MUNICIPAL WASTEWATER REUSE

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Keywords: Wastewater reuses, agricultural irrigation，industrial reuse，groundwater recharge, municipal wastewater reuse, augmentation of potable supplies, recreational and habitat restoration/enhancement, wastewater reuse guidelines and regulations

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Summary

Municipal wastewater reuse has become increasingly important since the 1980s, particularly in countries where shortage of water resources is severe. In addition, since many municipal wastewater treatment plants are required to meet stringent effluent limits to protect the water quality of the receiving streams, wastewater reuse becomes a viable and attractive alternative. Presently major wastewater reuse applications include agricultural irrigation, industrial reuse, groundwater recharge, urban reuse, augmentation of potable supplies and recreational and habitat restoration/enhancement.

A successful reuse application depends on many factors, of which quantity and quality must receive great attention. The former deals with how reliable and dependable the wastewater source is. The latter concerns with how safe the reused water is to human beings and the relevant ecosystem, in particular for long-term application.

Due to the complexity of wastewater sources and reuse applications, there are no national standards for wastewater reuse in most countries in the world. Currently, wastewater reuse practices are mainly managed via regulations and guidelines. The presence of pathogens, biodegradable and refractory pollutants, heavy metals and other toxic organics in the wastewater can be a health or environmental concern if adequate treatment level is not provided. However, since some of these chemical pollutants may be contributed by industries, an effective industrial pretreatment program is absolutely required before any potential reuse is considered.

Although a large number of wastewater reuse treatment technologies ranging from simple to complex systems are available, they predominantly come from water and wastewater treatment processes.

Depending on the type of reuse and cost, the treatment levels range from secondary to advanced treatment, which include a combination of biological treatment, disinfection, chemical coagulation, filtration, activated carbon, ultra-filtration and reverse osmosis. In recent years, new membrane technology has received a lot of attention in the field of wastewater reuse. It is believed that technology innovation will significantly increase the wastewater reuse applications in the coming years.

1. Introduction

As an alternative water resource, wastewater reuse is widely known to have many benefits. However, a successful application depends on a number of factors, of which quantity and quality must receive great attention. The former deals with how reliable and dependable the wastewater source is. The latter concerns how safe the reused water would be to human beings and the relevant ecosystem, in particular for long-term application.

In general, municipal wastewater reuse can be classified as direct and indirect reuse. Direct reuse requires distribution systems to deliver treated wastewater to the users. It is planned, deliberate, or intentional use of treated wastewater for some beneficial purposes. Direct reuse of treated wastewater for drinking water, however, is not a viable option at this time due to health risk concerns. Indirect reuse refers to the use of treated wastewater after its return to natural water sources (i.e. river, lake and aquifer) for purification and dilution. It involves natural buffers for greater temporal and spatial separation of treatment.

Reuse of treated municipal wastewater has become increasingly important since the 1980s, in particular in countries where shortage of water resources is severe. In California, USA, for instance, 900,000 m^3/d of municipal wastewater was available for reuse in 1987, an overall 35 percent increase from 1970.

Even with this increase, however, only 7 to 8 percent of the municipal wastewater is reclaimed for beneficial application and there is a significant potential for further development. In recent years, major considerations for designing wastewater treatment plants have extended towards the reuse opportunities.

In Florida, USA, all public water utility boards that have control over wastewater treatment plants must submit wastewater reuse feasibility studies at the time of permit application. In addition, applicants for permits for commercial/industrial uses and agricultural, landscape, and golf course irrigation uses which are located in water resource caution areas are required to use reclaimed water in place of higher quality water sources, unless it is demonstrated that its use is either not environmentally, economically or technically feasible.

Though being strongly associated with locality, the following types of reuse applications

have been applied to treated wastewater,

- Agricultural irrigation;
- Industrial reuse;
- Groundwater recharge;
- Urban reuse;
- Augmentation of potable supplies; and
- Recreational and habitat restoration/enhancement.

The potential for any of these applications is subject to the control of pathogens, biodegradable and refractory pollutants, heavy metals and other toxic organics. Since municipal wastewater treatment plants may receive toxic chemicals from industries, effective pretreatment and pollution prevention programs are absolutely necessary prior to the consideration of any potential reuse application .

Depending on the specific reuse application, a high level of treatment provided by the municipal wastewater treatment facilities may be required in order to protect human health and the environment. These concerns thus necessitate the formation of criteria, standards and guidelines that are appropriate for the users or consumers of this water, which again is manifested via its physical, chemical, biological and even radiological characteristics.

Due to the complexity of different wastewater sources and different reuse applications, however, there are no national standards for wastewater reuse. Currently, wastewater reuse is mainly managed via regulations and guidelines. In the USA, wastewater reuse is regulated and enforced by state agencies, not the federal government.

These state agencies issue reuse permits specifying conditions, requirements and limitations, as well as initiate enforcement actions for permit violations. The U.S. Environmental Protection Agency (EPA) published reuse guidelines in 1992, which has been used in the development of water reuse regulations by many state agencies. According to EPA, the guidelines are not intended to be used as standards.

An updated guidelines manual will soon be published by EPA to reflect technical advancements and institutional developments since 1992. At present, the largest volumes of treated wastewater are used for agricultural irrigation followed by landscape irrigation, urban application and industrial reuse.

In the U.S.A., for instance, approximately 34 and 63 percent of wastewater reuse is for agriculture in Florida and California respectively. In recent years, however, other applications have seen a rapid increase by taking reused sewage as an integrated part of national/regional water resources.

This chapter presents an overview of the wastewater reuse applications in some detail, and introduces current wastewater reuse treatment technologies. However, it is beyond the scope of this chapter to provide any detailed discussion on the treatment technologies.

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Biographical Sketches

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