*International Research Journal of Environment Sciences*_____ ISSN 2319–1414
Vol. **3(11),** 29-31, November **(2014)** *Int. Res. J. Environment Sci.*

Pretreatment of Effluent released by Steel Industry

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Available online at: www.isca.in, www.isca.me
Received 1st September 2014, revised 23rd October 2014, accepted 22nd November 2014

Abstract

The vast and rapid development of industries has lead to destruction of nature. Sources of nature like the water, air, soil, etc are being invariably polluted due to these industries. The release of toxic compounds from the various industries like the leather, chemical, pharmaceutical, steel, textile, food, play a major role in the nature imbalance. Pretreatment process step makes the initial purification easier and faster. This paper showcases the processing and effects of effluent released along with the initial treatment of the effluent, the pretreatment using alum, polyvinyl alcohol, and dolomite. The effect and optimization of various parameters are also explained.

Keywords: pollution, effluents, pretreatment, optimization, coagulation.

Introduction

Every effluent released into the environment is to be treated before being released into the environment. And if this doesn't take place the toxicity of the effluent increases leading to pollution. There are various stages of treating an effluent, the pretreatment, secondary treatment and the tertiary treatment[1] in table-1.

The above are the various pollutants found in the effluent released and their pretreatment methods[2]. The impurities can be removed by biological, chemical or physical methods[3].

This paper explains the use of economical and easily available compounds for the treatment of effluent that has various concentrations of toxic metals in them[4-6]. According to this pretreatment method Alum[7], Polyvinyl alcohol, and Dolomite are the major components used, under optimized conditions of time, concentration and pH.

Alum: Alum is also named as Potassium alum, potash alum, a crystalline solid and potassium aluminum sulphate. It is used for many of the purposes like purification of drinking water as a chemical flocculants, used for soak of some pickles and also used as deodorant. Sodium aluminum sulphate is a type of alum that is used in commercial backing powder. Alum helps cell walls of fruits and vegetables constant, so in this case alum is approved as food additive. Used in various medicines for different uses. It has various disadvantages, causes irritation to skin and mucous membrane, lung damage caused due to breathing, it also affect lunge tissues. Due to more amounts of salts in alum can make you sick.

It is an anhydrous carbonate mineral composed with calcium magnesium carbonate. When it is treated with water removes the hardness caused by carbonate minerals. Mineral dolomite is named as dolostone.

Table-1
Determination of Effluent characteristics by different Treatment Methods

S. No.	Effluent characteristics	Treatment methods
1	Bio-Chemical Oxygen Demand (BOD) Activated Sludge	Trickling filter or RBC Aerated lagoon Oxidation ditch
2	Total Suspended Solids (TSS) Sedimentation	Screening, Flotation, Chemical precipitation, Nitrogen Nitrification/ denitrification, Air stripping, Breakpoint chlorination, Phosphorus Chemical precipitation, Air stripping
3	Heavy metals	Biological treatment, Chemical precipitation, Evaporation, Membrane process
4	Pathogens	Chemical disinfection, UV radiation
5	Fats, Oil and Grease (FOG)	Coagulation, Flotation, Biological treatment, Membrane process, Volatile Organic Compounds Air stripping, Biological treatment, Carbon adsorption

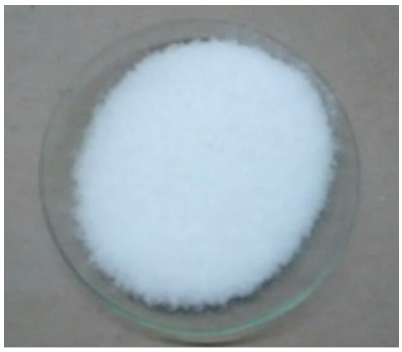

Figure-1
Alum (picture taken at chemical engineering lab, Andhra university) Dolomite

Lime is used in water utilities to prepare water for treatment processes by adjusting the water's pH. And to minimize the corrosion of pipes and equipment, utilities add lime to neutralize acidic water. Dolomite forms white, gray, or pink crystals; it is a double carbonate having alternating structural arrangement of calcium and magnesium ions. It removes impurities such as fluoride, iron, manganese and organic tannins etc., from water. It is used as ornamental stone, important petroleum reservoir rock, helps in buffer changes of pH in saltwater.

Figure-2
Dolamite (picture taken at chemical engineering lab, Andhra University)

Polyvinyl alcohol: It is a compond very commonly used in flocculating the solids present in the solution.Physically appears as white smally grained powder,that dissolves on heating and to react[8].

Material and Methods

Materials Required: Alum, Polyvinyl alcohol (PVA), Dolomite, Distilled water, Conical flasks, Pipette, pH meter.

Method: PVA solution preparation: 0.5gms of PVA is making up with 500 ml of distilled water. Dolomite Solution Preparation: 1gm of dolomite is making up with 100ml of distilled water. Alum Solution Preparation: 1gm of alum is making up with 100ml of distilled water. Pretreatment Sample Preparation: 0.1N Alum+1N PVA+0.1N dolomite are taken in a conical flask and 100ml of effluent is added and allowed to settle for 15 min to coagulate.

Results and Discussion

Table-2 explains the increase in the coagulation of the solids[9] in the effluent on addition of alum, dolomite and PVA. Leaving the sample undisturbed for intervals gives the sample being treated on increase in the solids settlement as the weight of solids decrease. Initial weight of the solids was 0.0352 gm/ml.

Table-2
Observation of weight of solids with various time intervals

S.No	Time (hr)	Weight of the solids (gm/ml)
1	1	0.0424
2	2	0.0309
3	3	0.0158

Table-3
Observation of pH with various time intervals

S. No	Time (hr)	pH
1	1	7.51
2	2	7.57
3	3	7.61

The above table-3 explains the pH remains constant after 3 hrs of time. The initial pH of the effluent was 7.69.

Table-4
Observation of weight of solids with various Alum dosage

S.No	Alum (ml)	Weight of the solids (gm/ml)
1	2	0.8192
2	4	0.8341
3	6	0.8692

The increase in the alum concentration of alum increases the coagulation and increases the solids weight. At 6ml of alum solids settle to the maximum leaving the effluent treated for next step of treatment in table-4 and table-5.

Table-5
Observation of pH with various Alum dosage

S.No	Alum (ml)	pH
1	2	7.84
2	4	7.42
3	6	7.19

At the concentration of 6ml of alum the pH remains constant. The untreated sample pH was 7.19.

Discussion: Hence, on observing all the above parameters time, alum concentration, and pH the optimized conditions were the alum concentration of 6ml,PVA 10ml,dolomite 10ml,time 3hrs and pH at 7.19 shown in figure-3. These parameters influence the estimation and removal of various compounds in the process of purification of wastewater into useful water[10].

Figure-3
The variation of alum concentration indicates the settlement (picture taken at chemical engineering lab, Andhra University)

Table-6
Observation of Optimized parameters

Time (hr)	pH	Alum (ml)	Untreated concentration (ppm)	pretreated concentration (ppm)
3	7.19	6	1198	535

Schematic Explanation of Pretreatment: PVA of 1N+0.1N Alum+0.1N dolomite

⇩

100ml of effluent is added

⇩

Time, pH, alum concentration were studied for optimization.

⇩

The alum concentration of 6ml, at a pH of 7.19 and time duration of 3hrs, the effluent is said to be at optimized condition was concluded in table 6.

Conclusion

The use of alum, dolomite, and polyvinyl alcohol were effective in treating the effluent as a part of pretreatment. This step enhances and speeds up the process of reusing the effluent by removing basic compounds. Coagulation is the basic principle behind this method, which allows the removal of compounds in them and treating it in large scale. The optimized conditions were studied carefully at each and every step of treatment that proves to be the most effective and economical method of treating the effluents before treating or recycling it.

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