Package Treatment Plant Operation and Management

Technologies and Performance: Part 1

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Introduction

In this session we will cover:

Common Suspended Growth Technologies

- Description
- Typical Configuration and Unit Processes
- Applicability
- Performance
- Examples

Extended Aeration Reactors

- Historically, probably the most common PTP technology in Australia
- Activated sludge (suspended growth) process with secondary clarification
- Typically incorporates screening/grinding and may also include flow equalisation (balancing)
- Complete mix /continuous feed process
- Most commercial systems operate in the endogenous phase of the metabolic growth curve

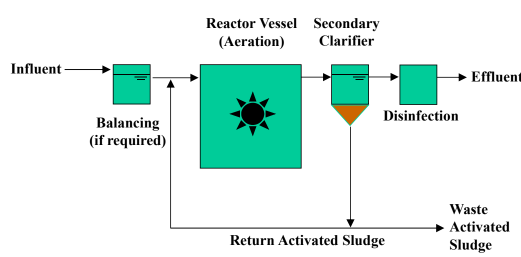
Extended Aeration Reactors

- Raw wastewater is continuously fed through the reactor vessel where it comes into successive contact with microorganism (MLVSS) population
- Organic content (BOD and TOC) converted as wastewater passes through reactor vessel
- Aeration is typically provided via mechanical means (blowers, pumps, aerators etc.)
- Extended aeration cycles required to maintain complete mixing and nitrification

Extended Aeration Reactors

- Reacted wastewater requires secondary clarification prior to discharge or additional treatment
- If required, disinfection takes place after this treatment stage
- Sludge from clarifier is either returned to the reactor vessel (RAS) or proportionally wasted for further treatment or disposal (WAS)
- Scum and floatables returned to reactor via passive or active return (skimmer)

Extended Aeration Reactors (Typical Configuration)



Extended Aeration Reactors (Applicability)

- Relatively smaller land area requirements for construction and installation
- Increased MCRT/HRT (treatment times) due to large reactor vessel volume
- Resistant to shock loads from high strength wastes as reactor mixing (dilution) is instantaneous and constant
- Less suited to low organic loading (small flow) conditions with extended aeration periods
- Generated solids are typically well stabilised

Extended Aeration Reactors (Performance)

- Potential for high BOD and SS (85 – 95%) removal and moderate to high nitrification (>80%) in well designed systems
- Targeted process control and aeration timing may allow for limited nitrogen removal (controlled anoxia)
- Phosphorus removal <50% (solids retention), greater difficult without chemical addition
- Pathogen reduction minor (<2 log) without disinfection

Oxidation Channels (Pasveer Ditches)

- Modified extended aeration AS process
- Often referred to in Australia by a commercial name "Pasveer" ditches
- NSW DPW installed a large number of these plants throughout rural NSW for small communities
- Typically incorporates screening/grinding (pre-treatment)
- Complete mix / continuous feed process
- Secondary clarification is required/installed in most situations

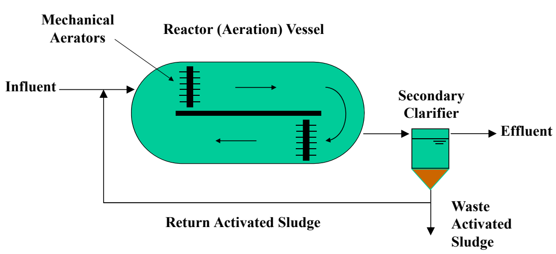
Oxidation Channels (Pasveer Ditches)

- Design typically consists of a ring or oval shaped channel
- Mechanical “brush” aerators generate a unidirectional flow around the channel
- Raw wastewater is continuously fed through the reactor where it comes into contact with microorganism population
- Typical velocities are 0.25 to 0.35 metres per sec
- Dissolved oxygen levels in the reactor decrease along the channel length (run)

Oxidation Channels (Pasveer Ditches)

- Reacted wastewater requires secondary clarification prior to discharge or additional treatment
- If required, disinfection takes place after this treatment stage
- Sludge from clarifier is either returned to ditch or proportionally wasted
- Scum and floatables are also wasted

Oxidation Channels (Typical Configuration)



Oxidation Channels (Applicability)

- Large land area requirement for construction
- Increased detention/treatment times
- Highly reliable and robust treatment process
- Anoxic zones can be obtained by design for nitrification / denitrification
- Resistant to shock loads, 20-30x dilution
- Typically produce less sludge and can support a sustained low F/M ratio environment (high MLVSS)
- Generated solids are well stabilised

Oxidation Channels (Performance)

- Reliably high BOD and SS (85 – 95%) removal and moderate to high nitrification (>75%) in well designed systems
- Advanced denitrification (N) and some biological P removal possible in purpose designed systems (aerobic/anoxic zones)
- Phosphorus removal ~50% (solids retention), greater difficult without chemical addition
- Pathogen reduction minor (<2 log) without disinfection

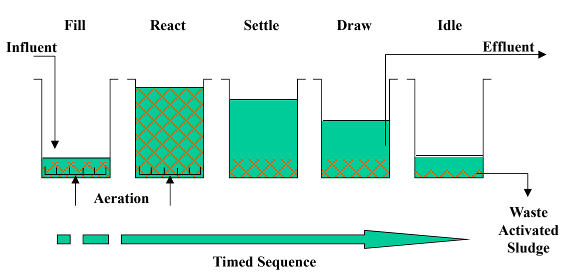
Sequencing Batch Reactors

- SBR's are a complete-mix AS process
- Utilise a fill and draw process to provide all wastewater treatment steps in the same vessel in a sequential order
- Systems typically comprise a balance tank (separate or integrated) and a batch reactor vessel
- The balance tank is used to moderate flows during non-continuous or intermittent flow conditions
- Separate 'secondary' clarifier not required

Sequencing Batch Reactors

- Most systems rotate through a five step cycle of:
  - **Fill** – raw effluent is fed into the reactor vessel
  - **React** – air is delivered to the reactor vessel for a set period depending upon the level of treatment required
  - **Settle** – aeration is ceased and solid/liquid separation occurs through sedimentation and flotation of solid material
  - **Draw** – supernatant (clear) water is drawn of from the water column using either fixed or floating decanter devices
  - **Idle** – once the sequence is complete the system is allowed to sit idle while awaiting the next 'batch'. Waste activated sludge (WAS) is pumped out of the reactor vessel

Sequencing Batch Reactors (Typical Configuration)



Sequencing Batch Reactors

- Activated sludge or mixed liquor is retained within the reactor vessel at all times
- No need for a separate clarification basin
- Treatment involves a closed cycle process
- In large systems it is common to see two reactor vessels operating side by side and fed from the same balance tank
- If required, disinfection takes place after the treated effluent has been decanted

Sequencing Batch Reactors (Applicability)

- Small to moderate land area requirement for construction / installation particularly if dual reactor vessels
- Well suited to intermittent flow conditions as balance tank (when used) moderates incoming flows
- May be sensitive to shock loads as microbiological populations within reactor vessel are conditioned to previous waste stream
- Highly flexible design - system can be easily staged or expanded

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Sequencing Batch Reactors (Performance)

- Reliably high BOD and SS (85 – 95%) removal and moderate to high nitrification (>75%) in well designed systems
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- Phosphorus removal ~50% (solids retention), greater difficult without chemical addition
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Purestream Inc. – 750kL SBR

Kingflow Wastewater Engineering

Graf Australia - KLARO E-Professional SBR

Intermittently Decanted Extended Aeration (IDEA) Plants

- Australian modification of the SBR treatment process (may be ICEAS)
- System retains 5-cycle process
- Raw wastewater is continually fed into the treatment reactor in a baffled compartment (pre-react zone)
- Applicability and performance is essentially same as traditional SBR design
- System is more resilient to shock loading and does not require flow equalisation

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