

CHAPTER 35

MANAGEMENT OF EFFLUENT AND SLUDGE FROM TREATMENT SYSTEMS

Yvonne Gotlop Bogatsu

**Department of Environmental Science
University of Botswana
Private Bag 0022
Gaborone, Botswana**

**Phone: 267-3552524 Fax: 267-356591
E-mail: gotlopyk@noka.ub.bw**

Management of Effluent and Sludge from Treatment Systems

Introduction

The type of effluent and sludge produced in developing countries especially in rural centres is known to be primarily of sewage characteristics. On the contrary the ongoing bloom of industrial development and technological advancement alters the composition of effluent in most developing countries. As such, the common practice of using combined wastewater treatment should be capable of treating wastewater which contains not only typical bacteria and chemical constituents but also complicated organic substances and heavy metals. Sludge from these systems is no longer the stabilised harmless sludge but is a hazardous type that requires proper disposal or treatment prior to reuse.

In the past, limited attention has been given to processes of treatment, handling, disposal and reuse of effluent and sludge especially in developing countries. *The aim of this chapter is to address methods used to handle effluent as well as sludge in the developing world, and to suggest ways of improving these practices.* While the constituents of these wastes vary due to changes in agricultural practices, industrial development and even changes in types of domestic wastes, the process of handling these pollutant loads has not improved, especially in less developed countries.

Reuse of effluent and sludge becomes a necessity as water demands exceed the available resources, and as such an improved quality effluent should be produced. Sludge is not only a by-product of wastewater treatment processes but even potable water treatment produces sludge. This sludge also requires to be dried, reused, or disposed of in an environmentally sound way. *As a reuse application, sludge could be used in place of chemicals in agricultural practices as soil conditioner and fertiliser, but even that exercise requires use of stabilised 'good' quality sludge.*

General

The word management is used in the environmental field to denote treatment, control through monitoring and legislation, and assessment to protect the environment from pollution and disposal or reuse. Effluent and sludge comprise water and solid matter out-flowing from domestic, institutional or industrial facilities. This may be in the form of treated wastewater from treatment plants, grey water in instances where it is not mixed with sewage water, effluent from potable water treatment plants, and industrial effluent. Grey water which usually comes from kitchen and bath water is usually allowed to directly soak away

into soil unless it is reused. In some instances it may be treated separately in lagoons to reduce treatment costs in conventional treatment plants

This chapter focuses on assessing management of effluent and sludge from various treatment facilities. Limited work has been done in this area particularly in the Africa region. Most of the previous work in developing countries focuses on aspects dealing with potable water systems, partly due to the scarcity and inadequate techniques of managing all types of water. This is demonstrated by the series of papers written on water in order to curb the way for water supply programmes, to mention but a few: WASH (1981), Snowy mountains Engineering, Swedish Geological International AB, WLP (1991), Gieske and Gould (1994). Since priority is given to water supply to meet the needs of the communities, only scarce attention has been paid to managing the wastes that emanate from such supplies.

Effluent Handling

Effluent describes any water outflowing from a facility, and its handling depends on the type of effluent being dealt with. For instance the way potable water effluent is handled varies from the handling of wastewater effluent. The general processes involve treatment, disposal, and possible reuse.

The methods applied in handling effluent from potable water treatment plants include among others, *lagooning, deep well injection, and recycling*. Effluent from these plants is usually 'reject' water, water which is used to backwash filters, and water used to flash clarifiers herein termed 'flashwater'.

The developing world has adopted a simpler combined approach for wastewater treatment, this is also used in some developed countries. *This method is applied in sewered systems and it involves combining treatment of industrial, institutional and domestic wastewater*. In this process wastewater from all these facilities is collected by the same sewer line and treated at a central plant. For unsewered centres such as rural locations on-site treatment is applied. This kind of treatment involves use of pit latrines, septic tanks or stabilisation ponds at the site where the wastewater is generated.

Water Treatment Plant Effluent

Effluent from drinking water treatment plants (WTP) is not of sewage nature. It is virtually less polluted in the sense that it is either back-wash-water, used to wash filters or flash-water which removes settled coagulated material from clarifiers. WTPs may also produce reject water in the form of brine from such plants as desalination plants. The only contaminants in that water would tend to be constituents which were initially in the water prior to treatment, algae, and

chemical substances which were used to treat that water.

Due to its characteristics it is much easier to manage effluent from drinking water treatment plants. Brine from such water treatment processes may be disposed of through injection into deep wells where these wells penetrate brackish groundwater (McGee, 1991). It may also be allowed to flow into saline surface water sources such as oceans. The general trend in developing countries such as Botswana is to dispose of this effluent in lagoons or into natural streams. For instance reject water from a desalination plant in south west Botswana is channelled to a lagoon which is not fenced or secluded from access by human or animals.

It is quite important to properly design a WTP so that effluent from such a plant does not contaminate the very water which is being extracted. Such effluent may be lagooned provided the water does not pose hazardous threats to health and to the environment. In instances where the water is lagooned, it should be allowed to evaporate after which the salt may be disposed of as solid waste. The lagoon should be fenced or isolated to prevent harmful effects on health. Filter backwash water may be recycled in the water treatment plant. For instance in some areas of Botswana it is recycled to the raw water intake point where it is blended with the raw water.

Effluent from Wastewater Treatment Plants

The most appropriate and common wastewater treatment method is the use of stabilisation ponds. Ponds seem to suit developing countries because they do not require complex technology: they are easy to manage, and they are less expensive. There is also the advantage of long, warm climates which provide an optimum environment needed by micro-organisms which function in stabilisation pond treatment. One of the disadvantages is the inevitable occupation of a lot of land which could be a drawback in certain developing countries. Another setback is the potential inability to handle shock loads especially if waste contains highly toxic and chemical substances. Other treatment methods used include conventional treatment plants such as activated sludge plants, biological filtration treatment systems and the like.

Typically, effluent from these treatment systems is disposed of in streams or it forms its own channel to flow along. This effluent may replenish water resources, or it may be used for such purposes as irrigation, construction, or even for recreation. Some countries such as Namibia recycle effluent for drinking purposes. That is quite a giant step considering the extent of monitoring and treatment required, the human perception factors that has to deal with, all in all, where water is scarce reuse of effluent should be emphasised.

Problems of Pollution from Effluent

Effluent from treatment plants be it potable or wastewater, should not deteriorate the quality of receiving water or pollute the environment. In developing countries this seems to be an unforeseen achievement. There has been serious pollution of groundwater from effluent seeping from latrines in a village in south east Botswana. This has resulted in high nitrate contamination and some of the boreholes were closed as a result. In an attempt to alleviate the contamination to groundwater, a special type of VIP latrine was introduced whereby the entire pit becomes sealed with concrete lining, and the vacuum tankers are utilised to desludge the system. Another alternative which was used was to provide sewer lines to connect the whole village to the sewage ponds.

Poor management of effluent results in pollution of the environment, and eventually becomes a health hazard. A wide range of factors contribute to inadequate management of effluent, particularly in developing countries. Among others, insufficient resources, lack of environmental awareness such as consequences of pollution. Lack of specialised human resources lead to use of unskilled labour to manage treatment systems. At times insufficient financial resources also result in use of the least expensive yet inefficient method of treatment.

Environmentally unsafe reuse practices may result in disastrous pollution of the environment. Eutrophication of lakes and dams may occur as polluted effluent recharges surface water sources.

It is quite necessary to set up an efficient system of monitoring effluent, in a way, this will reduce costs incurred in treating potable water polluted by effluent. This is carried out through assessing effluent quality from wastewater treatment plants. The process also involves monitoring the efficiency of water treatment, the methods used for disposal of effluent. Monitoring can be carried out through physical investigations, water quality testing, and recommendations for mitigating pollution caused by effluent.

An example of effluent monitoring is carried out in Botswana by government agencies. Although this only applies to effluent from wastewater systems, these agencies carry out inspections and they also assess wastewater treatment facilities in the country, and suggests ways of reducing pollution from these source where such effluent causes pollution.

Possibilities of Reusing Wastewater

The very fact that effluent enters channels implies replenishment of both surface and underground water sources. Good quality effluent allows continuity of flow

in streams and provides aquatic life with water and nutrients. The reuse of wastewater is a necessity for developing countries such as Botswana. As emphasised by Gotlop (1995) such factors as water scarcity, increasing water demands, and depletion of groundwater prompts the need to reuse water. Examples of such sources as the Notwane River in Botswana, Molatedi Dam in South Africa benefit from treated effluent. The Notwane, for instance, is known to be ephemeral, but due to replenishment from effluent it has become perennial from the point of discharge and downstream onwards. As indicated in TABLE 35.1 quite a sizeable amount of effluent flows from Gaborone sewage works into the Notwane River.

Effluent may also be used for agricultural purposes, for example in Lobatse, Botswana, treated wastewater is used for fodder crop watering.

Urban Centre	1990	1995	2000
A	14 475	23 513	35 543
B	5 010	7 308	11 493
C	4 393	5 837	8 058
D	3 224	3 903	4 704
E	1 261	1 625	2 049

Table 35.1: Estimated flows for treated wastewater effluent from urban centres of Botswana

Sludge Handling

Sludge from treatment facilities may be that from industrial plants such as slaughter houses, from wastewater treatment plants or from drinking water treatment facilities. In wastewater treatment, sludge is the largest of the by-products of the components removed by treatment (Tchobanoglous, 1992). Water treatment plants produce sludge in the form of waste from coagulation processes. The constituents of this sludge are usually organic wastes, flocculant matter consisting of chemicals used for coagulation.

Techniques of Handling Sludge

Techniques for handling sludge includes drying it then discarding it, reusing it

or incinerating it. Industrial waste sludge from meat industries is typically dumped or used for soil conditioning. For instance in Botswana sludge from abattoirs and piggeries is used as soil conditioner and fertiliser material. An example of such use is at Botswana Meat Commission, where dung and paunch contents are used as soil conditioner and fertiliser (German Technological Cooperation and the National Conservation Strategy, 1995). Another good example of sludge treatment is practised in Swaziland at Conco plant. At this plant waste sludge produced during wastewater treatment is further treated prior to disposal at the solid waste site.

Ideal methods of dealing with sludge from wastewater treatment processes include thickening and stabilisation. By the time sludge leaves ponds it is already at the stabilised stage, however, further stabilisation may be carried out to reduce odours and pathogens. The most common procedure for dealing with sludge from wastewater stabilisation ponds or other wastewater treatment facilities is to treat it in drying beds. In some instances untreated sludge has been dumped indiscriminately in the open or at waste dump sites. Sewage sludge in itself is not harmful to the environment, it in fact provides the necessary nutrients and organic material for the soil and plants. It becomes harmful when sludge contaminates land and water resources. *Sludge from combined wastewater treatment systems is likely to contain high levels of industrial pollutants such as heavy metals, persistent agro-chemicals and other similar substances.* As such care must be taken in handling such sludge. This implies the need to not only test water resources for pollution but also scrutinise possible pollution from sludge or soils which contain sludge.

Sludge from potable water treatment plants may be in the form of flocs which settle at the bottom of clarifying tanks during coagulation processes during water treatment. This sludge may contain organic matter such as algae, flocs of particulate matter, chemicals such as lime slurry, soda-ash, alum chlorine and other chemicals used in water treatment. If such sludge reaches sewer systems it may complicate and inhibit processes in sewage treatment. Waste sludge from water treatment systems may be lagooned for evaporation, then after being dried it may be discarded as solid waste. Depending on the liquid content drying beds may be used, sludge may then be reused or disposed of.

References

Gieske A. and Gould J. (1994), editors. *Proceedings of the Integrated Water Resources Management Workshop*. Gaborone.

Gotlop Y. K. (1996). *Wastewater Reclamation and Reuse: Summary*. Eighteenth IAWQ Biennial International Conference and Exhibition: Book 7, page 120-121. Singapore.

German Technical Co-operation and the National Conservation Strategy (1995). *Proceedings: 2nd International Waste Management Congress*, Francistown.

McGhee T. J. (1991). *Water Supply and Sewerage*, 6th edition. McGraw-Hill, New York.

Snowy Mountains Engineering, Swedish Geological International AB, WLPW Consultants (1991). *Botswana National Water Master Plan*. Volume 6. Report with Department of Water Affairs, Gaborone.

Tchobanoglous, G. (1992) revised for Metcalf and Eddy Inc. *Wastewater Engineering Treatment, Disposal, Reuse*. 2nd edition. Tata McGraw-Hill, New Delhi.