Oxidation Ditch (OD) Design Considerations – Excerpt from Small Towns and Rural Arid Areas Water Supply and Sanitation Project (ADB TA 4853-SRI), Final Report, Annex 1 Urban Water Supply and Sanitation – Technical Standards and Options, In association with IDP Consult Inc., March 2008.

Process Design and Physical Considerations

The Oxidation Ditch process is a version of the activated sludge process in which the wastewater is subjected to an extended period of aeration. Primary sedimentation tanks are not required, but screening and grit removal of the raw wastewater should be included to avoid difficulties with the clogging of pipe work and pumps. A final sedimentation tank is needed for the mixed liquor that comes from the aeration ditch to separate out the sludge. The clarified effluent from the sedimentation tank is the treated effluent from the ditch system. Because little bacterial reduction takes place in the aeration process, the effluent usually required tertiary treatment for disinfection before final disposal.

The ditch is constructed in the form of an endless channel fitted with mechanical aerators. The usual shape of the ditch is oval in plan with a rectangular shaped cross section. It is normal to construct the ditch in reinforced concrete, but simpler, less expensive options can be considered to suit local conditions. The standard width of channel is 2.0 to 6.0 m and the usual water depth is 1.0 to 3.0 m. It is common to provide two channels to allow maintenance to be carried out, but the volume of the anticipated 2030 flows from the proposed sewered areas in the Project Towns do not warrant twin channels. It is intended to provide the required retention volume in a single ditch channel.

The aerators provide the necessary oxygen for treatment, mix the activated sludge with the incoming raw wastewater, and impart a flow velocity to the mixed liquor. The flow velocity is sufficient to retain the solids in suspension in the ditch. The usual type of aerators are brush rotors fitted on a horizontal axis.

The final sedimentation tank is normally a circular, radial-flow tank constructed in reinforced concrete. The tank is fitted with rotating scrapers to guide the settled sludge into a central hopper for removal from the tank by hydrostatic head. Part of the sludge that is withdrawn from the sedimentation tank is returned to the aeration ditch as activated sludge, while the excess sludge disposed of.

The extended length of aeration in the ditch provides effective oxidation of the organic matter and results in a stable sludge that needs no further treatment. It can be discharged directly to drying beds for air drying without fear of nuisance. However, it is normal to thicken the sludge in a thickening tank before discharging it to drying beds. The thickening process reduces the volume of the sludge that has to be dried and, hence, reduces the area of drying beds that are needed.

Design Parameters

The design parameters that are used for the design of an aeration ditch system are usually given as a range of values. The actual value of the parameter that is used for design is dependent upon local conditions and on the quality of treatment that is required. Ranges of common values for the most relevant design parameters are shown on the following table.

Parameter Unit Range

Sludge Loading (F:M) Factor	kgBOD/kgMLSS 0.05 – 0.15
MLSS mg/l	2,000 – 5,000
Recycle Ratio	0.75 – 1.50
Retention at ADWF	Hours 24 – 48
BOD Removal %	90 – 95
Sludge Age Days	12 – 20
Sludge production	kg DS/kgBOD/d 0.7 – 0.8
Oxygen Requirement	kg O2/kgBOD/d 1.8 – 2.2

Treatment Efficiency

An oxidation ditch system could provide an effluent that can reliably comply with almost all of the limits in the proposed revised National Environmental Regulations. The most significant exception is the fecal coliform (FC) standard. Because conventional treatment plants are not designed for the reduction or removal of micro-organisms, the efficiency of the removal of fecal coliforms in an oxidation ditch system is very poor.

In order to comply with the FC criteria in the proposed CEA Regulations, the effluent from an oxidation ditch would need to be given tertiary treatment in the form of disinfection. Disinfection is the process of the reduction of pathogens of concern to humans and animals to acceptable levels of risks of transmission of diseases. The disinfection methods that are generally considered for use consist of chemical methods (chlorine, chlorine dioxide and ozone), physical methods (UV irradiation and membrane micro-filtration), and biological methods (ponds).

In relation to specific disinfection methods a number of conclusions have been reached through research studies. Briefly, the effectiveness of chlorine for the inactivation of viruses, helminths and protozoa is lower than for bacteria and depends to a large extent on having the appropriate conditions, viz. optimum pH, adequate chlorine contact time, and low levels of ammonia and suspended solids. Ultraviolet irradiation is effective for disinfection of bacteria and viruses, but has yet to be fully assessed for inactivation of protozoa and helminths. Maturation ponds with 3 - 4 ponds in series, giving an overall retention time of at least twenty days, will not entirely eradicate fecal coliforms, but will reduce their numbers to acceptable levels. Ponds will also reduce helminth eggs and protozoal cysts to undetectable levels.

Where there is insufficient land available for the construction of maturation ponds, the most commonly used disinfection method is chlorination.