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Review on Pretreatment of Effluent Released from Steel Industry

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Abstract

There are many reasons for the environmental pollution. One of the main reason is the vast industrialization, which contributes to 78% of the world's pollution. There are various industries like leather, food, automobile, pharmaceutical, leather, textile, etc, responsible for the destruction of nature. Steel is one of the major metal produced in huge quantities which releases toxic effluents like nickel, copper, cadmium, lead, nitrates, chromium. These elements lead to great destruction in both flora and fauna by variety of diseases and loss of natural habitats. Biological, physical, and chemical techniques help in the treatment. This paper reviews on treating these effluents initially by simple laboratory methods.

Keywords: Industrialization, Toxic effluents, Pretreatment, Pollution, Major metals.

Introduction

There various reasons for the cause of pollution of soil, air, and water. Mainly the urbanization and industrialization is the main cause. The steel industry is one of the cause to disturb the flora and fauna nature with the release of toxic compounds into the water like nitrates, ammonia, lead, nickel, chromium etc. The aquatic life cycle is totally disturbed due to these toxic compounds. This article gives an idea about the methods of treating the toxic compounds using simple and easily available purifying techniques.

Nitrates

Nitrate levels at or above 10 mg/L level have been known to cause a fatal blood disorder in infants under six months of age called methemoglobinemia or "blue-baby" syndrome; which causes reduction in the oxygen-carrying capacity of blood. The symptoms of blue-baby syndrome are often confused with other illnesses.

Cadmium

Acute exposure to cadmium fumes may cause bronchial problem but can resolve after a week if there is no respiratory damage. More severe exposures can cause tracheo-bronchitis, pneumonitis, and pulmonary edema. Symptoms of inflammation may start hours after the exposure and include cough, dryness and irritation of the nose and throat, headache, dizziness, weakness, fever, chills, and chest pain.

Lead

The lead reacts with the various organs and tissues in the body like heart, lungs, kidneys, and nervous system. The increased intake of lead causes dizziness, coma, and ultimately to death.

Nickel

An uptake of too large quantities of nickel has chances of development of lung cancer, nose cancer, larynx cancer and prostate cancer, sickness and dizziness after exposure to nickel gas, lung embolism, respiratory failure, birth defects, asthma and chronic bronchitis, allergic reactions such as skin rashes, mainly due to jewellery, heart disorders.

Chromium

Chromium(III) is an essential nutrient for humans and shortages may cause heart conditions, disruptions of metabolisms and diabetes. But the uptake of too much chromium(III) can cause health effects as well, for instance skin rashes. Chromium(VI) is a danger to human health, mainly for people who work in the steel and textile industry. People who smoke tobacco also have a higher chance of exposure to chromium. Chromium(VI) is known to cause various health effects. When it is a compound in leather products, it can cause allergic reactions, such as skin rash. After breathing it in chromium(VI) can cause nose irritations and nosebleeds. Hence the above chemicals are carcinogenic and effective on health and environment. In order to treat the effluent various methods are involved. The treatment involves the

pretreatment, primary treatment, secondary and tertiary treatment. The below chemicals help widely in the treatment in a very simple and quick method. These chemicals are also considered to be easily, cheaper and eco friendly in nature.

Table 1: Various methods of treating effluent released

INDUSTRY	PRETREATMENT
TEXTILE	Neutralization, precipitation, biological treatment.
FOOD AND BEVERAGES	Centrifugation, screening, biological treatment, chemical treatment.
PHARMACEUTICALS	Evaporation, drying.
PULP AND PAPER INDUSTRY	Sedimentation, neutralization, biological treatment.
PLASTIC AND RESIN	Neutralization, biological treatment.
METAL PLATING	Chemical precipitation, drying, sedimentation
DETERGENTS	Chemical floating, chemical precipitation.

Dolomite

The salient feature of our natural dolomite is its higher degree of purity, wet ability and whiteness. Our natural Dolomite mineral powder is popular for its shear and compressive strength. Our natural dolomite is fire resistive and solid.

Water softening:

Hydrated lime (calcium hydroxide) treated with water removes hardness caused by carbonate minerals. Treating with lime remedies non-carbonate hardness--that is, hardness resulting from non-carbonate calcium minerals and magnesium salts.

pH Adjustment:

Water utilities use hydrated lime to prepare water for treatment processes by adjusting the water's pH. To minimize corrosion of pipes and equipment, utilities add lime to neutralize acidic water.

Coagulation and flocculation:

Addition of lime to the water helps in coagulation of the waste particles resulting in the settlement of particles as clumps.

Disinfection:

With increase in water at a pH of 10.5 to 11 by adding lime inhibits the growth of bacteria and some viruses.

Purification

Lime removes impurities such as fluoride, iron, manganese and organic tannins from water. The magnesium in dolomite lime is especially effective in removing silica from water. A side effect of the lime-enhanced softening process is arsenic removal, while disinfection with lime also serves to remove most heavy metals.



Fig 1: Dolomite

Alum

Alum is seen in its crystalline form, although it is most often sold as a powder. Potash alum is a fine white powder that you can find sold with kitchen spices or pickling ingredients. It is also sold as a large crystal as a "deodorant rock" for underarm use.

Table 2: Types of Alum

TYPE OF ALUM	ALUM USES
POTASSIUM ALUM (KAl(SO ₄) ₂)	In the pickling process, tanning of leather, flocculant in water, after shave treatment.
SODA ALUM (NaAl(SO ₄) ₂ ·12H ₂ O)	In food as an acidulant {baking powder}.
AMMONIUM ALUM (NH ₄ Al(SO ₄) ₂ ·12H ₂ O)	It is used for tanning, dyeing textiles, making textiles flame

	retardant, in the manufacture of porcelain cements and vegetable glues, in water purification and in some deodorants.
CHROME ALUM($KCr(SO_4)_2 \cdot 12H_2O$)	It is used in tanning and can be added to grow lavender or purple crystals.
ALUMINIUM SULFATE	This compound is also known as papermaker's alum. However, it is not technically an alum.

Uses of Alum

Alum has several household and industrial uses. Potassium alum is used most often, although ammonium alum, ferric alum and soda alum may be used for many of the same purposes like purification of drinking water as a chemical flocculant, in styptic pencil to stop bleeding from minor cuts, adjuvant in vaccines, deodorant "rock", pickling agent to help keep pickles crisp, flame retardant, the acidic component, an ingredient in some homemade and commercial modeling clay, an ingredient in some depilatory (hair removal) waxes, skin whitener, ingredient in some brands of toothpaste.



Fig 2: Alum

Polyvinyl Alcohol(PVA)

It is a compound very commonly used in flocculating the solids present in the solution. Physically appears as white small grained powder, that dissolves on heating and to react.

Pretreatment stages

Physical:

- Sedimentation - gravity settling of pollutants.
- Flotation - removes wastewater by gas bubbles.
- Air stripping - removes volatile and non volatile particles.

Chemical:

- Neutralization - maintaining acidity and alkalinity.
- Precipitation - adding chemicals to change composition of pollutants and settle them down.
- Coagulation-flocculation and coagulation on adding chemicals.
- Adsorption - adhering of pollutant to the chemical compounds.
- Disinfection - using UV to sterilize.
- Breakpoint chlorination - addition of chlorine.

Biological:

- Air activated sludge - aerobic process converts wastewater.
- Aerated pond/lagoon - aerobic process with agitators to allow oxygen transfer.
- Trickling filter - fixed film aerobic process.
- Rotating biological contactor - fixed film aerobic process similar to trickling filter.
- Oxidation ditch - aerobic process.

Conclusion

On the reviewing about various methodologies and variety of toxic compounds and their toxicity, there is scope of treating the effluent primarily at the stage of pretreatment with economical and easily available chemicals and methods. There are various chemical compounds available in nature, but only few chemical have the property to be effective, less toxic, simple, available and inexpensive. Hence, the use of these chemicals in the process begins with lessening the toxicity can conclude with efficient reduction at the final treatment step.

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