IQRA NATIONAL UNIVERSITY PESHAWAR

DEPARTMENT OF CIVIL ENGINEERING

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Q.NO (01)

What are Waste Water Treatment and its importance? Why rectangular tanks are preferred over circular tanks for removal of settleable solids during preliminary treatment?

ANSWER:

Treatment of waste water is a process used to remove contaminates from waste water or sewage. Wastewater is the combination of liquid and water transported wastes from homes, commercial buildings, industrial facilities and institution along with any ground water infiltration and surface water and storm water inflow that may enter the sewer system.

It is the application of engineering method to improve the sanitation of human community primarily by providing the removal and disposal of human waste treatment and reuse application for various purposes.

IMPORTANCE OF WASTE WATER TREATMENT:

Large industries, factories, and mills generate tons of sewage every day. Some of this waste is so harmful that if it is allowed to leave the neighborhood area, it can cause various diseases and contamination of land and water. It is easy to eliminate solid waste but it is not so easy to remove chemical and biological contaminants from these wastes, so they can be sent to safe areas. This is done with the help of sewage treatment plants.

Drainage and wastewater treatment have been part of our culture since the first civilizations. However, there are certain third world countries that do not have such plants in the factories.

1) Environment protection and pollution control to step the consumption of fresh water by pollution and to return waste water to the water cycle as a beneficial source of water.
2) Water resources reassessment and development to alignment and enhance availability of water (ground water, surface water).
3) Water resources allocation to the competing group of water users in the society i-e municipal, industrial agricultural.
4) By disposing of treated waste water in order to reduce ground water contamination and protect aquatic life.
5) Primary objective of waste water engineering is to provide a good sanitary environmental condition in a city.

6) Water utilization by various groups of water users which comprises the delivery of consumptive use and waste water generation (the waste water could be conserved and waste water generation reduced)
7) Supplying more water to match the demand focusing mainly on the assessment and development of new water resources.

RECTANGULAR TANKS ARE PREFERRED OVER CIRCULAR TANKS

Both rectangular and circular configurations have been commonly used in clarifier basins. The relative merits of the two have been discussed at length for decades. Historically, the selection of rectangular versus circular clarifiers has been based on past experience and the preference of the design engineer or design company. Initial wastewater treatment plant designs in the United States were reasonably balanced between rectangular and circular when collector or scraper systems were designed from steel. With the introduction of biological treatment, corrosion became more of a concern and circular clarifiers became more popular. Non-metallic chain and flight sludge collection systems for rectangular clarifiers were introduced more than 20 years ago and have overcome the corrosion problem, leading to a resurgence of rectangular clarifiers, particularly for large wastewater treatment plants. Let's compare the benefits of each configuration.

Rectangular clarifiers typically require less land than circular clarifiers for a similar surface area (21% less in theory). The reduction becomes even more significant in a multiple-unit design, where common concrete walls are used between rectangular basins. The resulting land availability is a major advantage for treatment plant layout. Construction cost is also reduced as a result of the common concrete walls.

The even flow distribution configuration for rectangular clarifiers requires simpler and less expensive pipe work layout and pumping requirement as compared to circular clarifiers where the pipes require a more complicated layout pattern and perhaps a separate pumping station, as well.

Many clarifiers now need to be covered for odor or volatile organic compound (VOC) control. Covers for rectangular clarifiers (using chain and flight systems) are much easier to design and install as well as being less expensive.

Q.NO (02)

What is the difference b/w Aerobic & Anaerobic waste water treatment? Briefly describe activated sludge process with diagram?

ANSWER

Indeed, anaerobic and aerobic wastewater treatment technologies can be used independently or in combination with one another.

Aerobic systems require some means of supplying oxygen to the biomass, which may be accomplished by wastewater treatment ponds (which work by creating a large surface area for introducing air to the wastewater), and/or by incorporating some type of mechanical aeration device to introduce oxygen into the biomass. Due to the need to circulate the wastewater or otherwise aerate it, aerobic systems tend to be less energy efficient than their anaerobic counterparts.

By contrast, anaerobic systems must be designed to prevent the exposure of the biomass sludge to air. This can be accomplished via airtight, enclosed digesters that are primarily used for batch treatment cycles, or by up flow anaerobic sludge blanket (UASB) systems that keep the biomass layer submerged below the treated effluent that, as the name suggests, flows upward toward the surface of the tank.

As a result of these system design differences, anaerobic systems tend to offer a few benefits over aerobic systems, including

- Lower operational costs and energy demands,
- Though they also tend to be slower,
- Usually require more upfront capital.

Biological wastewater treatment uses naturally-occurring microorganisms to feed on complex organic matter, converting them into simpler substances. This type of treatment is divided into two broad categories: anaerobic and aerobic treatment.

ANAEROBIC WASTEWATER TREATMENT PROCESS

The anaerobic wastewater treatment uses anaerobic bacteria that change organic matter into organisms that contain large quantities of methane gas and carbon dioxide. In some systems, this process is used as a pre-treatment to aerobic wastewater treatment. The professionals at AOS can discuss various municipal wastewater treatment options including aerobic and anaerobic wastewater treatment processes.

Also known as anaerobic digestion (AD), anaerobic treatment is an energy-efficient process in which microorganisms transform organic matter in the wastewater into biogas in the absence of oxygen. To achieve this oxygen-free environment, the entry of air into anaerobic tanks is prevented, typically by a gastight cover.

AEROBIC PROCESS IN WASTEWATER TREATMENT

With aerobic treatment, microorganisms convert organics into carbon dioxide and new biomass in the presence of oxygen. Aerobic microorganisms require oxygen so air must be continuously circulated through the tanks. Forced air from an air blower or compressor is mixed with the wastewater, where the aerobic bacteria feed on the waste in the water.

In the aerobic process, air is circulated throughout a treatment in order to cause bacteria that break down waste within the wastewater. Electricity is used throughout the process. Some systems may use a pre-treatment process that reduces solids that aerobic bacteria may have difficulty compressing.

The aerobic bacteria in sewage treatment feed on the water, which is mixed with air. The bacteria reproduce and continue to attack the waste, with some waste settling on the bottom of water as sludge. This sludge may be pumped out of the system so that the system is not clogged. A disinfectant may be used at the final stage, possibly along with a filtering process.

AEROBIC VS ANAEROBIC WASTEWATER TREATMENT: One key difference between aerobic and anaerobic wastewater treatment is the process by which the treatment mechanisms work.

COSTS OF AEROBIC AND ANAEROBIC WASTEWATER TREATMENT

Aerobic treatment units are typically more expensive to operate than alternative processes. The operation requires continued use of electricity, and solids must be pumped out of the system frequently. Additionally, professionals must inspect and maintain electrical and mechanical components. The septic tanks must also be maintained. However, the quality of the water is often improved with the implementation of aerobic wastewater treatment.

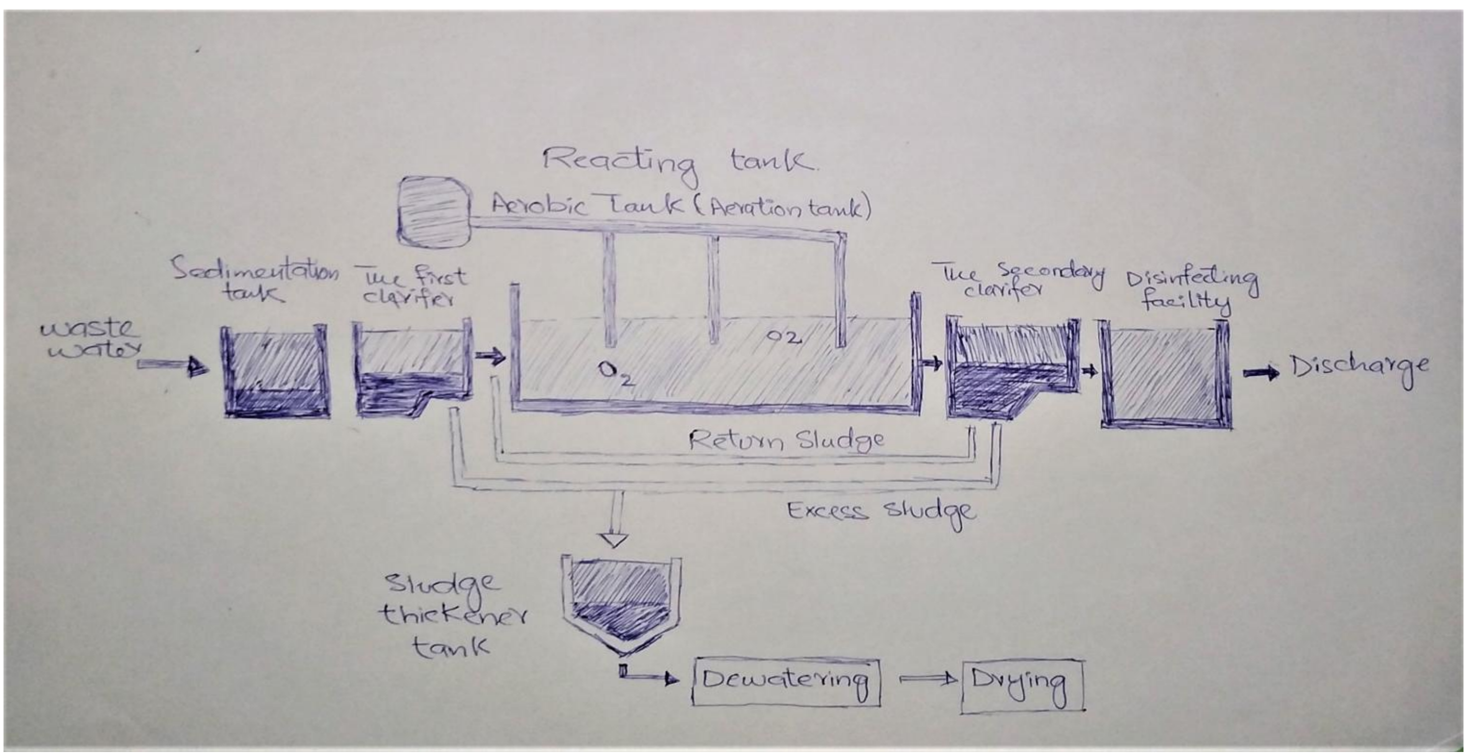
In comparison, the anaerobic wastewater treatment process is typically more economically friendly for the following reasons:

- The anaerobic treatment of wastewater generates much less sludge than the aerobic treatment does.
- The sludge produced in anaerobic wastewater treatment can be used for soil enrichment.
- There are lower costs required to handle sludge compared to those incurred in aerobic treatment.
- Fewer chemicals are used in the process when compared to aerobic wastewater treatment.
- The biogas can be used to produce electricity and heat and serve as a renewable energy source that effectively replaces fossil fuels.

However, the anaerobic wastewater treatment process provides some oversight to ensure that the methane-rich biogases are properly released. Methane should be flared to minimize its environmental impact.

ACTIVATED SLUDGE

The activated sludge process is the biological process by which non-settleable substances occurring in dissolved and colloidal forms are converted into settleable sludge which is removed from the liquid carrier (water). At a plant the activated sludge is settled out along with the suspended solids present in the wastewater. The activated sludge process provides one of the highest degrees of treatment obtainable within the limits of practical economy and present knowledge of the art and science of waste treatment.



Q.NO (03)

What is meant by assimilative capacity of receiving water bodies? How does it help in waste water treatment?

ANSWER

Assimilative capacity refers to the ability of the environment or a portion of the environment (such as a stream, lake, air mass, or soil layer) to carry waste material without adverse effects on the environment or on users of its resources. Pollution occurs only when the assimilative capacity is exceeded. Some environmentalists argue that the concept of assimilative capacity involves a substantial element of value judgment, i.e., pollution discharge may alter the flora and fauna of a body of water, but if it does not affect organisms we value (e.g., fish) it is acceptable and within the assimilative capacity of the body of water. It is level to which water body or nature control the toxicity without affecting the aquatic life.

ASSIMILATIVE CAPACITY HELPS IN WASTE WATER TREATMENT

Two other concepts are closely related:

1) Critical load; and

2) Self purification.

The term critical load is synonymous with assimilative capacity and is commonly used to refer to the concentration or mass of a substance which, if exceeded, will result in adverse effects, i.e., pollution. Self purification refers to the natural process by which the environment cleanses itself of waste materials discharged into it. Examples include biodegradation of wastes by natural bacterial populations in water or soil, oxidation of organic chemicals by photochemical reactions in the atmosphere, and natural die-off of disease causing organisms.

Determining assimilative capacity may be quite difficult, since a substance may potentially affect many different organisms in a variety of ways. In some cases, there is simply not enough information to establish a valid assimilative capacity for a pollutant. If the assimilative capacity for a substance can be determined, reasonable standards can be set to protect the environment and the allowable waste load can be allocated among the various dischargers of the waste. If the assimilative capacity is not known with certainty, then more stringent standards can be set, which is analogous to buying insurance (i.e., paying an additional sum of money to protect against potential future losses). Alternatively, if the cost of control appears high relative to the potential benefits to the environment, a society may decide to accept a certain level of risk.

More recently, pollution prevention has been heavily promoted as an appropriate goal for all segments of society. Proper interpretation of these goals requires a basic understanding of the concept of assimilative capacity. The intent of Congress was to prohibit the discharge of substances in amounts that would cause pollution, not to require a concentration of zero. Similarly, Congress voted to ban the discharge of toxic substances in concentrations high enough to cause harm to organisms.

- Within the land treatment system, comprising of soil, plant and hydro geological systems, a number of different processes occur with each playing a role in the assimilative capacity for different contaminants.
- The assimilative capacity for land treatment in the evaluation area is dependent on the unique properties of the site selected, and its design (land management and irrigation management).
- A summary table which outlines the relative assimilative potential in the evaluation area of various constituents in wastewater after being subject to a range of process.

Mechanisms to deal with the wastewater constituents differ. Within the land treatment system, comprising soil, plant and hydro geological systems, a number of different processes occur with each playing a role in the assimilative capacity for different constituents. The parts of the land treatment system and their role in renovating wastewater.

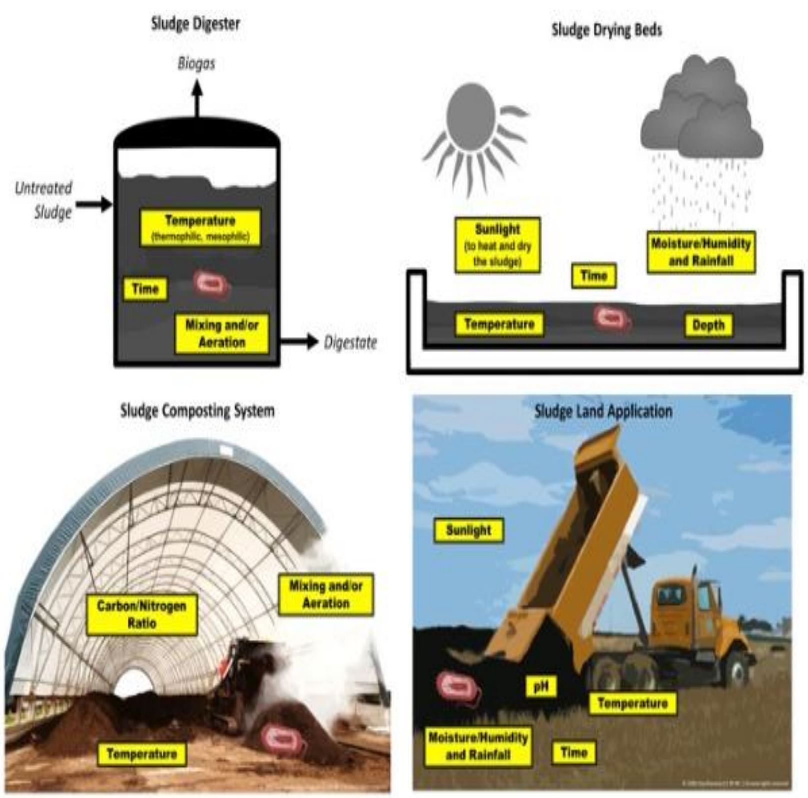
Q.NO (04)

Briefly describe sludge management and its advantages in waste water engineering?

ANSWER

SLUDGE

The residue that accumulates in sewage treatment plants is called sludge (or bio-solids). Sewage sludge is the solid, semisolid, or slurry residual material that is produced as a by-product of wastewater treatment processes. This residue is commonly classified as primary and secondary sludge. Primary sludge is generated from chemical precipitation, sedimentation, and other primary processes, whereas secondary sludge is the activated waste biomass resulting from biological treatments. Some sewage plants also receive septage or septic tank solids from household on-site wastewater treatment systems. Quite often the sludge's are combined together for further treatment and disposal.



SLUDGE MANAGEMENT

Sludge is generated during primary and secondary treatment of wastewater. "Bio-solids" is a word used to describe sludge that receives treatment at a centralized facility and meets land application standards. "Fecal sludge" is a term used to describe sludge generated from an onsite sanitation technology that has not been transported in a sanitary sewer. It can be "raw or partially digested, a slurry or semisolid, and results from the collection, storage or treatment of combinations of excreta and black water, with or without grey water. The fundamental mechanisms of how pathogen levels are reduced in the management of sludge, bio-solids, and fecal sludge are similar as are the treatment technologies. Accordingly, for the remainder of this chapter, the word sludge will be used to describe both bio-solids and fecal sludge, except in locations where management strategies for a particular sludge type may differ.

The direct disposal of untreated sludge is not desirable because:

- It has odors associated with it,
- It is comprised primarily of water which makes transport and disposal more expensive, and
- It contains harmful environmental pollutants and pathogens. An important point to consider is that in a centralized wastewater treatment plant, while the total volume of sludge is small compared to the total volume of wastewater, sludge management can cost up to 60 percent of the overall operating costs of wastewater treatment.
- Also, if managed incorrectly and released into the environment without adequate treatment, conventional pollutants and pathogens found in sludge can negate the health and environmental benefits of wastewater treatment. Sludge management is an integral component of centralized or semi-centralized wastewater system and onsite systems serving cities and small communities alike. Fecal sludge management has also become a distinct area of sludge management with books and conferences devoted to it.

There are many technologies in management of wastewater sludge. These technologies can be broken down into the following processes:

- Stabilization
- Thickening,
- Dewatering, and
- Other processes that includes composting.

Sludge stabilization typically uses biological and chemical processes to reduce odor, water content, and the presence of pathogenic organisms in sludge. The purpose of dewatering is to reduce water content because sludge associated with primary and secondary treatment of wastewater only has a solids content of half to several percent (sludge is thus mostly comprised of water in its original untreated state). The outputs from sludge management include treated sludge and may also include biogas and other resources. Because treated sludge contains valuable resources (e.g., energy, carbon, nitrogen, and phosphorus), bio-solids and fecal sludge are considered an integral part of a resource recovery strategy (e.g., a viable soil amendment if pathogens are reduced to safe levels). This is because the majority of these two nutrients are present in human urine, and not feces.

FACTORS AFFECTING PATHOGENS IN SLUDGE MANAGEMENT SYSTEMS

During sludge processing, pathogens are inactivated by different mechanisms. These mechanisms will be similar for bio-solids and fecal sludge. Reviews the major mechanisms that lead to pathogen destruction in four common sludge management technologies. The efficiency of each of these mechanisms is dependent on a number of environmental, design, and operational factors. Temperature and time have been identified as perhaps the two most important factors in achieving significant pathogen destruction during sludge management.

Q.NO (05)

Define environmental impact assessment (EIA)? In your opinion what parameter should be considered while conducting EIA for newly proposed waste water treatment plant?

ANSWER

Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

Environmental Impact Assessment (EIA) is a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers. By using EIA both environmental and economic benefits can be achieved, such as reduced cost and time of project implementation and design, avoided treatment/clean-up costs and impacts of laws and regulations.

Parameter to Be Considered While Conducting EIA for Newly Proposed Waste Water Treatment Plant

Although legislation and practice vary around the world, the fundamental components of an EIA would necessarily involve the following stages:

- Screening to determine which projects or developments requires a full or partial impact assessment study;
- Scoping to identify which potential impacts are relevant to assess (based on legislative requirements, international conventions, expert knowledge and public involvement), to identify alternative solutions that avoid, mitigate or compensate adverse impacts on biodiversity (including the option of not proceeding with the development, finding alternative designs or sites which avoid the impacts, incorporating safeguards in the design of the project, or providing compensation for adverse impacts), and finally to derive terms of reference for the impact assessment;
- Assessment and evaluation of impacts and development of alternatives, to predict and identify the likely environmental impacts of a proposed project or development, including the detailed elaboration of alternatives;
- Reporting the Environmental Impact Statement (EIS) or EIA report, including an environmental management plan (EMP), and a non-technical summary for the general audience.
- Review of the Environmental Impact Statement (EIS), based on the terms of reference (scoping) and public (including authority) participation.
- Decision-making on whether to approve the project or not, and under what conditions; and
- Monitoring, compliance, enforcement and environmental auditing. Monitor whether the predicted impacts and proposed mitigation measures occur as defined in the EMP. Verify the compliance of

proponent with the EMP, to ensure that unpredicted impacts or failed mitigation measures are identified and addressed in a timely fashion.

The purpose of the assessment is to ensure that decision makers consider the environmental impacts when deciding whether or not to proceed with a project. The International Association for Impact Assessment (IAIA) defines an environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made".

EIAs are unique in that they do not require adherence to a predetermined environmental outcome, but rather they require decision makers to account for environmental values in their decisions and to justify those decisions in light of detailed environmental studies and public comments on the potential environmental impacts

Environmental Impact Statement (EIS) should contain the following information's/data:

- Description of proposed action (construction, operation and shut down phase) and selection of alternatives to the proposed action.
- Nature and magnitude of the likely environmental effects.
- Possibility of earthquakes and cyclones.
- Possible effects on surface and ground water quality, soil and air quality.
- Effects on vegetation, wild life and endangered species.
- Economic and demographic factors.
- Identification of relevant human concerns.

Environmental Impacts Assessment and Mitigation Measures

The first attempt to assess the environmental impacts was done within the "Initial Environmental Examination – IEE level study". Using the basic data from this Study, following the general recommendations for elaboration of the environmental impacts, using updated information and large amount of new data and taking into consideration all media and their interaction, detailed Environmental Impact Study was prepared. In order to assess in more details possible impacts during construction, operation phase and post operation phase (closure) or some changes which are planed in the view of capacity or technology, of the access roads, main collectors, the siphon and the WWTP, following phases and activities have been taken in consideration:

a) Construction Phase

- Construction of the access roads and main collectors (left and right river bank);
- Construction of the siphon structure across the River Vardar;
- Preparatory works at the location of the WWTP (tree cutting, humus removal and flattening of the location) and excavation works;
- Transport and disposal of surplus excavated material;
- Construction of the structures of the WWTP (civil works, use of heavy machinery and vehicles);
- Disposal of construction waste;
- Installation of the equipment;

- Construction of accommodation facilities for the workers (water supply, sewerage, waste disposal).

b) Operation Phase

- Treatment technology/ operation of the equipment for sewerage treatment and effluent production;
- Operation of equipment for sludge production (digester, drying beds and biogas production);
- Sludge (with dangerous substances) disposal on temporary storage at WWTP site.

The END