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Waste-Water Treatment Management

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Abstract: Highly treated waste-water effluent from municipal waste-water treatment plants can be reused as a reliable source of water for agricultural irrigation, landscape irrigation, industrial recycling and reuse, groundwater recharge, recreational uses, non-potable urban reuse or even potable reuse Treated waste-water effluent can be used for the irrigation of crops or landscaped areas. The main consideration associated with this effluent application method is the quality of the treated water and its suitability for plant growth. Some constituents in reclaimed water that are of particular significance in terms of agricultural irrigation include elevated concentrations of dissolved solids, toxic chemicals, residual chlorine and nutrients. The issue of the use of reclaimed water for drinking purposes has been approached with extreme caution because of public rejection and because of health, safety and aesthetic concerns. Although extensive research is being conducted in this field, many constraints remain, notably the determination of appropriate quality criteria for such water.

Key words: Waste water · Treatment · Drinking purposes · Reclaimed watere

INTRODUCTION

After treatment, waste-water is either reused or discharged into the environment. Highly treated waste-water effluent from municipal waste-water treatment plants can be reused as a reliable source of water for agricultural irrigation, landscape irrigation, industrial recycling and reuse, groundwater recharge, recreational uses, non-potable urban reuse or even potable reuse. If not reused, treated waste-water is commonly discharged into a water body and diluted. Environmental regulations, guidelines and policies ensure acceptable discharge of waste-water effluent.

Effluent Reclamation and Reuse: Effluent reclamation and reuse has received much attention lately, owing to growing demand for water and unsustainable rates of consumption of natural water resources. A major concern in reuse applications is the quality of the reclaimed water, which is the main factor dictating the selection of the waste-water treatment process sequence. This section describes the various effluent reuse applications with emphasis on effluent quality issues.

Irrigation: Treated waste-water effluent can be used for the irrigation of crops or landscaped areas. The main consideration associated with this effluent application method is the quality of the treated water and its suitability for plant growth. Some constituents in reclaimed water that are of particular significance in terms of agricultural irrigation include elevated concentrations of dissolved solids, toxic chemicals, residual chlorine and nutrients. Another highly important consideration is public health and safety hazards resulting from the potential presence of bacterial pathogens, intestinal parasites, protozoa and viruses. Concerns vary with the intended irrigation use and the degree of human contact. Potential constraints associated with the use of reclaimed waste-water for irrigation include the marketability of crops and public acceptance, surface and groundwater pollution in the absence of adequate management and high user costs, notably the cost of pumping effluent to irrigated land [1].

Industrial Use: Reclaimed water is ideal for industries using processes that do not require water of potable quality. Industrial uses of reclaimed water include evaporative cooling water, boiler-feed water, process

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water and irrigation and maintenance of the grounds and landscape around the plant. Each type of reuse is associated with a number of constraints on its applicability; the use of reclaimed water in cooling towers, for example, creates problems of scaling, corrosion, biological growth, fouling and foaming. These problems are also encountered when fresh water is used, but less frequently. Reclaimed water used as boiler feed water must be softened and demineralized, while process water quality is dependent on the requirements of the manufacturing process involved [2].

Recreational Uses: Reclaimed water is widely used for recreational purposes, including landscape maintenance, aesthetic impoundments, recreational lakes for swimming, fishing and boating, ornamental fountains, snow making and fish farming [3]. The required treatment level for reclaimed water is dictated by the intended use: the greater the potential for human contact, the higher the treatment level required. For example, non-restricted recreational water use requires the treatment of secondary effluent by coagulation, filtration and disinfection to achieve a total coliform count of fewer than 3 per 100 milliliters [4].

Groundwater Recharge: Groundwater recharge using reclaimed waste-water serves to mitigate water table decline, protect groundwater in coastal aquifers against salt-water intrusion and store reclaimed water for future use. Groundwater recharge methods include surface spreading in basins and by direct injection into aquifers. Surface spreading utilizes flooding, ridge and furrow, constructed wetlands and infiltration basins. This application method improves the quality of the reclaimed water considerably as it percolates successively through soil, unsaturated zone and aquifer. Direct injection involves the pumping of reclaimed water directly into an aquifer. Drawbacks of this method include high effluent treatment cost and the high cost of the necessary injecting facilities. The major disadvantage of groundwater recharge using reclaimed water is the increased risk of groundwater contamination [5, 6].

Potable Reuse: The issue of the use of reclaimed water for drinking purposes has been approached with extreme caution because of public rejection and because of health, safety and aesthetic concerns. Although extensive research is being conducted in this field, many constraints remain, notably the determination of appropriate quality criteria for such water. At the present time, the option of direct potable use of reclaimed municipal waste-water is limited to extreme situations.

Effluent Disposal: Treated waste-water effluent, if not reused, is disposed of either on land or into water bodies.

Discharge into water bodies is the most common disposal practice. It takes advantage of the self-purification capacity of natural waters to further treat the effluent. However, waste-water effluent discharge must be based on sound engineering practice if the receiving environment is not to be adversely affected. Excessive quantities of organic material may cause rapid bacterial growth and depletion of the dissolved oxygen resources of the water body. In addition, changes in pH or concentrations of some organic and inorganic compounds may be toxic to particular life forms. Accordingly, outfall structures must be designed for adequate dispersal of the effluent in the receiving waters in order to avoid localized pollution. Depending on the characteristics of the receiving waters, many factors are considered for proper mixing and dispersal of effluent. These factors include flow velocity, depth stratification due to salinity and temperature, shape, reversal of current and wind circulation 48. The temperature and salinity of the effluent should also be taken into consideration. The disposal area should be downstream from any location where water is to be withdrawn for human consumption. This section addresses major considerations that need to be taken into account when treated waste-water effluent is discharged into water bodies, including rivers and streams, lakes and seas and oceans. Specific mathematical models devised to assess the effect of effluent discharge on receiving bodies and to aid in the design of out falls will not be discussed here.

Discharge into Rivers and Streams: Waste-water effluent discharge into rivers should be such as to ensure rapid vertical mixing of the effluent over the full river depth and avoid foaming problems. This can be achieved by using a multiport diffuser that extends across the width of the river. A diffuser is a structure that discharges the effluent through a series of holes or ports along a pipe extending into the river.

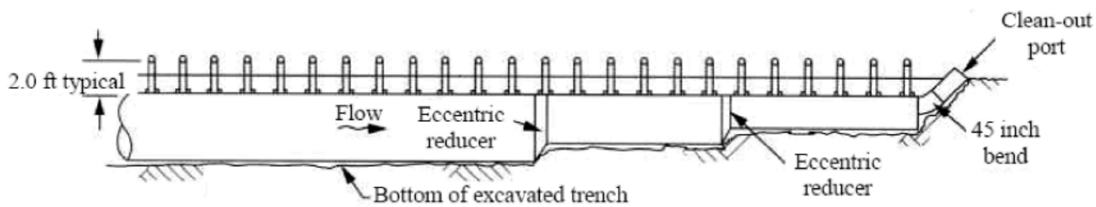

Fig. 1: Typical river diffuser outfall

Table 1: Usepa, npdes and ecedr for discharges from waste-water treatment plants

Parameter	NPDES[a]			EC EDRWD[b]	
	30-day average concentration	7-day average concentration	Percentage of removal[c]	Concentration (mg/L)	Percenatge of removal[c]
BOD_5	30 mg/L	45 mg/L	85	25	70-90
TSS	30 mg/L	45 mg/L	85	35-60	70-90
PH	6-9	-	-	-	-
COD	-	-	-	125	75
Total nitrogen[d]	-	-	-	10-15	70-80
Total phosphorus[d]				1-2	80

Discharge into Lakes: Being larger and deeper than rivers, lakes are subject to temperature stratification and less pronounced natural mixing via currents. Consequently, the lower strata in a lake are usually subject to conditions of low temperature and low dissolved oxygen, which slow down the decomposition of organic matter. Consequently, it is essential to ensure that appropriate mixing occurs when waste-water effluent is discharged into a lake in order to prevent the formation of an anaerobic stratum. In shallow lakes, effluents are adequately dispersed by wind-induced currents that ensure appropriate mixing.

Discharge into Seas and Oceans: Oceans are extensively used for waste-water disposal because of their great assimilation capacity. Waste-water is of lower density than seawater and consequently, upon discharge, the effluent forms a rapidly rising water plume which entrains large amounts of ambient water, enhancing waste-water dilution. If the water is not stratified, the plume will rise to the surface, where the waste-water will be diluted by ambient currents. A marine outfall should be designed to ensure sufficient dilution of the effluent before it reaches the surface of the water or is carried inshore by ambient currents [7]. The outfall carries the waste water to an offshore discharge point through a pipe laid on or buried in the ocean floor. The discharge maybe through a single-port or a multiport outfall structure that is similar to a river outfall (Figure 1).

Effluent Guidelines and Standards: A significant element in waste-water disposal is the potential environmental impact associated with it. Environmental standards are developed to ensure that the impacts of treated waste-water discharges into ambient waters are acceptable. Standards play a fundamental role in the determination of the level of wastewater treatment required and in the selection of the discharge location and outfall structures. Regulations and procedures vary from one country to another and are continuously reviewed and updated to reflect growing concern for the protection of ambient waters. The United States Environmental Protection Agency (USEPA) developed the National Pollutant Discharge Elimination System (NPDES) permit programme in 1972 to control water pollution by regulating point sources that discharge pollutants into waters. Accordingly, industrial, municipal and other facilities are required to obtain permits if their discharges go directly into surface waters. Under this programme, secondary treatment standards were established by USEPA for publicly owned treatment works (POTWs), governing the performance of secondary waste-water treatment plants. These technology-based regulations, which apply to all municipal waste-water treatment plants, represent the minimum level of effluent quality attainable by secondary treatment in terms of BOD5 and TSS removal [8]. Table 1 lists the NPDES limitations for secondary waste water treatment plants and the European Community Environmental Directive Requirements (EC EDR) for discharges from urban waste-water treatment plants.

New Directions and Concerns: A worldwide trend toward acceptance of the concept of reuse is currently observable, as water shortages have intensified. This has led to an increase in the use of dual water systems and satellite reclamation systems [6]. At the same time, however, potential microbial and chemical water contamination, especially from new trace contaminants, has become a growing source of concern and consequently direct potable reuse of reclaimed water is likely to remain impracticable. In response to these increasing concerns, new technologies offering significantly higher removal rates are being designed and implemented. These technologies include pressure-driven membranes, carbon adsorption, advanced oxidation, ion exchange and air stripping systems. Membrane technologies, which were formerly restricted to water desalination applications, are now being tested for the production of high quality water for indirect potable reuse and are expected to become the predominant treatment technologies in the near future.

In the field of sludge reclamation and reuse technologies, increased attention is being devoted to the production of sludge that is clean, has less volume and can be safely reused. Developments in this area have been slower than in the field of waste-water treatment, but a number of new technologies have emerged, including high-solids centrifuges, egg-shaped digesters and powerful heat dryers. Other developments include temperature-phased anaerobic digestion and auto-thermal aerobic digestion processes, which destroy volatile solids more effectively and yield enhanced production of class A biosolids [8]. Sludge land filling and incineration continue to decrease due to stricter regulations and increased public awareness. The current trend is in the direction of more reuse opportunities through the production of class Abiosolids. Volume reduction with a view to decreased disposal requirements is also an ongoing concern.

REFERENCE

1. Bataineh, F., M. Najjar and S. Malkawi, 2002. Wastewater Reuse. Paper presented at the Water Demand Management Forum, Amman, Jordan.
2. Centre International de Hautes Etudes Agronomiques Méditerranéennes (CIHEAM). Annual Report 2000.
3. Development and Agri-Food Policies in the Mediterranean Region. Paris: CIHEAM, 2000.
4. Droste, R.L., 1996. Theory and Practice of Water and Wastewater Treatment. New York: John Wiley and Sons.
5. Elarde, J.R. and R.A. Bergman, 2001. “The cost of membrane filtration for municipal water supplies”. Chapter 1 in Membrane practices for water treatment. Edited by S.J. Duranceau. Denver: American Water Works Association.
6. Food and Agriculture Organization, 1992. Wastewater Treatment and Use in Agriculture. FAO Irrigation and Drainage Paper 47. Rome: United Nations.
7. Liu, D.H.F. and B.G. Lipták, 1999. Wastewater Treatment. Boca Raton, Florida: Lewis.
8. Metcalf and Eddy, Inc. 2003. Wastewater Engineering: Treatment and Reuse, fourth edition. New York: McGraw-Hill.
9. Nesaratnam, S., 1998. Effluent Treatment. Leatherhead, Surrey: Pira International.