Factors Affecting the Performance of BNR Plants in Johannesburg

Water is life.

Presented by

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Presentation

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- Introduction.
- Design of treatment works.
- Process management.
- Plant operation.
- Process monitoring.
- Conclusion.

Introduction

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In 2006, a survey carried out by consultants on small to medium sized works in South Africa, indicated that only 2 out of 51 plants investigated regularly complied with the general effluent quality standard.

Design of Treatment Works

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- **Process selection:**
- **Appoint competent process designers.**
- **Input from the client.**
- **Select processes that attain only the required results.**
- **Select processes that have been successfully implemented under similar conditions.**
- **Clients past experience with the selected process.**
- **Are existing staff able of understand the process?**

Design of Treatment Works

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- Design of structures:
- Structures that meet the process requirements.
- Input from operational staff.
- Implement proven designs.

Design of Treatment Works

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- **Equipment selection:**
- **Previous experience.**
- **Life cycle cost.**
- **Reliability.**
- **Easy to operate and maintain.**

Design of Treatment Works

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- Equipment selection:
- Availability of spares.
- Robust construction.
- Local content.
- Effective maintenance programme.

Process Management

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- **Personnel selection:**
- **Educational qualifications to suit the technology chosen.**
- **Select committed personnel.**
- **Personnel must fully understand the processes.**
- **Personnel must understand the effects of operational changes on process requirements.**

Process Management

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- **Training of Personnel:**
- **Process personnel should only be trained for their needs.**
- **Training should be carried out by personnel who fully understand those needs.**
- **Training should not be seen as a substitute for education.**

Plant Operation

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- **BNR process requirements:**
- **Ratio of TKN : COD (< 0.08)**
- **Ratio of TP : COD (< 0.02)**

Plant Operation

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Characteristics of the reactor feed:

- **If the TKN / COD ratio > 0.08**
- **Not possible to completely remove N biologically.**
- **Improved by optimizing de-nitrification process.**

Plant Operation

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Characteristics of the reactor feed.

- **If the TP / COD ratio > 0.02**
- **Not possible to completely remove P biologically.**
- **Improved by increasing VFA production.**

Plant Operation

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Treatment capacity

- **Operate reactors at design capacity.**
- **Under the design capacity**
- **Over the design capacity**

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Plant Operation

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- **Factors affecting the BNR process:**
- **Characteristics of the bio-reactor feed.**
- **Control of residual dissolved oxygen concentrations.**
- **Presence of free and bound oxygen in un-aerated zones.**
- **Control the recycling of nitrate.**
- **Control the recycling of waste liquors.**
- **Control of MLSS concentration.**

Plant Operation

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Adjustment to the reactor feed:

- **Enhance de-nitrification potential by supplementing the reactor feed with particulate substrate:**

- **Reduce the number of PSTs in operation.**
- **Increase carry-over of particulates from sludge fermenters.**

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Aeration control:

- **Determine the aerator pattern for the minimum d.o requirement.**
- **Set high and low D.O. limits for each aerated zone.**
- **Switch aerators on from the front and off from the back.**
- **Prevent over-aeration.**

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Operation of recycle pumps:

- Maximise denitrification potential.
- Optimise number of a-recycle pumps.
- Limit nitrate recycle.
- Set inflow to s-recycle ratio at between 1 : 0.6 to 0.8.

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- Free Oxygen presence in un-aerated zones caused by:
- Inflow turbulence.
- Excessive static mixer turbulence.
- Vortex formation by mixers.
- Air entrainment from recycle pumps.

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- **Process stability:**
- **Operate at optimum MLSS concentrations for various reactor temperatures.**
- **Minimize variation in MLSS concentrations between summer and winter temperatures.**
- **Maximize MLSS concentration for minimum aeration requirements.**

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Plant Operation

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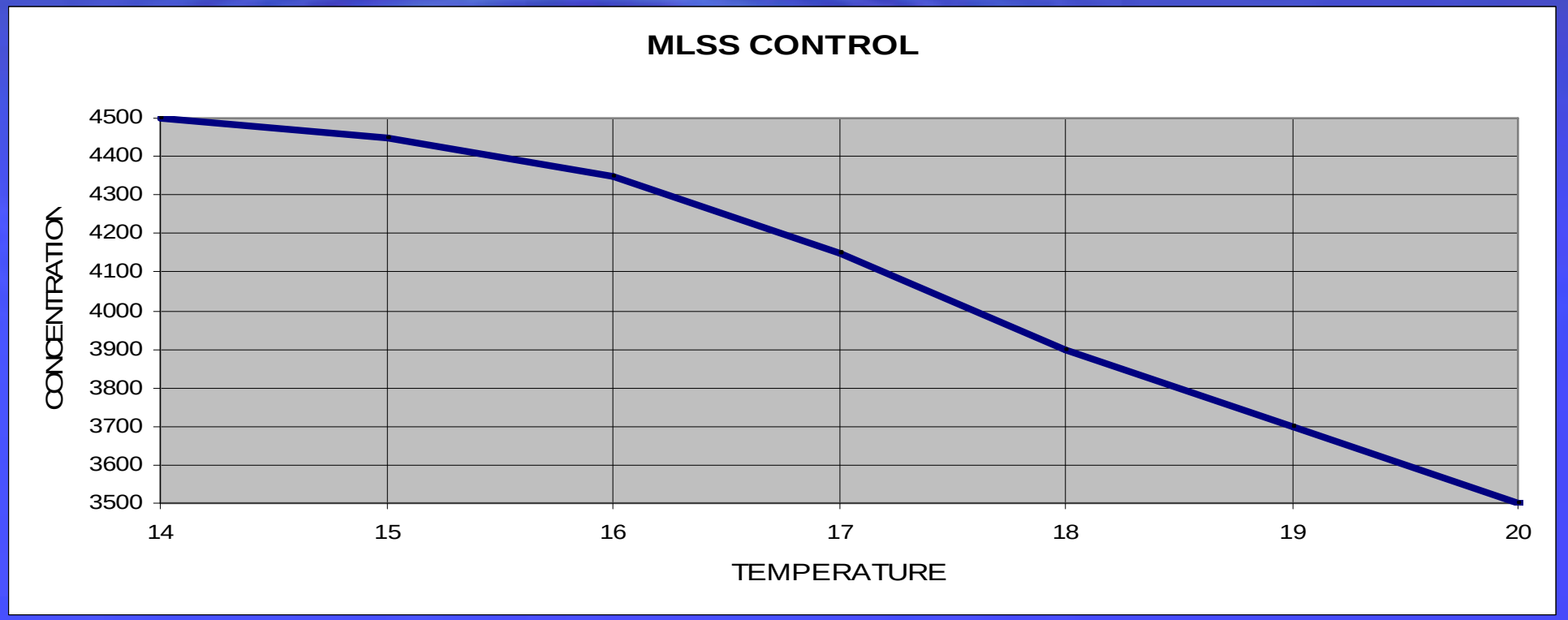

Process Monitoring

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- In - situ Sensors to measure
- Residual dissolved oxygen concentration.
- MLSS concentration.

- Flows Meters to measure
- Flow rate into reactors.
- Clarifier underflow recycle rate (s - recycle).

Process Monitoring

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Portable DO meter and grab sampling

- **Anaerobic zone**
- **Presence of bound oxygen (NO_3).**
- **Presence of free oxygen (O_2)**
- **Minimize bound and free oxygen presence.**

Process Monitoring

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Portable DO meter and grab sampling

- Anoxic zone
- Presence of free O_2.
- NO_3 concentration at end of zone.
- Maximize the de-nitrification potential.

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Conclusions

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- Appropriate process design selection.
- Incorporate proven designs for structures.
- Effective maintenance program for reliable equipment.
- Competent Process Managers.
- Operate plants to attain process requirements.
- Adequate process monitoring.

Acknowledgements

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