Combined Low Cost Treatment Technologies for Wastewater Reuse-A Viable alternative

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Abstract

“Water” is the most used commodity but the misused one. Because of tremendous growth in population & industry; water has over exploited and it has become one of the scarcest resources of all the time. With the huge cost involved in conventional treatment technologies and continual research & development (R&D) in the field of water and wastewater treatments have evolved newer as well as low cost treatment technologies which comprises of Constructed Wetlands (CW), Ponds and Lagoons, Aerobic and anaerobic filters, Charcoal Adsorption and Broken brick adsorption for polishing of water etc. But the approach is growing towards the use of the available technologies in combination and with modification in conventional sequential operations. The greywater & blackwater generated from various sources, typically from institutional sources can be efficiently treated and reused/recycled for different purposes includes gardening, floor cleaning and washing vehicles etc. The present paper focuses on potential of various low cost treatments that can be employed for efficient and effective reuse/recycle of greywater as well as blackwater.

Keywords: Constructed Wetlands, Greywater, Broken brick & Charcoal Adsorption

1. INTRODUCTION

In the present era of ever increasing population with haphazard growth in the cities and towns as well as tremendous growth in Industrialization has over exploited the sources of water & water has become one of the scarcest commodity all over the world; Also, the demand for the fresh water is ever increasing day by day.

As there is increase in water demands the subsequent generation in the wastewater generation has increased spirally. Water demand for the urban areas are decided as 135 Lpcd & for rural areas it has been decided as 60 Lpcd. Almost 85-90% of water is discharged as wastewater from domestic and industrial sources and potential lies in reuse & recycle of this wastewater after employing proper treatment technologies.

While providing the treatments to these wastewaters “Cost Economics” is the prominent aspect which has profound impact in the decision of employment of the treatment technologies. For the many developing Asian countries including India, Pakistan, Nepal, Bhutan etc. high cost treatment technologies are not feasible at all & tremendous research and development (R&D) has done on timely basis which includes the Constructed Wetlands, Ponds & Lagoons, Anaerobic baffle reactors etc.

While “recycling” is a term generally applied to aluminum cans, glass bottles, and newspapers, water can be recycled as well. Water reusing is using treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a ground water basin (referred to as ground water recharge). Water is sometimes recycled and reused onsite; for example, when an industrial facility recycles water used for cooling processes. A common type of recycled water is water that has been reclaimed from municipal wastewater, or sewage. The term water recycling is generally used synonymously with water reclamation and water reuse. Through the natural water cycle, the earth has recycled and reused water for millions of years. Water recycling, though, generally refers to projects that use technology to speed up these natural processes. Water recycling is often characterized as “unplanned” or “planned.” A common example of unplanned water recycling occurs when cities draw their water supplies from rivers that receive wastewater discharges upstream from those cities. Water from these rivers has been reused, treated, and piped into the water supply a number of times before the last downstream user withdraws the water. Planned projects are those that are developed with the goal
of beneficially reusing a recycled water supply.

Recycled water can satisfy most water demands, as long as it is adequately treated to ensure water quality appropriate for the use. In uses where there is a greater chance of human exposure to the water, more treatment is required. As for any water source that is not properly treated, health problems could arise from drinking or being exposed to recycled water if it contains disease-causing organisms or other contaminants. Recycled water is most commonly used as non-potable (not for drinking) purposes, such as toilet flushing, floor cleaning, irrigation, gardening, car washing and construction. Other non-potable applications include cooling water for power plants and oil refineries, industrial process water for such facilities as paper mills and carpet dyers, toilet flushing, dust control, construction activities, concrete mixing, and artificial lakes. The amount and quality of greywater will govern its usage. Irrigation and toilet flushing are two common uses, but nearly any non-contact use is a possibility. Toilet flushing can be done either by direct bucketing or by pumping greywater to an overhead tank connected by suitable piping to the toilets.

Although most water recycling projects have been developed to meet non-potable water demands, a number of projects use recycled water indirectly for potable purposes. Asano (2004) categorized reusable treated wastewater in many forms such as direct-potable, indirect potable, direct non-potable and indirect non-potable. Direct potable reuse refers to projects that discharge recycled water to a water body before reuse. Direct potable reuse is the use of recycled water for drinking purposes directly after treatment. These projects include recharging ground water aquifers and augmenting surface water reservoirs with recycled water. In ground water recharge projects, recycled water can be spread or injected into ground water aquifers to augment ground water supplies, and to prevent salt water intrusion in coastal areas.

Water recycling is a sustainable approach and can be cost-effective in the long term, the treatment of wastewater for reuse and the installation of distribution systems can be initially expensive compared to such water supply alternatives as imported water or ground water. Institutional barriers, as well as varying agency priorities, can make it difficult to implement water recycling projects. Finally, early in the planning process, agencies must implement public outreach to address any concerns and to keep the public involved in the planning process. As water demands and environmental needs grow, water recycling will play a greater role in our overall water supply. By working together to overcome obstacles, water recycling, along with water conservation can help us to conserve and sustainably manage our vital water resources.

**Greywater generation and Composition**

Water used in hand washing and bathing generates around 50-60% of total greywater and is considered to be the least contaminated type of grey water. Common chemical contaminants include soap, shampoo, hair dye, tooth paste and cleaning products. It also has some faecal contamination through body washing. Water used in cloth washing generates around 25-35% of total greywater. Wastewater from the cloth washing varies in quality from wash water to rinse water. Greywater generated due to cloth washing can have faecal contamination with associated pathogens and parasites such as bacteria. Kitchen greywater contributes about 10% of the total greywater volume. It is contaminated with food particles.
oils, fats and other wastes. It readily promotes and supports the growth of microorganisms. Kitchen greywater also contains chemical pollutants such as detergents and cleaning agents which are alkaline in nature and contain various chemicals. Therefore kitchen wastewater may not be well suited for reuse in all types of greywater systems (NEERI, 2007). The chemical characteristics of grey water typically are presented in Table No.2 (NEERI, 2007).

**Low Cost Treatment Technologies for Reuse/Recycle**

The amount spent on pollution control should be optimum. The general approaches available for pollution control are waste minimization (low-waste technology), wastewater conservation and development of low cost treatment options. Greywater and black water from a building which is connected to a municipal sewerage system are disposed of into municipal sewers directly and treatment is given in a centralized facility.

In the areas where sewerage system is non-existent the black water is treated primarily in a septic tank and effluent from septic tank and grey water are disposed of into ground through soak pit. In some cases untreated greywater is used for gardening. There is a need to develop appropriate technology for green building constructed in sewered and unsewered areas especially from the operation and maintenance viewpoint. There should be more inclination towards the development of sustainable treatment plants. The natural systems of waste treatment are the obvious choice for sustainability. This is will extract the desirable features such as benefit from warmer temperatures, use of little mechanization, utilization of minimum electric power and reuse for non-domestic purposes. Further the systems to be adopted for sustainable treatment should need less land, are easier to construct and can generate some income. All these aspects ensure sustainability of the treatment plants and will keep them acceptable, affordable, and manageable for a long time.

2. METHODOLOGY

The reuse and recycle of greywater as well as blackwater requires series of treatments similar to the conventional treatment plants which comprises of Primary, Secondary & sometimes tertiary treatments. The simulation can be carried out on economical basis with low cost treatment technologies available in the wastewater field.

**Primary Treatments**

- Fine/Coarse Screening,
- Oil & Grease Traps,
- Settling Tanks.

**Secondary Treatments**

- Chemical Methods,
- Biological Treatments-Aerobic & Anaerobic,
- Secondary Settling & Sludge Treatment.

**Tertiary Treatments**

- Charcoal Filtration
- Broken Bricks Adsorption for polishing the treated water.

**Treatment options available:**

**Grey Water Reuse**

**Grey Water Reuse/Black Water Reuse:**

3. RESULTS AND DISCUSSIONS

The typical average results obtained from various treatment options are summarized in the below table:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Treated Greywater</th>
<th>Treated Raw sewage</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td></td>
<td>&lt;6-9</td>
<td>&lt;6-10</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>mg/L</td>
<td>&lt;100</td>
<td>&lt;180</td>
</tr>
<tr>
<td>Oil &amp; Grease</td>
<td>mg/L</td>
<td>&lt;100</td>
<td>&lt;100</td>
</tr>
<tr>
<td>BOD, 27°C</td>
<td>mg/L</td>
<td>30-75</td>
<td>&lt;100</td>
</tr>
<tr>
<td>COD</td>
<td>mg/L</td>
<td>&lt;250</td>
<td>&lt;250</td>
</tr>
<tr>
<td>Ammonia</td>
<td>mg/L</td>
<td>2-5</td>
<td>&lt;250</td>
</tr>
<tr>
<td>Sulphide</td>
<td>mg/L</td>
<td>&lt;100</td>
<td>&lt;250</td>
</tr>
<tr>
<td>TKN</td>
<td>mg/L</td>
<td>&lt;2</td>
<td>&lt;250</td>
</tr>
<tr>
<td>Dissolved Phosphorous (as P)</td>
<td>mg/L</td>
<td>3-5</td>
<td>&lt;250</td>
</tr>
</tbody>
</table>

4. CONCLUSION

“Low Cost Wastewater” treatment technologies are the viable alternatives as they proved efficient and effective in both cost-wise and treatment-wise. Also, the effluent obtained from various combinations of low cost treatment technologies are mitigating the required criteria for reusing and recycling of greywater as well as blackwater. Removal of organics (BOD and COD) and
suspended solids is very high and steady over the years of operation. Removal of nutrients (nitrogen and phosphorus) is usually low and does not exceed 50% for various greywater and blackwater. Hybrid constructed wetlands & their combination of various types offer to achieve higher treatment effect especially for Solids and nutrients.

The greywater and blackwater treated with the low cost technologies can be efficiently reused and recycled at various uses including gardening, floor washing, vehicle cleaning etc.

5. CASE STUDIES

Some of the wetlands in Nepal from Constructed Wetlands Manual
- Hospital wastewater treatment (Dhulikhel Hospital)
- Combined laboratory and domestic wastewater treatment (ENPHO)
- Institutional wastewater treatment (Kathmandu University)
- Municipal wastewater treatment (Sunga, Thimi)
- Grey water treatment (Private residence)
- Septage and landfill leachate treatment (Pokhara)

6. REFERENCES


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