## Testing and Monitoring On-site Systems



## Introduction

- Monitoring is essential when the performance of a system must be accurately quantified.
- However, rigorous monitoring of wastewater quality and quantity requires a significant amount of time and resources.
- Monitoring of on-site systems may be justified where problem identification is difficult or where the performance of a new / emerging technology needs to be verified.



## Monitoring Parameters

Hydraulic Load

- Without useful data on hydraulic load, wastewater quality data can be useless.
- As a minimum it should be measured at the same frequency as bio-chemical data.
- Water meter readings may be adequate (excluding external water use) but data loggers should be considered.



## Monitoring Parameters

Household Behaviour

- Where possible, try to establish the timing of specific activities that generate wastewater (e.g. laundry, showers).
- If appropriate, ask the residents to keep a diary of these details.
- Identify the type of cleaning agent, detergent, disinfectant and antibiotic inputs to the system.



## Monitoring Parameters

Biochemical Oxygen Demand ($BOD_5$)

- $BOD_5$ is the quantity of oxygen used in the degradation of organic matter in water.
- $BOD_5$ analysis is undertaken in a laboratory using a standard analytical technique.
- A reduction in organic load is the key aim of secondary treatment.
- Need to be aware of the relationship with Chemical Oxygen Demand (COD).



## Monitoring Parameters

Total Suspended Solids (TSS)

- TSS include organic and inorganic material suspended in a sample.
- TSS analysis undertaken in a laboratory using a standard analytical technique.
- High TSS loads can have a detrimental effect on downstream processes and cause blockages in land application areas.

## Monitoring Parameters

Faecal Coliforms (FC)

- FC bacteria are commonly used as an indicator of faecal contamination. Can be used as an indicator of the likelihood of pathogen contamination.
- FC analysis is undertaken in a laboratory using a standard analytical technique.
- FC concentrations will vary by orders of magnitude depending on the level of treatment.



## Monitoring Parameters

pH

- Approximate pH can be checked using a calibrated instrument or colour comparator strips.
- Should be near neutral (7.0). Wide / frequent fluctuation of pH is detrimental to processes (reduced solids settleability / micro-biological activity).
- pH should be kept between 6.0 and 9.0.




## Monitoring Parameters

Electrical Conductivity

- Measure of the ability of a solution to conduct an electrical current.
- Conductivity increases as the proportion of ions in solution increase.
- Typically measured in the field using a calibrated analytical probe. Results typically expressed as deciSiemens per metre (dS/m) or microSiemens per centimetre (uS/cm).



## Monitoring Parameters

Nitrogen

- Nitrogen (N) is found in three forms – organic N, ammoniacal N and oxidised N.
- Total Kjeldahl Nitrogen (TKN) is the concentration of organic N and ammoniacal N. These forms of N are dominant in anaerobic effluent.
- Total Oxidised Nitrogen (TON) is the concentration of nitrate ($NO_3$) and nitrite ($NO_2$).



## Monitoring Parameters

Nitrogen

- The dominant form of nitrogen will depend mainly on oxygen status but also pH.
- Dominant form of nitrogen can vary over very short periods of time.
- Need to look at specific forms when monitoring to gain an understanding of treatment efficiency.

## Monitoring Parameters

Phosphorus

- Typically found in one of three forms in domestic wastewater: orthophosphate (e.g. $PO_4^{-3}$, $HPO_4^{-2}$); polyphosphate (e.g. $P_2O^{-4}$) and organic phosphate.
- Orthophosphates are readily available for biological metabolism, while poly and organic phosphates must first undergo some form of conversion.



## Monitoring Parameters

Dissolved Oxygen (DO)

- DO can be used to assess the efficiency of most secondary treatment processes.
- Secondary treated effluent should generally have a high DO.
- But… be careful, DO can fluctuate significantly within very short periods.



## Monitoring Parameters

Other Parameters

- Total Oil and Grease (TOG)
- Surfactants (MBAS - methylene blue active substances)
- Chemical Oxygen Demand (COD)
- Free Residual Chlorine (FRC)
- Volatile Suspended Solids (VSS)



## Sampling Programs

- Care should be taken when sampling effluent to use correct procedure.
- Sample bottles must be rinsed with deionised water before being taken out to site. Bottles for laboratory analysis may need to be acid washed.
- Consult individual laboratories for advice on sample bottles (number, volume of sample).
- Appropriate PPE must be worn (e.g. latex or vinyl coated gloves).



## Sampling Programs

- Bottle should be rinsed with the sample liquid three times before collection (except for microbiological sample bottles).
- Do not leave an air gap in the bottle as this can affect the result of some analyses.
- Clearly label each sample bottle (location, time, date, sampled by).
- Keep laboratory samples at ~4°C (i.e. esky on ice) and deliver / analyse as soon as possible.

## Sampling Programs

- Careful consideration is required when selecting:
  - Sampling location
  - Sampling time
  - Sampling frequency
  - Parameters for analysis



## Sampling Programs

- Programs to measure the specific treatment efficiency of a particular component must include monitoring of both influent and effluent.
- Domestic wastewater is subject to significant temporal variation. Grab samples are only a snapshot of performance.
- Composite sampling can allow assessment of average wastewater quality over a period.



## Sampling Programs

- Notwithstanding, grab samples can be useful when conducting compliance testing of multiple systems.
- Realistically, only situations with significant legal / market implications or a high risk of impact will justify greater focus.
- However it is important to recognise that effluent quality data does not automatically provide an accurate diagnosis of system performance.



## Monitoring Periods

- What is an appropriate frequency and duration for monitoring?
- Basic compliance testing: a grab sample of effluent once a week for a month (each sample should be taken at a different time of day)?
- Long-term treatment efficiency: 24 hour composite samples of influent and effluent every day for a month?



## Interpretation of Results

- It is not always advisable to assess the results of monitoring against regulatory standards in isolation.
  - Consider the resolution of the data (i.e. the suitability of sampling frequency and duration).
  - Consider temporal variation (e.g. hydraulic load / peak pollutant periods).
  - Consider potential external impacts on readings (sampling errors, rainfall, higher than average pollutant inputs).



## Typical Treatment Performance

| Parameter | Septic Tank | Secondary[1] | Advanced Secondary[2] |
|---|---|---|---|
| $BOD_5$ (mg/L) | 140-200 (180) | 5-50 (20) | 5-15 (10) |
| TSS (mg/L) | 30-100 (80) | 5-50 (30) | 5-15 (10) |
| Faecal Coliforms (cfu/100ml)[3] | $10^6$-$10^8$ | $10^2$-$10^4$ | $10^1$-$10^3$ |
| TN | 40-100 (60) | 15-50 (30) | 10-50 (20) |
| TP | 5-15 (10) | 5-10 (8) | 5-10 (8) |

Source: USEPA Onsite Wastewater Treatment Systems Manual 2002.

Note 1: Traditional package plants and reed beds with no disinfection.

Note 2: Sand filters, some biofilters and textile filters.

Note 3: Secondary or advanced secondary effluent can achieve faecal coliform concentrations <100cfu/100ml with active disinfection.