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Effluents and Waste Water Treatment by Physical, Chemical and Biological Method

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ABSTRACT
During the last 30 years, the prompt population increment, the environmental issues as the result of urbanization of the cities and development of industries in large scale. Among the other pollutants: water pollution is one of the important issues. Such pollution not only affects human health but also harmful agriculture and the earth. Drinking safe and clean water is one of the rising problems around the world. This review article highlight conventional waste water treatment consists of physical, chemical and biological method to remove insoluble particles and soluble contaminants from effluents.

Keywords : Effluents, Waste Water Treatment Physical, Chemical, Biological Method.

I. INTRODUCTION

Effluent is considered to be water pollution is such as outflow from the sewage treatment facilities or waste water discharge from industries. Effluent is defined by the United States Environmental Protection Agency as "wastewater- treated or untreated- that flows out of a treatment plant, sewer, or industrial outfall. It generally refers to wastes discharged into surface waters".

The Compact Oxford English Dictionary defines effluent as "liquid waste or sewage discharged into a river or the sea". Thus an effluent is something that flows out; a stream flowing out of a lake, reservoir, etc; the outflow of a sewer, septic tank, etc; sewage that has been treated in a septic tank or sewage treatment plant; sewage or other liquid waste that is discharged into a body of water, a discharge of liquid waste, as from a factory or nuclear plant.

In spite of having an efficient design and technology, some waste generation is inevitable in any manufacturing processes. Managing the waste by reuses, recycle or otherwise recover and dispose is the responsibility of the industry itself. The waste may be solid, liquid, or a gas, but the old system of leaving it to the open environment, is a barbaric act against the interest of mankind and nature. Disposal of effluent and waste in a safe, efficient and effective manner is the remedy to avoid adverse environmental effects.

Poor management of waste treatment and effluent disposal systems, results in potential public health risk. Variable factors including prevailing and seasonal weather conditions, topography, separation distances from residences and public facilities, the quantity, concentration and the type of effluent and the nature of the receiving water environment are factors that are to be assessed when designing a waste treatment and effluent disposal system. No nuisance from odour or danger to public health and safety is to be caused by waste and effluent disposal systems.

II. CHARACTERSTICS OF EFFLUENTS

The characteristics of effluents are depending on the source and type of it. For example, an effluent like municipal waste water will be having different characteristics from that of a factory, or from that of a shrimp farm, or from that at a mine. Each of the effluent has to be analyzed and studied for its characteristics.

For example, municipal wastewater is mainly comprised of water (99.9%) together with relatively small concentrations of suspended and dissolved organic and inorganic solids. Among the organic substances present in sewage are carbohydrates, lignin, fats, soaps, synthetic detergents, proteins and their decomposition products, as well as various natural and synthetic organic chemicals from the process industries.

Municipal wastewater also contains a variety of inorganic substances from domestic industrial sources including a number of potentially toxic elements such as arsenic, cadmium, chromium, copper, lead, mercury, zinc, etc. Even if toxic materials are not present concentrations likely to affect humans, they might well be at phototoxic levels, which would limit their agricultural use. However, from the point of view of health, a very important consideration in agricultural use of wastewater, the contaminants of greatest concern are the pathogenic micro- and macro-organisms.

Wastewater discharged from an industrial plant contains various types of impurities depending on the type of dyes, chemicals, auxiliaries and process used. Some of these impurities are considered toxic while some are not. Of course, the toxicity or harmfulness also depends on the amount present in a certain amount of wastewater and its potential use. For example water is used for drinking purposes. irrigation in the fields, in various types of textile, chemical, food processing. leather processing and pharmaceutical industries, and also to maintain the aquatic life in the canals and rivers. In all these cases different level of purity in terms of toxicity and harmfulness is required.

Of the many variable characteristics often studied and most critical in an industrial effluent are pH, suspended solids, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total suspended solids (TSS), Total dissolved solids (TDS), Total Organic Carbon (TOC), oil and grease content, Total Phosphorous, Total Nitrogen, Ammonia, and physical characteristics like colour, odour and temperature. The strength of the wastewater is often determined by measuring the amount of oxygen consumed by microorganism like bacteria in biodegrading the organic matter. BOD is not an accurate quantitative test, although it could be considered as an indication of the quality of a water source. The presence of radioactive substances, fecal bacteria, and heavy metals are also important.

III. METHODS FOR WASTE WATER TREATMENT

Wastewater treatment consists of applying known technology to improve or upgrade the quality of a wastewater. Usually wastewater treatment will involve collecting the wastewater in a central, segregated location (the Wastewater Treatment Plant) and subjecting the wastewater to various us treatment processes.

Its objective is to produce an environmentally-safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer). Using advanced technology it is now possible to re-use sewage effluent for drinking water.

Wastewater treatment, however, can also be organized or categorized by the nature of the treatment process operation being used; for example, physical, chemical or biological.

A. Physical Method

Physical methods include processes where no gross chemical or biological changes are carried out and strictly physical phenomena are used to improve or treat the wastewater. Examples 'coarse screening' to remove larger object and sedimentation (or clarification). In the process of sedimentation, physical phenomena relating to the settling of solids by gravity are allowed to operate; Usually this consists of simply holding a wastewater for a short period of time in a tank under dormant conditions, allowing the heavier solids to settle, and removing the "clarified" effluent. Another physical treatment process consists of aeration - that is, physically adding air, usually to provide oxygen to the wastewater. Still other physical phenomena used in treatment consist of filtration. Here, wastewater is passed through a filter medium to separate solids. An example the use of sand filters to further remove entrained solids from a treated wastewater. Permitting greases or oils, for example, to float to the surface and skimming or physically removing them from the wastewaters is often carried out as part of the treatment process.

In certain industrial wastewater treatment processes strong or undesirable wastes are sometimes produced over short periods of time. Since such "slugs" or periodic inputs of such wastes would damage a biological treatment process, these wastes are sometimes held, mixed with other wastewaters, and gradually released, thus eliminating "shocks" to the treatment plant. This is called equalization. Another type of "equalization" can be used to even out wide variations in flow rates. For example, the wet well of a pump station can receive widely varying amounts of wastewater and, in turn. pump the wastes onward at more uniform rates.

B. Chemical Method

Chlorination, Ozonation, Neutralization, Coagulation, Adsorption, and lon Exchange are examples of chemical methods. Chemical treatment consists of using some chemical reaction or reactions to improve the water quality. The most commonly used chemical process is chlorination. Chlorine, a strong oxidizing chemical, is used to kill bacteria and to slow down the rate of decomposition of the wastewater. Another strong oxidizing agent that has also been used as an oxidizing disinfectant is ozone.

A chemical process commonly used in many industrial wastewater treatment operations is neutralization. Neutralization consists of the addition of acid or base to adjust pH levels back to neutrality. Since lime is a base it is sometimes used in the neutralization of acid wastes.

Coagulation consists of the addition of a chemical that, through a chemical reaction. forms an insoluble end product that serves to remove substances from the wastewater. Polyvalent metals are commonly used as coagulating chemicals in wastewater treatment and typical coagulants would include lime (that can also be used in neutralization), certain iron containing compounds (such as ferric chloride or ferric sulphate) and alum ($K2SO4.Al2(SO4)3\ 24H2O$).

Certain processes may actually be physical and chemical in nature. The use of activated carbon to "adsorb" or remove organics, for example, involves both chemical and physical processes.

C. Biological Method

Biological treatment methods use microorganisms, mostly bacteria, in the biochemical decomposition of wastewaters to stable and products. More microorganism, or sludge are formed and a portion of the waste is converted to carbon dioxide, water and other end products. Generally, biological treatment methods can be divided into aerobic and anaerobic methods, based on availability of dissolved oxygen.

Aerobic methods include Activated Sludge Treatment Methods, Trickling. Folters, Oxidation Ponds, Lagoons etc. Here oxidation of the organic matter takes place.

Anaerobic methods include Anaerobic Digestion. Septic Tanks, and Lagoons where mostly reduction of carbon in organic compounds into hydrocarbons takes place.

The solids which are removed are primarily organic but may also include inorganic solids. Treatment must also be provided for the solids and liquids which are removed as sludge. Finally, treatment to control odours, to retard biological activity, or to destroy pathogenic organisms may also be needed.

Wastewater may contain high levels of the nutrients nitrogen and phosphorus. Excessive release to the environment can lead to a buildup of nutrients, called eutrophication, which can in turn encourage the overgrowth of weeds, algae, and cyanobacteria (blue-green algae). This may cause an algal bloom, a rapid growth in the population of algae. The algae numbers are unsustainable and eventually most of them die. The decomposition of the algae by bacteria uses up so much of oxygen in the water that most or all the animals die, which creates more organic matter for the bacteria to decompose. In addition to causing a deoxygenating condition, some algal species produce toxins that contaminate drinking water supplies. Different treatment processes are required to remove nitrogen and phosphorus.

D. Some examples of Biological Methods are

Nitrogen Removal

The removal of nitrogen is effected through the biological oxidation of nitrogen from ammonia to nitrate (nitrification), followed by denitrification, the reduction of nitrate to nitrogen gas. Nitrogen gas is released to the atmosphere and thus removed from the water.

Nitrification itself is a two-step aerobic process, each step facilitated by a different type of bacteria. The oxidation of ammonia (NH3) to nitrite (NO_2^-) is most often facilitated by Nitrosomonas; while the nitrite oxidation to nitrate (NO_3^-), is facilitated by Nitrobacter.

Denitrification requires anoxic conditions to encourage the appropriate biological communities to form. It is facilitated by a wide diversity of bacteria. Sand filters, lagooning can all be used to reduce nitrogen, but the activated sludge process can do the job the most easily.

Phosphorus Removal

Phosphorus removal is important as it is a nutrient for algae growth in many fresh water systems. Phosphorus can be removed biologically in a process called enhanced biological phosphorus removal. In this process, specified bacteria, called Polyphosphate Accumulating Organisms (PAOs), are selectively enriched and accumulate large quantities of phosphorus within their cells. When the biomass enriched in this bacteria is separated from the treated water, these bio-solids have a high fertilizer value.

Phosphorus removal can also be achieved by chemical precipitation, usually with salts of. iron (e.g. ferric chloride), aluminium (e.g., alum), or lime. This may lead to excessive sludge production as hydroxides precipitates and the added chemicals can be expensive. Chemical phosphorus removal requires significantly smaller equipment than biological removal and it is easier to operate and is often more reliable than biological phosphorus removal. Once removed, phosphorus, in the form of a phosphate-rich sludge, may be stored in a land fill or resold for use in fertilizer.

Disinfection

The purpose of disinfection in the treatment of waste water is to substantially reduce the number of microorganisms in the water to be discharged back into the environment. The effectiveness of disinfection depends on the quality of the water being treated (e.g., cloudiness, pH, etc.). the type of disinfection being used, the disinfectant dosage (concentration and time), and other environmental variables. Common methods of disinfection include ozone, chlorine, ultraviolet light, sodium hypochlorite and Chloramines.

Chlorination remains the most common form of waste water disinfection due to its low cost and long-term history of effectiveness. One disadvantage is that chlorination of residual organic material can generate chlorinated-organic compounds that may be carcinogenic and harmful to the environment. Further, because residual chlorine is toxic to aquatic species, the treated effluent must also be chemically de-chlorinated, adding to the complexity and cost of treatment.

Ultraviolet (UV) light can be used instead of chlorine, iodine, or other chemicals. Because no chemicals are used, the treated water has no adverse effect on organisms that later consume it. UV radiation causes damage to the genetic structure of bacteria, viruses, and other pathogens, making them incapable of reproduction.

IV. CONCLUSION

Throughout the years, the water is polluted because of urbanization, industrialization and unskilled utilization of natural water resources. There are numerous methods of removing effluents from the sewage water and treating the waste water for reuse. The scarcity of the shortage of water globally, various studies has been carried to solve this problem and in this connection, waste water treatment is among the one. In this review article, a brief and detailed introduction of the waste water has been highlighted. One the basis of reviewed literature in this article, following are the some concluded remarks-

- The advanced new green technical methods are being used to overwhelm the conventional techniques of wastewater treatment.
- Some techniques covenant with decrease of heavy metals where other techniques compact with lessening of Phosphorus and Nitrogen.
- The biological method particularly fungi and bacteria for wastewater treatment, specifically for colored compounds in the molasses found distilleries wastes.

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