Due to the increase in the rate of sedimentation will eliminate the requirement of multiple tanks for sedimentation, resulting in a reduction in initial investment of the plants.

B. Desalination

Desalination is a process of removal of minerals from water (mostly seawater). Solar distillation, Vacuum distillation, Multi-Stage Flash distillation, Multiple-effect distillation, Vapour-compression evaporation, Reverse Osmosis, Freeze-thaw, Electrodialysis membrane, Membrane distillation, Wave-powered distillation are the various processes used of which RO is the most popular method due to its comparative cost-effectiveness.

This RO process employs multiple filters in series to trap the minerals present in water. As the seawater's mineral content is high, these filters require quick replacement due to their ineffectiveness after pores of the membrane are blocked. Instead, using coagulates to draw together minerals and settle them using a magnetic field will help us in decreasing the quantity of filters, decrease plant size, increase the service life of filters, and reduce maintenance cost.

C. Sewage Treatment Plant

Ferric chloride(FeCl3)is used in wastewater treatment facilities to precipitate phosphorus to remove it from the system because a high concentration of it at discharge will eventually lead to eutrophication (excessive nutrients in water bodies) and hypoxia (oxygen deficiency) in local waterways. But by nature ferric chloride is magnetic in nature and this property can be for reducing settling time by exposing it to the magnetic field during the sedimentation process.

V. RESULT

We performed with different techniques and coagulant material(given below) to improve the system's performance. After some experiment, We found out that an alum with a magnet at the bottom of the container increased the system's efficiency.

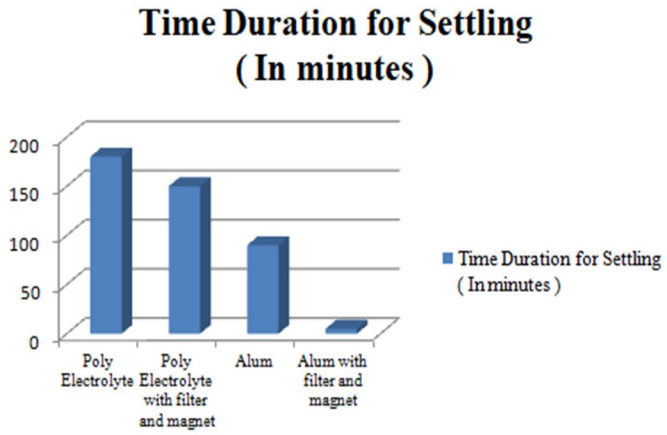


Fig.4

VI. CONCLUSION

In ETP, Sedimentation is an essential treatment that represents a longer span of around 2 hours in the entire plant. Because of this, the limit of the plant every hour is radically diminished. In a large portion of modern wastewater, the attractive particles present in wastewater so presenting a magnet at the base of the sedimentation tank will lessen time . With the assistance of alum, Non-attractive and attractive molecules will join which is called coagulation and flocculation. Magnet's attractive field pulls in particles to settle quickly, which will expand the limit every hour of the framework.

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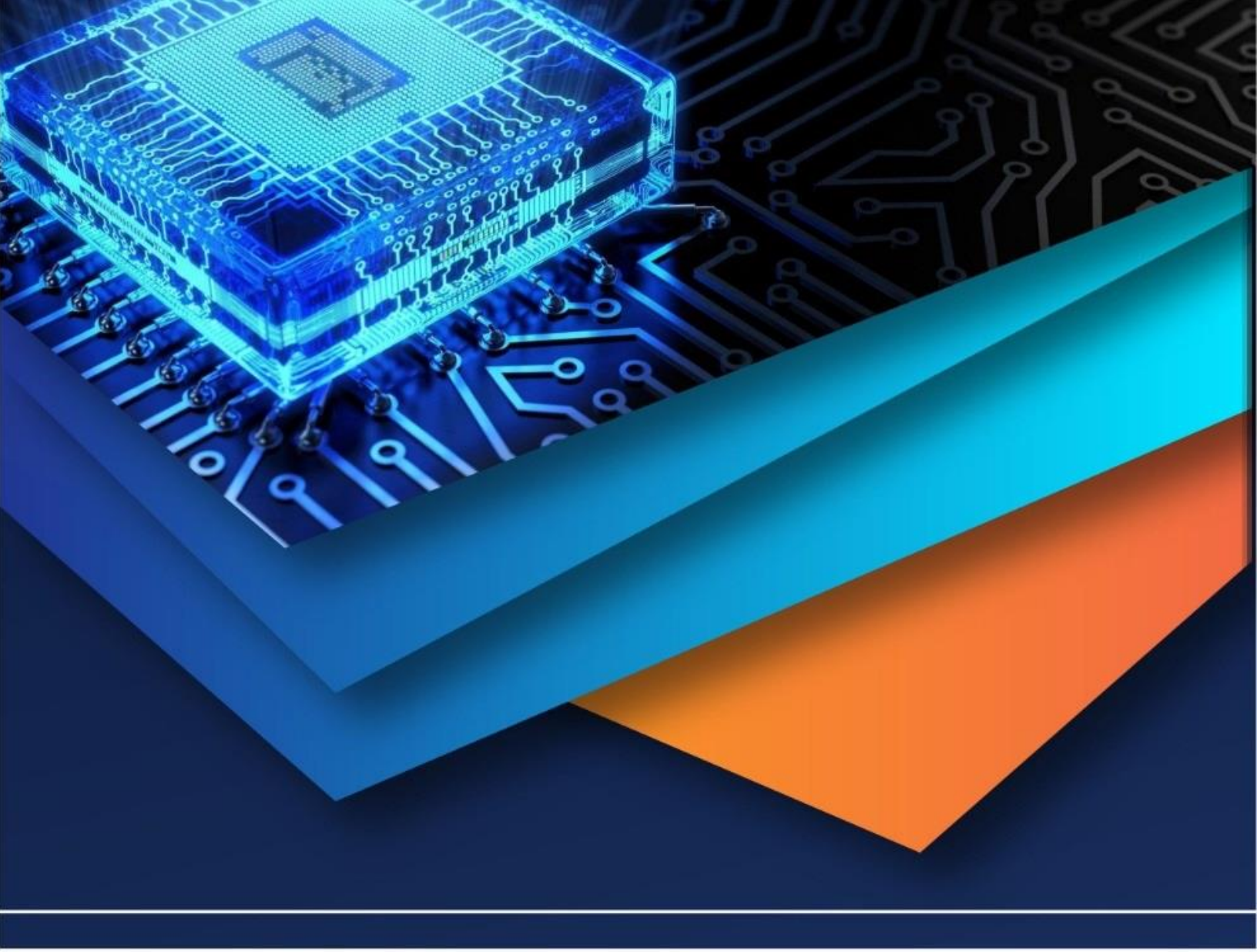

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