

Wastewater composition and its treatment process

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Abstract

In many arid and semi-arid countries, water is becoming an increasingly scarce resource, and planners are forced to consider any sources of water that might be used economically and effectively to promote further development. At the same time, with the population expanding at a high rate, the need for increased food production is apparent. The potential for irrigation to raise both agricultural productivity and the living standards of the rural poor has long been recognized. Whenever good-quality water is scarce, water of marginal quality will have to be considered for use in agriculture. Although there is no universal definition of 'marginal quality' water, for all practical purposes it can be defined as water that possesses certain characteristics that have the potential to cause problems when it is used for an intended purpose. For example, brackish water is marginal quality water for agricultural use because of its high dissolved salt content, and municipal wastewater is marginal quality water because of the associated health hazards. From the viewpoint of irrigation, use of a 'marginal' quality water requires more complex management practices and more stringent monitoring procedures than when good quality water is used.

Keywords: Wastewater, biodegradable

Introduction

Wastewater

WW is any water that has been influenced by human utilize. WW is "utilized water from any mix of residential, mechanical, business or farming exercises, surface overflow or storm water, and any sewer inflow or sewer penetration

^[1]. WW is generally divided into two categories: black water and gray water. Black water refers to toilet waste and gray water refers to the remaining wastewater from sinks, showers, laundry, etc. The amount of waste water coming from house varies according to the hours of the day, days and seasons ^[2, 3].



Fig 1: (a) Domestic waste water (b) industrial waste water (c) Stormwater Run off Waste water

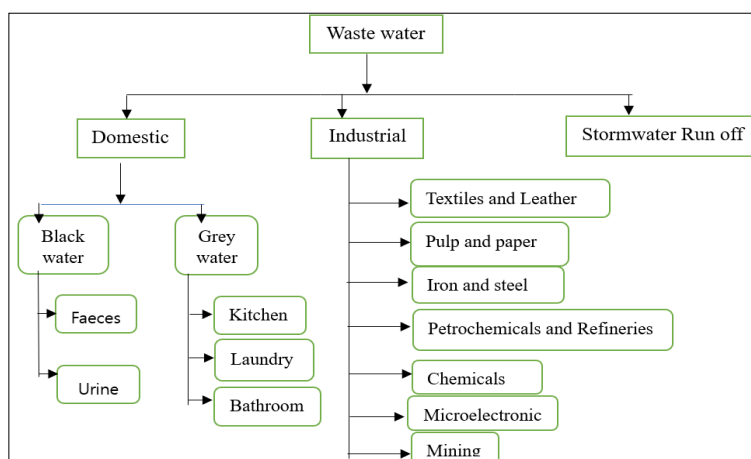


Fig 2: Type of waste water

- 1. Domestic Wastewater:** it is also known as MWW. Basically, wastewater from residential colony (e.g. houses), business buildings (e.g. hotels and hostels) and institutions (e.g. offices, colleges, schools, university). It can be categorized into greywater and blackwater.
- 1. Greywater:** it is a sullage of liquid waste from washrooms, laundries, kitchens etc.
- 2. Blackwater:** it is wastewater generated in toilets and urinals. Blackwater may also contain some flush water besides urine and faeces (excreta).
- 2. Industrial wastewater:** it is liquid waste from industrial establishments such as factories, power plants, chemical plants, food processing units and other many production units etc.
- 3. Stormwater Runoff:** it is water from streets, open yard etc after a rainfall event which run through drains or sewers.

Characteristic of wastewaters

Depending on its source, wastewater has peculiar characteristics. Industrial wastewater with characteristics of municipal or domestic wastewater can be discharged together. Industrial wastewater may require some pretreatment if it has to be discharged with domestic wastewater. The characteristics of wastewater vary from industry to industry and therefore would have different treatment processes. Industrial effluent (IF), Hospitals and Municipal waste water (MWW) is also called sewage, include domestic wastewater derived from households, toilet, wash basin business buildings and institutions etc. Theirs waste water contains more than 99 % of water and the remaining 1% includes suspended and dissolved organic and inorganic matter as well as microorganisms. It includes various waters with diverse wastes composition relatively small concentrations of suspended and dissolved organic and inorganic solids. Among the organic substances present in sewage are dye, carbohydrates, lignin, fats, soaps, synthetic detergents, proteins and their decomposition products, as well as various natural and synthetic organic chemicals from the process industries. MWW also contains a variety of inorganic substances from domestic and 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 in concentrations likely to affect humans, they might well be at phytotoxic 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. The major organic components in domestic waste water are carbohydrates, proteins and fats, oils and grease. Carbohydrates and proteins are easily biodegradable. Fats, oils and grease are more stable which decomposes slowly by microorganisms. Chlorides come from the softener used to treat hard water and from added chlorine. Human excreta also add chlorides, nitrogen, phosphorus and pathogenic microbes- viruses, protozoa, bacteria, helminths, to MWW.

Table 1: Typical composition of untreated domestic wastewater ^[4]

Contaminants	Concentration (mgL-1)		
	Weak	Medium	Strong
Total Dissolved (TDS)	250	500	850
Fixed	145	300	525
Volatile	105	200	325
Total Solids	350	720	1200
Suspended Solid	100	220	350
Fixed	20	55	75
Volatile	80	165	275
Total organic Carbon (TOC)	80	160	290
BOD at 20oc	110	220	400
Nitrogen	20	40	85
Chemical oxygen demand	250	500	1000
organic	8	15	35
phosphorus	4	8	15
Free Ammonia	12	25	50
Inorganic	3	5	10
Alkalinity (as CaCO ₃)	50	100	200
Sulphate	20	30	50
Volatile organic compound (VOC)	<100	100-400	>400
Grease	50	100	150

Wastewater Treatment

India is the second most populous country in the world with 1.4 billion population. Of the total population, 65 % is residing in the rural areas and 35% of the population is concentrated in urban centers. The generation of wastewater is estimated about 39,604 Million Liters per Day (MLD) in rural regions and in the urban centres, the generation of wastewater has been estimated as 72,368 MLD. The increased availability of more water for sanitation has improved living standards in urban cities. rapid urbanization may provide new opportunities for economic development but may exert additional pressure on freshwater resources meeting the needs of food and water in areas where water resources are scarce and areas where expansions are happening at an unprecedented pace. The population increase of such cities necessitates the identification of water resources to support such growth. The goal of wastewater treatment is to reduce the environmental effects of wastewater return flows or to permit re-use by enhancing the quality of "used" water sources by lowering pollutant levels below sectoral quality requirements. In places such as urban areas where there is prevalent water scarcity, wastewater treatment provides an alternative source of clean and safe water for domestic use ^[5, 6]. A major source of freshwater resources that can be utilized to sustain river flows, particularly during droughts, may also come from treated wastewater flows. Depending upon the size or the volume of wastewater from an industry, the technique to be employed changes. Wastewater can go through up to four levels of treatment – primary, secondary, tertiary and advanced – to remove waste. Sometimes, preliminary treatment precedes primary treatment. Different sites treat wastewater to different levels. We treat the wastewater so it's fit for purpose. Today wastewater treatment in India is being looked at from different angles ^[7]. Sedimentation, biological and chemical processes are commonly used in waste water treatment processes. Typically, technology has a role in each stage of wastewater treatment. The most recent technologies include aerobic granulation, aerobic granular reactors, aerated lagoons, bio-oxidation, advanced oxidation systems, and an activated sludge model ^[8, 9]. A typical type of wastewater treatment plant is shown in Figure 3.

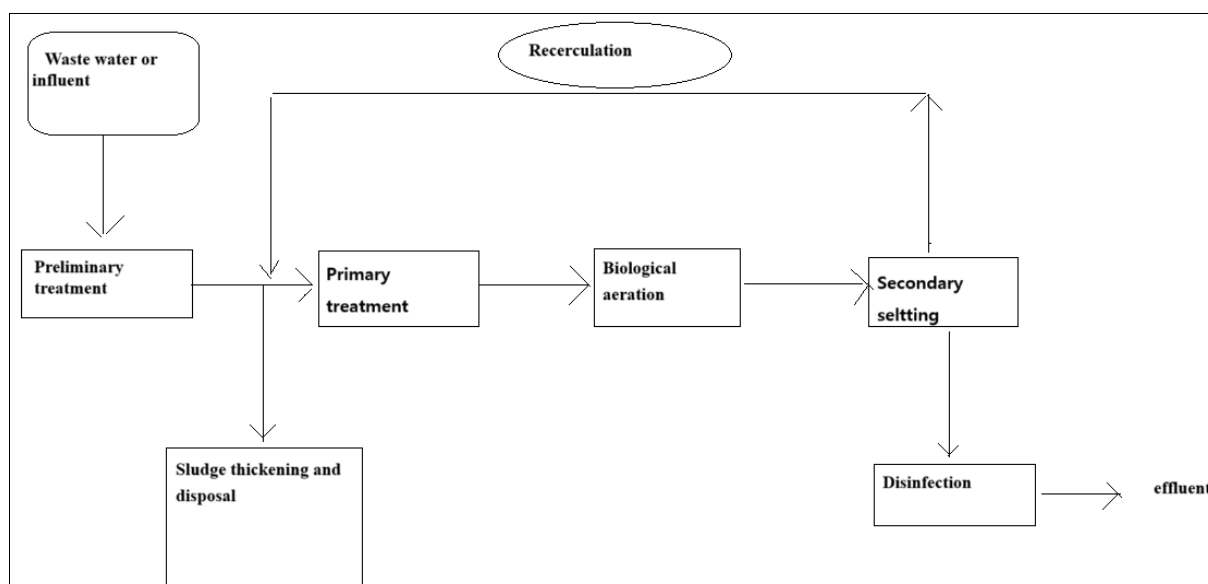


Fig 3: Typical wastewater treatment plant ^[10]

- a. **Preliminary Treatment:** Removes coarse suspended and grits. These can be removed by screening, and grit chambers respectively. This enhances the operation and maintenance of subsequent treatment units.
 - b. **Primary treatments:** Primary treatment removes material that will either float or readily settle out by gravity. It includes the physical processes of screening, grit removal, comminution, and sedimentation. Screens are made of long, closely spaced, narrow metal bars.
 - c. **Secondary treatment:** Secondary treatment removes the soluble organic matter that escapes primary treatment. It also removes more of the suspended solids. Removal is usually accomplished by biological processes in which microbes consume the organic impurities as meals, converting them into CO₂, H₂O and Energy for their own growth and reproduction. The removal of organic matter is when nitrogen compounds and phosphorus compounds and pathogenic microorganisms are removed. The treatment can be done three basic biological treatment methods like in (a)trickling filters (b) activated sludge methods (c) oxidation pond. A fourth, less common method is rotating biological contactors (RBC) or non-biological treatment methods like in anaerobic treatment, oxidation ditches, stabilization ponds etc ^[11].
 - d. **Tertiary treatment:** Tertiary treatment of wastewater normally means final filtration of the treated effluent. Tertiary treatment on the other hand can achieves levels of water purification that make the water safe for reuse in water-intensive processes or even as a drinking water. this stage, the remaining suspended solids are separated until concentrations of 5-10 mg/L, residual phosphorus and nitrogen components, and microbial load are obtained at discharge. This type of treatment involves the use of advanced filtration, adsorption and disinfection technologies. We filter the water and disinfect it with chlorine or UV light. This kills any remaining microorganisms.
1. **Depth filtration:** In this case, suspended substances pass through a filter bed consisting of granular material (as in sand filters) or compressible material (as in free-fiber cloth filters). There are three “dimensions” over which to develop the filtration instead of two: this is why it is a much more efficient process with the same size of machinery used.
 2. **Surface Filtration:** Treatment occurs with a filter medium through a staining process, thus two-dimensional (as in the case of micro-net cloth filters).
 3. **Membrane filtration:** In this type, wastewater passes under pressure through a thin membrane. This consists of hollow fibers or sheets of composite material (spirally wound). This is a staking process, as in the case of surface filtration.

Reuse of Waste Water

Wastewater can be a valuable resource in cities or towns where the population is growing and water supplies are limited. In addition to easing the strain on limited freshwater supplies, the reuse of wastewater can improve the quality of streams and lakes by reducing the effluent discharges that they receive. Wastewater may be reclaimed and reused for crop and landscape irrigation, groundwater recharge, or recreational purposes. Reclamation for drinking is technically possible, but this reuse faces significant public resistance.

There are two types of wastewater reuse: direct and indirect. In direct reuse, treated wastewater is piped into some type of water system without first being diluted in a natural stream or lake or in groundwater. One example is the irrigation of a golf course with effluent from a municipal wastewater treatment plant. Indirect reuse involves mixing reclaimed wastewater with another body of water before reusing it. In effect, any community that uses a surface water supply downstream from the treatment plant discharge pipe of another community is indirectly reusing wastewater. Indirect reuse is also accomplished by discharging reclaimed wastewater into a groundwater aquifer and later withdrawing the water for

use. Discharge into an aquifer (called artificial recharge) is done by either deep-well injection or shallow surface spreading.

Conclusion

Water is essential for maintaining clean water supplies and for the health of people, animals, and the environment. The demand on freshwater resources can be decreased by reusing treated wastewater for a variety of applications, including industrial processes, irrigation, and even drinking water following tertiary treatment.

References

1. Suhad AAAN Almuktar, Suhail N Abed, Miklas Scholz. Wetlands for wastewater treatment and subsequent recycling of treated effluent: A review, *Environmental Science and Pollution Research*,2018;25(24):235–95. <https://doi.org/10.1007/s11356-018-2629-3>. PMID: 29959736, PMCID: PMC6096557.
2. Yuhua Zhou, Ning Duan, Xuefang Wu, Hao Fang. COD discharge limits for urban wastewater treatment plants in China based on statistical methods, *Water*,2018;10(6):777.
3. Hanchang SHI. INDUSTRIAL WASTEWATER-TYPES, AMOUNTS AND EFFECTS POINT SOURCES OF POLLUTION: LOCAL EFFECTS AND IT'S CONTROL – Vol. I.
4. Mohini Singh, Srivastava RK. Treatment efficacy of short rotation woody species and their economic appraisal in vegetation filter system, *Annals of Plant and Soil Research*,2014;16(4):289–93.
5. Liao Z, Chen Z, Xu AO, Gao Q, Song K, Liu J, Hu HY. Wastewater treatment and reuse situations and influential factors in major Asian countries. *J Environ Manag*,2021;282:111976.
6. Ali I, Khan Z, Peng C, Naz I, Sultan M, Ali M, Mahmood M, Niaz Y. Identification and elucidation of the designing and operational issues of trickling filter systems for wastewater treatment. *Pol J Environ Stud*,2017;26:2431–44.
7. Yang H, Abbaspour K. Analysis of wastewater reuse potential in Beijing. *Desalination*,2007;212:238–50.
8. Łuczkiwicz A, Jankowska K, Fudala-Książek S, Olańczuk-Neyman K. Antimicrobial resistance of fecal indicators in municipal wastewater treatment plant. *Water Res*,2010;44:5089–97.
9. Vymazal J, Kröpfelová L. Types of constructed wetlands for wastewater treatment. In: *Wastewater Treatment in Constructed Wetlands with Horizontal Sub-Surface Flow*. Dordrecht, The Netherlands: Springer, 2008, 121–202.
10. Peace Amoatey, Richard Bani. Chapter 20: Wastewater Management, *Waste Water - Evaluation and Management*, Intech. Open, 2011. <https://doi.org/10.5772/2051>.
11. Peace Amoatey (Mrs), Professor Richard Bani. Wastewater Management Department of Agricultural Engineering, Faculty of Engineering Sciences, University of Ghana, Ghana, 2011.