Low cost wastewater treatment

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Domestic and agricultural wastewaters are usually discharged into surrounding streams and rivers causing water pollution. Wastewater, even after secondary treatment is a major source of nutrients that can cause eutrophication of lakes and streams and deterioration of water quality.

The main objectives of sanitation strategies in the growing cities are to avoid surface water and ground water pollution. This results in the necessity to implement appropriate sanitation approaches to the specific conditions for removing oxygen-consuming organic matters and nutrients from municipal wastewater.

Therefore it becomes more and more important to develop appropriate wastewater treatment processes, which combine high treatment efficiency with low capital investment, maintenance costs, and simple operation requirements. At the present time, aerobic processes are widely used for municipal wastewater treatment. However, aerobic processes have serious drawbacks including considerable investment, operation and maintenance costs, and high sludge production.

Because of lack of enough financial source and shortage of skilled manpower for facility operation, most developing countries cannot afford to construct and operate enough municipal wastewater treatment plants.

Anaerobic treatment

Fortunately anaerobic treatment processes provide another option for municipal wastewater treatment. Anaerobic treatment processes not only consume lower grade energy, but also produce useful energy in the form of biogas.

As a consequence, anaerobic treatment of municipal wastewater seems to be an ideal and sustainable solution for water environmental protection.

Conventional wastewater treatment requires large capital investments and consumes large amounts of energy. Therefore, interest is increasing in the use of aquatic plants as a simple and energy efficient means of removing nutrients from wastewater.

In deed, more research effort has been concentrated on the ability of rooted aquatic plants to perform this treatment functions. In recent years interest has increased on wastewater treatment through wetlands because of their low cost and energy requirement. Natural and constructed wetlands have been referred to as very efficient system for removing nutrients discharged into natural ecosystems from different sources.

Many aquatic plants actively transport oxygen to the anaerobic layers of the soil and thus help in oxidation and precipitation of heavy metals on the root surfaces

In all the studies about wetland, some nitrogen and phosphorus quantities and other pollutants were removed from wastewater when if flowed through wetlands and it has generally been found that treatment systems that include emergent plants are more efficient than those without plants.

Wetlands

Depending upon their location in the landscape, wetlands fall into three categories. First, the typical bogs (raised bogs) which are perched at a higher level and are totally cut off from the influence of surface water. They are entirely dependent upon precipitation for their water and nutrient supply, and are therefore, very poor in major plant nutrients.

Second, the palustrine wetlands, which are located in a shallow depression, surrounded by upland, and receive nutrients with the runoff from their surroundings. The nutrients are likely to accumulate or move out with subsurface water movement. The Third most common, category includes wetlands lying at the interface between upland and open water. These wetlands receive nutrient passing through them from land towards the open water.

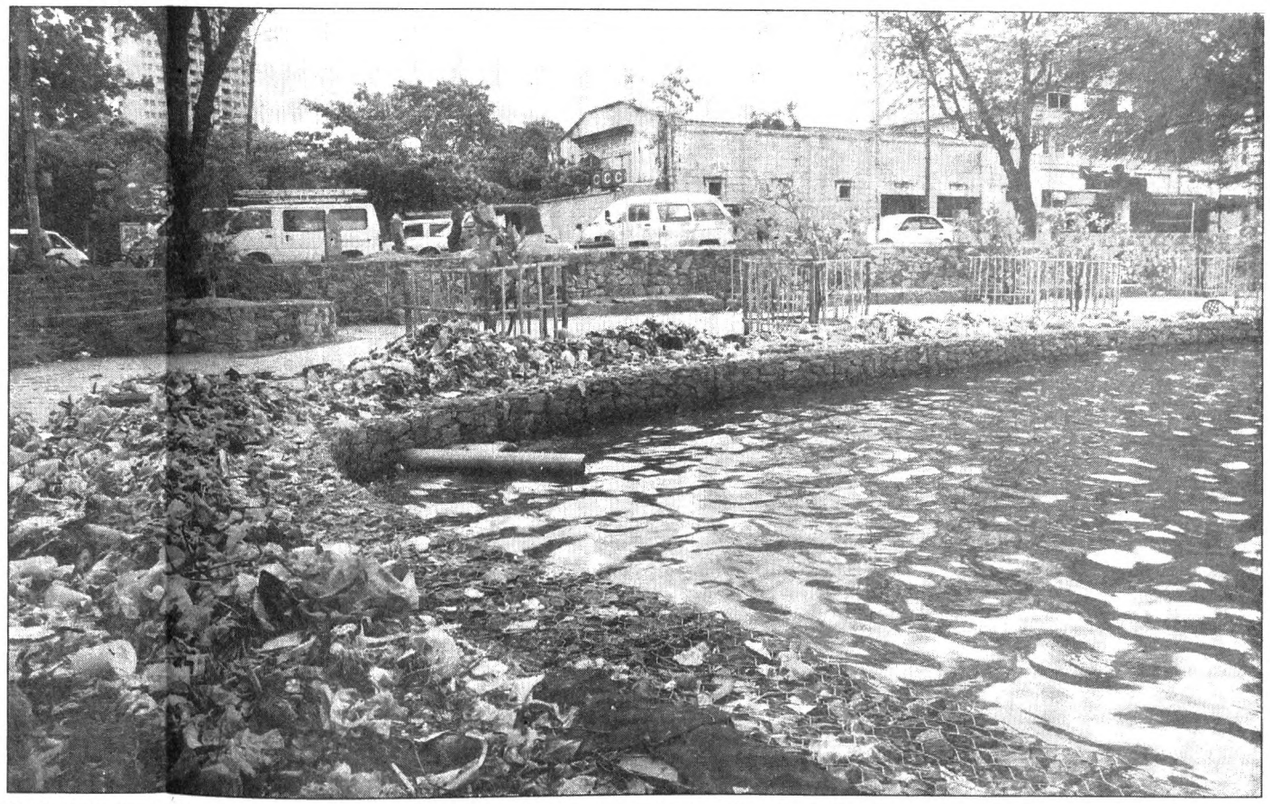
Aquatic plants are an essential component of a wetland, and contribute to the nutrient transformation by abetting in the physical, chemical and microbial processes besides removing nutrients for their own growth. They offer mechanical resistance to the flow, increase to the flow, increase the retention time and facilitate settling of suspended particulate.

They improve conductance of the water through the soil as the roots grow and create spaces after their death. The plants add organic matter into the water as well as providing a large surface area for microbial growth. Many aquatic plants actively transport oxygen to the anaerobic layers of the soil and thus help in oxidation and precipitation of heavy metals on the root surfaces.

Macrophytes

The submerged macrophytes directly oxygenate the water column. The emergent and free floating macrophytes shade out the water surface and prevent the growth of algae. Free-floating plants can completely eliminate oxygen in the water column leading to enhancement of reduction reactions. The absorption of nutrients by macrophytes varies with the species and is related to their growth under different conditions.

The main types of aquatic plants used in constructed wetlands are the Common Reed (Phragmites australis), the Common Reedmace (Typha latifolia).



Sanitation strategies in growing cities are to avoid surface water and ground water pollution.

The process involves the use of existing or planted root system of reeds (Typha latifolia). So the plants survive on the nutrients in the wastewater. Since aquatic plants have a natural mechanism for pumping air via their root system, the root area provides oxygen rich environment, which supports a range of aerobic bacteria similar to those, found in other sewage treatment process.

Nutrient transformation is one of the major wetland functions, which is translated into their value for improving this quality of wastewater. Efforts are made to use wetlands for disposal of wastewaters from various sources and with different characteristics. Wetlands are now being constructed worldwide, designed especially for wastewater treatment at secondary and tertiary level.

An erroneous impression is often conveyed that natural wetlands can be used for disposal of domestic wastewater and industrial effluents, and that the constructed wetlands offer a cost effective alternative to conventional wastewater treatment, particularly for developing countries.

Nutrient transformation

Nutrient transformation in wetlands depends upon a large number of variables which include the hydrological regime, nutrient concentrations in the effluent, nutrients already present in the system, the kind of vegetation (annual, perennial, submerged or emergent,), sediments (minerals or organic), and other biota. High runoff and low retention periods may scour the sediments and release the nutrients and organic matter into the open water.

Several physical, chemical and biological processes are involved in the transformation of nutrients within the wetland. The major physical process is the settling of suspended particulate matter. The reductetion in the particular organic matter is a cause of reduction in Biochemical Oxygen Demand of wastewaters.

The chemical processes include absorption, chelation and precipitation, which are responsible for the major removal of phosphorous and heavy metals.

Among the biological processes, the most important are those mediated by the microorganisms, and include the oxidation or reduction of carbon, nitrogen and sulphur depending upon the availability of oxygen. Generally, the reduction reactions dominate the systems in the presence of high organic matter in the effluents, and most of the nitrogen is lost through denitrification.

Constructed wetland

Constructed wetland can be used to upgrade the quality of waste stabilization pond effluent to an acceptable level. From bacteriological point of view, the constructed wetland could not completely remove coliforms from the effluent. The same could be said about the chemical quality.

Constructed wetland provides the reuse of both effluent and sludge.

Treated effluent can be used for irrigation.

Sludge can be used as Fertilizer for agriculture. Reeds can also be harvested to produce biogas, compost, raw material for basket wearing and roofing essentials.

In the view of the above points constructed wetlands are suitable for high efficiency wastewater treatment, especially for post treatment, because the wetland organisms can adopt to the wastewater inflow and utilize the various organic and inorganic pollutants during the metabolic and other life process.