Journal of Advances and Scholarly Researches in Allied Education
Vol. 16, Issue No. 11, November-2019, ISSN 2230-7540

Waste Water Management

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Abstract - The problem of limited fresh water sources has worldwide ramifications. Rising global demand is the single most important contributor to the rapid and severe decline of the world's freshwater supplies. As a result of this problem, the scientists were inspired to develop novel and inexpensive approaches to fixing it. In order to make wastewater from industrial operations suitable for use in agriculture, many solutions have been proposed, one of which is the removal of dangerous pollutants. This article sheds light on both traditional and contemporary approaches utilised for this function, with special focus on the recycling of waste products and the utilisation of renewable materials derived from natural resources. The article also zeroes attention on a minor but growing development in the industry: the use of polymer nanocomposites in the purification of water. Nanocomposites made from polymers found in nature are called "polymer nanocomposites."

Keywords - waste water, Freshwater, Scientists, Industrial Operations.

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1. INTRODUCTION

Wastewater is defined as water whose physical, chemical, or biological qualities have been altered to the point where it is unfit for certain uses, including but not limited to human consumption. The majority of human "waste" gets disposed of into waterways as a result of normal, daily activity. Human wastes (faeces and urine), food scraps, fat, washing powder, fabric conditioners, toilet paper, chemicals, detergent, home cleansers, dirt, and micro-organisms (germs) are only some of the items that may make people sick and damage the environment. Because so much of the available water winds up as wastewater, proper treatment of this resource is crucial. To protect human health and the environment, wastewater must be treated, which involves a series of processes and technological advancements that eliminate the vast majority of wastewater's toxins. To safeguard public health, economic stability, social harmony, and political stability, it is necessary to manage wastewater in a way that does not harm the environment.[1]

1.1 History of wastewater treatment

Though drainage systems were developed before to the eighteenth century, wastewater treatment is a more recent activity. In the past, workmen would dump buckets of "night dirt" into "honeywagon" tanks as they passed them down the streets. It was shipped to the country to be dumped on farms. The introduction of flush toilets in the nineteenth century contributed to a rise in the waste produced on these farmlands. Despite Edwin Chadwick's 1842 suggestion that "rain to the river and sewage to the earth," communities started using drainage and storm sewers to carry wastewater into waterbodies due to this transportation difficulty. Gross pollution and health issues for downstream consumers resulted from dumping garbage into waterways.[2]

The first "modern" sewage system for waste water conveyance was constructed in Hamburg, Germany, by an English engineer called Lindley in 1842. The Lindley system is still in use today, with only minor modifications due to advancements in materials and the installation of manholes and other sanitary sewer appurtenances. Wastewater treatment was not a priority until the health risks associated with inadequate disposal were no longer tenable. Many other approaches were tested during the late 1800s and the early 1900s, and it wasn't until 1920 that the procedures we use now were put into practise. However, until the middle of the twentieth century, it was designed based on trial and error. Septic systems with a central location for waste disposal were promoted and developed. the towns that provide their wastewater to the treatment facility pay for the service.[3]

2. CHARACTERISTICS OF WASTEWATER

A variety of factors determine the unique qualities of a given wastewater source. Sewage from a variety of different industries, including those with effluent characteristics similar to municipal or residential wastewater, might be released simultaneously. Discharging industrial wastewater into the same system as household wastewater may necessitate some sort of preparation. Different industries have different wastewater characteristics, so different treatment methods are required. For example, a cocoa processing company may include a skimming tank in the initial treatment stage to deal with spilled cocoa butter, while a beverage plant may omit such a feature in the design. Wastewater pollutants may be broken down into three broad groups: physical, chemical, and biological. Indicators used to detect such pollutants include.[4]

i. Physical

- The level of salt may be determined by its electrical conductivity.
- Inorganic salts and trace quantities of biological materials dissolved in water make up Total Dissolved Solids (TDS).
- The term "suspended solids" (SS) refers to any material that is in a liquid state but is not dissolved.[5]

ii. Chemical

- Measured in terms of dissolved oxygen (DO), this parameter reveals how much oxygen is present in a given volume of water.
- The quantity of oxygen needed by aerobic bacteria to break down the organic matter in a water sample during a certain time period is measured by the biochemical oxygen demand (BOD).
- To measure the amount of organic material in a sample that may be oxidised by a powerful chemical oxidant, scientists use a metric called chemical oxygen demand (COD).

iii. Biological

- Total coliforms include both faecal coliforms and common soil bacteria, and are thus indicative of a broader problem with water quality.
- One sign of faeces in the water is faecal coliforms. Escherichia coli, or E. coli, is the usual bacterium used as a lead indicator.
- Water samples are analysed for helminths, or worm eggs.[6]

2.1 Process of wastewater treatment

In the same way that physical, chemical, and biological contaminants may be classified into distinct groups, so too can the unit activities and processes utilised to treat wastewater be split down into different subsets. The different functional units and processes that go into wastewater treatment are summarised below: [7]

i. Physical unit operations

- Screening
- Comminution
- Flow equalization
- Sedimentation
- Flotation
- Granular-medium filtration

ii. Chemical unit operations

- Chemical precipitation
- Adsorption
- Disinfection
- Dechlorination
- Other chemical applications

iii. Biological unit operations

- Activated sludge process
- Aerated lagoon
- Trickling filters
- Rotating biological contactors
- Pond stabilization
- Anaerobic digestion

2.2 Levels of wastewater treatment

There are three broad levels of treatment: primary, secondary and tertiary. Sometimes, preliminary treatment precedes primary treatment. [8]

i. Preliminary Treatment

The coarse particles and grits are taken out in the preliminary treatment. Screening and grit chambers are two methods for removing them. The efficiency and longevity of future treatment units are improved as a result. Standing-wave flumes, which monitor flow rates, are typically used at this point in the treatment process.

ii. Primary Treatment

Sedimentation is used to get rid of the heavier, more dense solids, such organic and inorganic matter, while skimming is used to get rid of the lighter, more buoyant materials (scum). BOD5, suspended particles, and grease and oil can all be reduced by up to 65% at this point. Some heavy metals, organic phosphorus, and nitrogen are also taken out. However, at this point, neither the colloidal nor dissolved components are eliminated. Primary effluent is the discharge produced by primary sedimentation units.[9]

iii. Secondary Treatment

In order to get rid of any lingering organics and suspended particles, the main effluent must undergo a process called secondary treatment. Aerobic biological treatment techniques also remove biodegradable dissolved and colloidal organic waste. Nitrogen molecules, phosphorus compounds, and disease-causing microbes are eliminated during the process of decomposing organic materials. Anaerobic treatment, oxidation ditches, stabilisation ponds, etc. are all examples of non-mechanical techniques of treatment, as are trickling filters, activated sludge treatments, and rotating biological contactors (RBC).

iv. Tertiary Treatment

When it is necessary to remove certain wastewater elements that cannot be eliminated by secondary treatment, tertiary treatment (also known as advance treatment) is used. Significant levels of nitrogen, phosphate, heavy metals, biodegradable organics, bacteria, and viruses can be eliminated with proper pretreatment. Secondary effluent can be filtered using either an old-fashioned sand (or equivalent medium) filter or a more modern membrane material. Helminths can be eliminated by using either a filter or a membrane, both of which have shown improvements. Disk filtration is the most up-to-date technique, and it filters liquids using enormous discs of cloth material mounted on spinning drums (FAO, 2006). Chlorine, ozone, and ultraviolet (UV) irradiation may now be used to disinfect water, bringing it up to par with global requirements for agricultural and urban reuse.[10]

3. WASTEWATER REUSE IN AGRICULTURE

Wastewater reuse through irrigation serves dual purposes as a means of disposal and reuse. However, before it can be utilised for agricultural or landscape irrigation or for aquaculture, raw urban wastewater often requires some degree of treatment. Primary treatment is often the bare minimum for reapplying treated wastewater for irrigation in developed nations. If the wastewater is utilised to irrigate crops that are not eaten by people, or if it is used to irrigate orchards, vineyards, and some processed food crops, then the treatment may be regarded adequate. [11]

To that end, using nutrients found in municipal wastewater and treated effluents as a supplementary fertiliser is a huge plus. Implementing effective ways to improve crop yields and quality, preserve soil productivity, and protect the environment will be crucial to the success of using treated wastewater for agricultural production. For each given set of conditions, the best answer can be found by combining several different options. Knowing the source and quality of the effluent in advance is essential for the user. Effluent from a wastewater treatment plant can be reused either alone or in combination with potable water. Irrigation streams in and around major cities like Accra and Kumasi have occasionally been discovered to contain heavy metal concentrations above safe limits. Countries are obligated to create and implement regulations that are in conformity with WHO recommendations.[12]

4. INDUSTRIAL WASTEWATER TREATMENT

Generally speaking, the nature of the wastewater from a certain industry determines the best kind of plant to be erected. However, the most important factor in achieving these goals is implementing appropriate housekeeping techniques to reduce waste. All four stages of wastewater treatment (primary, secondary, and advanced) used on industrial wastewater are also used on municipal wastewater. Many of the therapeutic strategies outlined here can also be used. However, certain industries may have special considerations because of the nature of the contaminants they face.

The cities of Accra and Tema, which produce the majority of Ghana's industrial wastewater, are home to breweries, distilleries, textile, chemical & pharmaceutical, and institutional & hotel operations. The mining industry is the main source of river pollution in the western and central regions of Ghana. Industrial facilities in Ghana are required to get a permit from the Environmental Protection Agency (EPA-Ghana) and construct or install their own sewage treatment facilities. The industrial wastewater treatment plants in Ghana are sampled quarterly by the Environmental Protection Agency (EPA) for analysis in-house. The vast majority of permit-holders have treatment plants, albeit their efficacy varies.[13]

5. CHALLENGES OF WASTEWATER MANAGEMENT

The management of wastewater is not difficult from a technological standpoint, but it might run into problems on a socioeconomic level. Some of the challenges are discussed in more detail farther down.[14]

i. Infrastructure

The majority of legislators do not make improvements to wastewater infrastructure a priority, which is one of the reasons why so few investments are made. Because practically all of the water that is generated is eventually turned into wastewater, it is essential that the infrastructure for treating wastewater be given the same level of priority as that of water treatment plants.

ii. Pollution of water sources

The effluent from sewage treatment plants has a significant impact on the quality of the receiving water; it alters the aquatic environment and, as a result, disrupts the aquatic ecosystem. Carbonaceous matter, nutrients, trace elements, and salts are all components of the food that we eat, and they are also found in our urine and faeces (black water). In addition to medications (drugs), chemicals, and, more recently, hormones (contraceptives), the wastewater treatment facility also receives discharges of these types of substances. Guidelines for discharge must be followed exactly at all times. Because of this, future generations will have access to water sources that are sustainable.

Both the precautionary principle and the polluter-pays concept, which work together to avoid or limit pollution to wastewater, have shown to be extremely effective in developed nations and ought to be adopted in developing countries as well.

iii. Choice of appropriate technology

Selecting the Right Technology Donor money drives the economies of most developing nations, so that's where the majority of the money for wastewater treatment plants comes from. This is why they often make suggestions on what kind of technology should be used. As a result, it becomes very difficult for the beneficiaries to manage the facility's operations and maintenance of parts when they take over the facility, as the technical competence, power needs, etc. are not sustainable.[15]

iv. Sludge production

Development of Sludge Sewage sludge is a byproduct of wastewater treatment. An efficient means of disposal is essential. Risks should be considered if it must be used in farming nonetheless. Heavy metals found in wastewater have prompted concerns that their usage in agriculture might result in the buildup of heavy metals in soils and the subsequent contamination of harvests.

v. Reuse

It is possible to recycle effluents that are not harmful to the environment and utilise them for things like agricultural irrigation and aquaculture. However, there is a problem: the reuse of wastewater becomes difficult if wastewater treatment plants are not maintained and monitored continuously to ensure that acceptable effluent quality is being produced.

6. CONCLUSION

We can't live without water, thus wastewater is here to stay. Human activity pollutes and alters the properties of the water we consume, turning it into wastewater. Treatment of wastewater is both possible and necessary for the protection of the environment and the promotion of public health. There are both conventional and non-conventional approaches to treating wastewater, and selecting one should be based on a number of criteria, including the nature of the wastewater being treated (municipal or industrial), the availability of necessary technical expertise, the cost and power requirements, and the feasibility of the proposed solution. Waste stabilisation ponds, for example, are an effective low-cost, low-technology alternative to the trickling filters and activated sludge systems that have failed in most poor nations like Ghana. Aquaculture and irrigation are two of the many possible applications for wastewater that conforms to established discharge criteria.

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