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- **Monitoring and Sampling for Industrial Effluent Management and Treatment**

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Sampling v. On-Line Monitoring?

Pros and Cons for each approach:

a) Sampling

*Approach involves autosampling at
either time based or flow related
intervals, followed by laboratory
analyses*



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Types of Samples

Grab Sample

Represents one moment in time and is not mixed with any other samples.

Used as a tool to help in treatment process

Can be done for oil and grease, pH, chlorine residual ect.

- **Done manually**

- **Wide mouth glass container**
- **Bucket**
- **PTP 150**



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Types of Samples

Composite

Composite samples are small volumes of sample taken over time and placed in a large container.

Composite samples can be taken in two ways, fixed volume or flow proportional



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Sequential Sampling

Usually done when monitoring for specific events like slugs.

Used by enforcement to check industry and determine pollutant trending

Multiple bottles are used with the standard being the 24 bottle sampler.

One or more samples collected in individual bottle each hour.

Flexible enough to take samples/bottle or multiple bottles/sample



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Sampling v. On-Line Monitoring

a) Sampling : Pros -

- *Samples can be taken to lab for many different parameter analyses to be done*
- *List of parameters can be changed as required*
- *Analyses can be repeated/varified*
- *Methods for analyses can be “blue book”*
- *Required by regulators for many discharges –in some cases required by Law*



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Sampling v. On-Line Monitoring

a) Sampling : Cons –

- Sampling and analyses give historical data only –no possibility of control etc*
- Due to intermittent sampling events can be missed*
- Requires skilled laboratory personnel and appropriate facilities –can be costly*



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On-Line Monitoring -Pros

- *Provides real time based data*
- *Allows pro-active responses*
- *Allows process control*
- *Potential for automatic control systems*
- *Can provide systems to improve efficiency and provide cost savings*
- *No laboratory facilities or personnel required*

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On-Line Monitoring -Cons

- *Usually single parameter per instrument*
- *Operator input required (–but may be lower skill levels than lab personnel)*
- *May require ancillary system to be maintained –pumps, filtration etc*
- *High capital (but hopefully low revenue) costs*



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On-Line Monitoring – parameters available:

- Organic load:
 - ✓BOD
 - ✓COD
 - ✓TOC
 - ✓Surrogates
- Nutrients:
 - ✓Nitrogen as ammonia
 - ✓Nitrogen as nitrate or nitrite
 - ✓Phosphorus as ortho-phosphate
 - ✓Phosphorus as total phosphate

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What Instrumentation is available for this?

“Cabinet” analysers, requiring Infrastructure :

- **Sample pumping system**
- **Sample pretreatment system**
- **Weatherproof Enclosure eg kiosk**

New developments (developing over last 5 years) :

“In situ” analysers

- **Require none of the above**



HIGH QUALITY CABINET ANALYSERS



COD



BOD

PO4

NO3-N

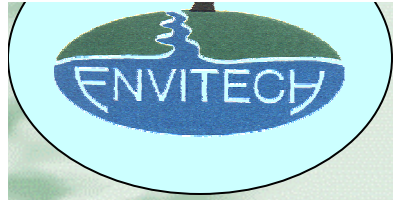
NH3-N



TOC

TOXICITY

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IN SITU .

3 In Situ Buoys – 10 parameters:



NH_4



NO_3 , TOC, COD, UV_{254} ,
SV, SS, SI, turbidity



PO_4



On-Line /// In-situ Carbon monitoring

Applications (just a few examples!):

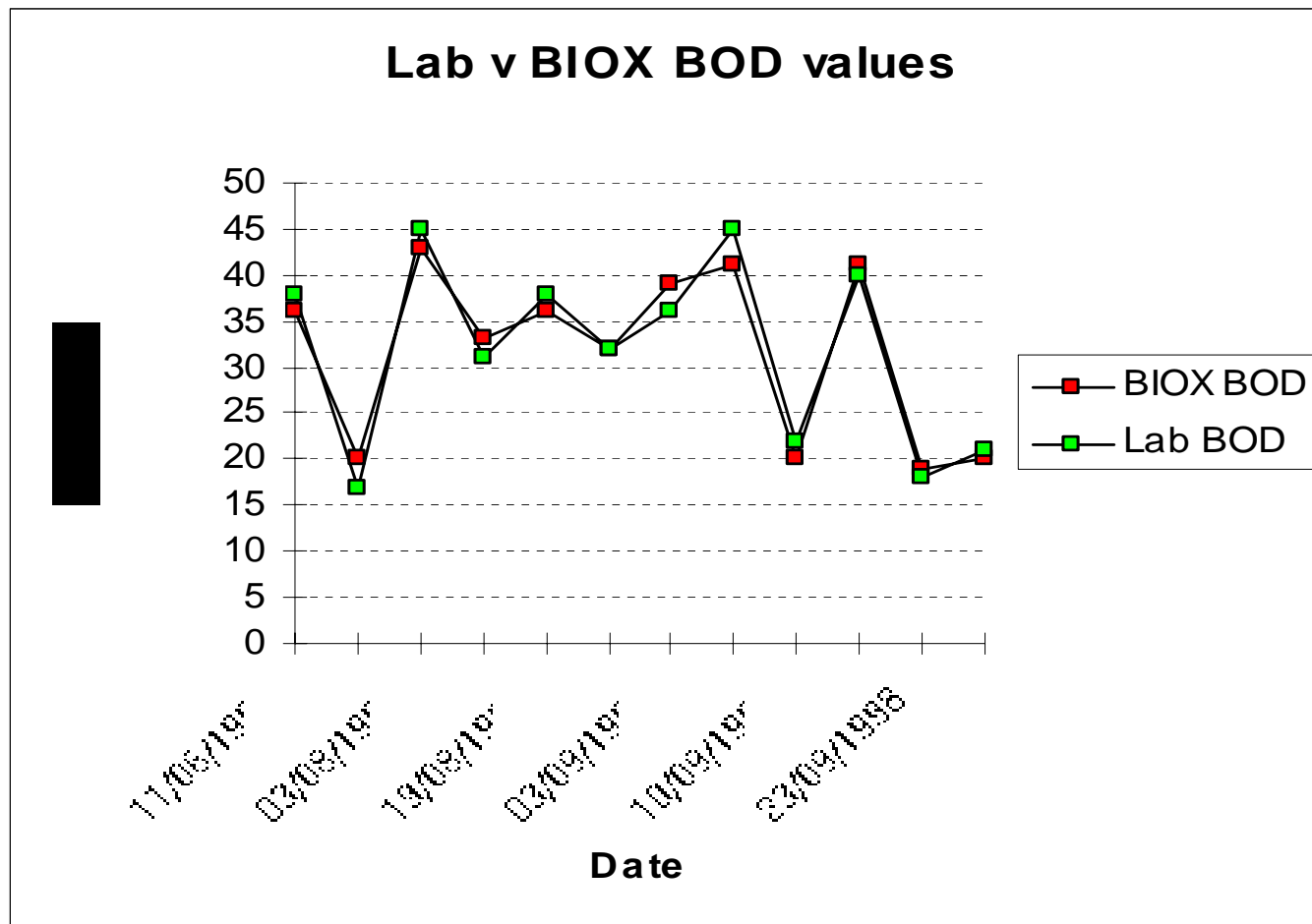
- C Compliance monitoring as BOD, COD or TOC
- F Feedforward control of treatment processes
- D Detection of high levels in influent to municipal plant—traders illegal discharges?
- D Detection of high levels in influent to industrial plant—allowing detection of product losses –major potential savings!!!



a) Consent monitoring - Paper effluent (1)

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a) Consent monitoring - Paper effluent (2)

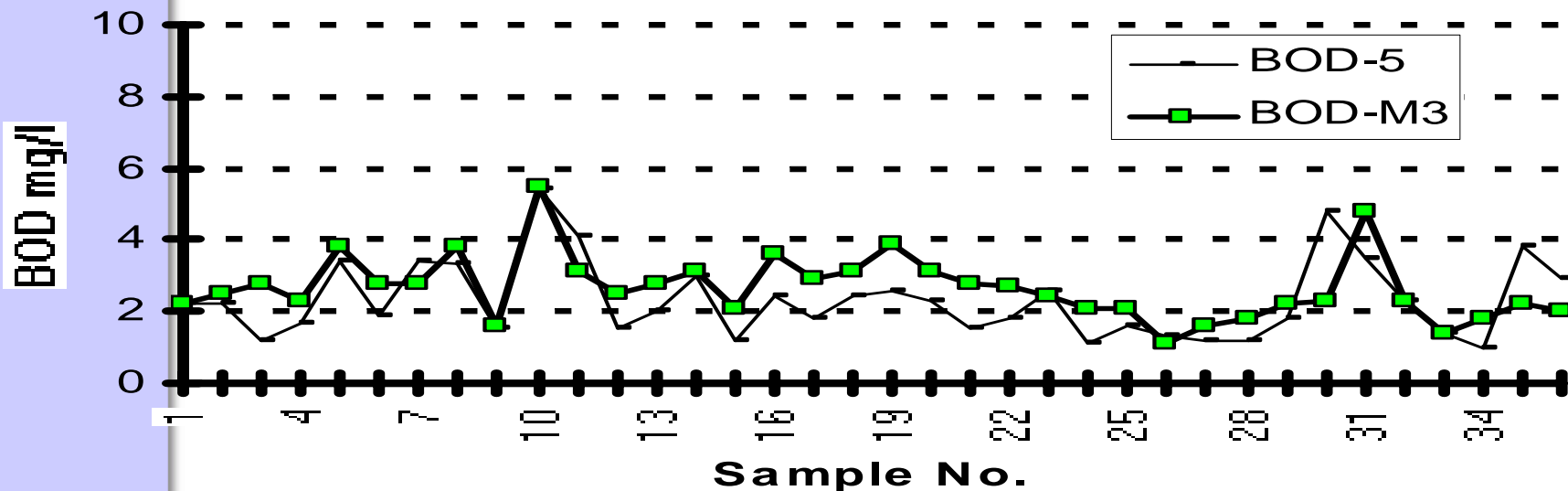
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The UK's first on-line BOD monitor installed as part of discharge consent from paper company in South Wales operated very successfully for over 10 years. Replaced with new unit 3 years ago

Low BOD's less than 5 can be accurately traced



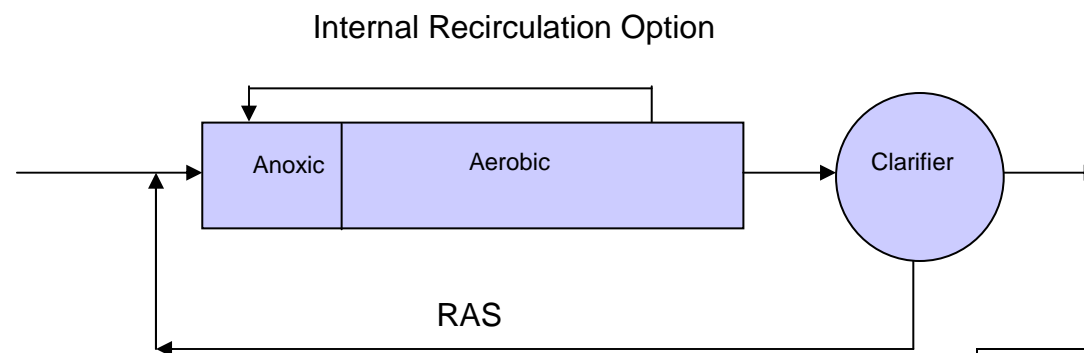
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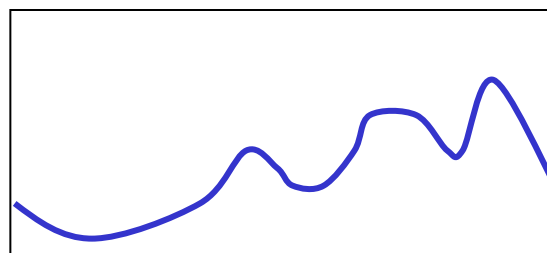
b) Feedforward control of treatment processes

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Load



Time of day

TYPICAL
DIURNAL
LOAD
PATTERN

**CONSIDER
WasteWater
Treatment
Profiles**

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Proposed Compressor Control

Control O₂ plant compressor

Match oxygen production with diurnal variations in demand

- Large compressor production range: 77 – 88 TPD

Store surplus O₂ as liquid oxygen and supplement during times of elevated BOD loads



Cost Savings - Energy



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Air compressor base power demand reduction
Treatment indicator: BOD load & O₂ reactor vent gas

	Two compressors (before 05/01)	One compressor most times (after 06/01)
Avg. O ₂ Production	114 t/d	79 t/d
Power Usage	10,710 MWh	9,140 MWh
Savings [8c/kWh]	NA	\$125,600

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Annual Cost Savings - Laboratory



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BOD₅ sampling reduction

361 samples in FY 2001

179 samples in FY 2002

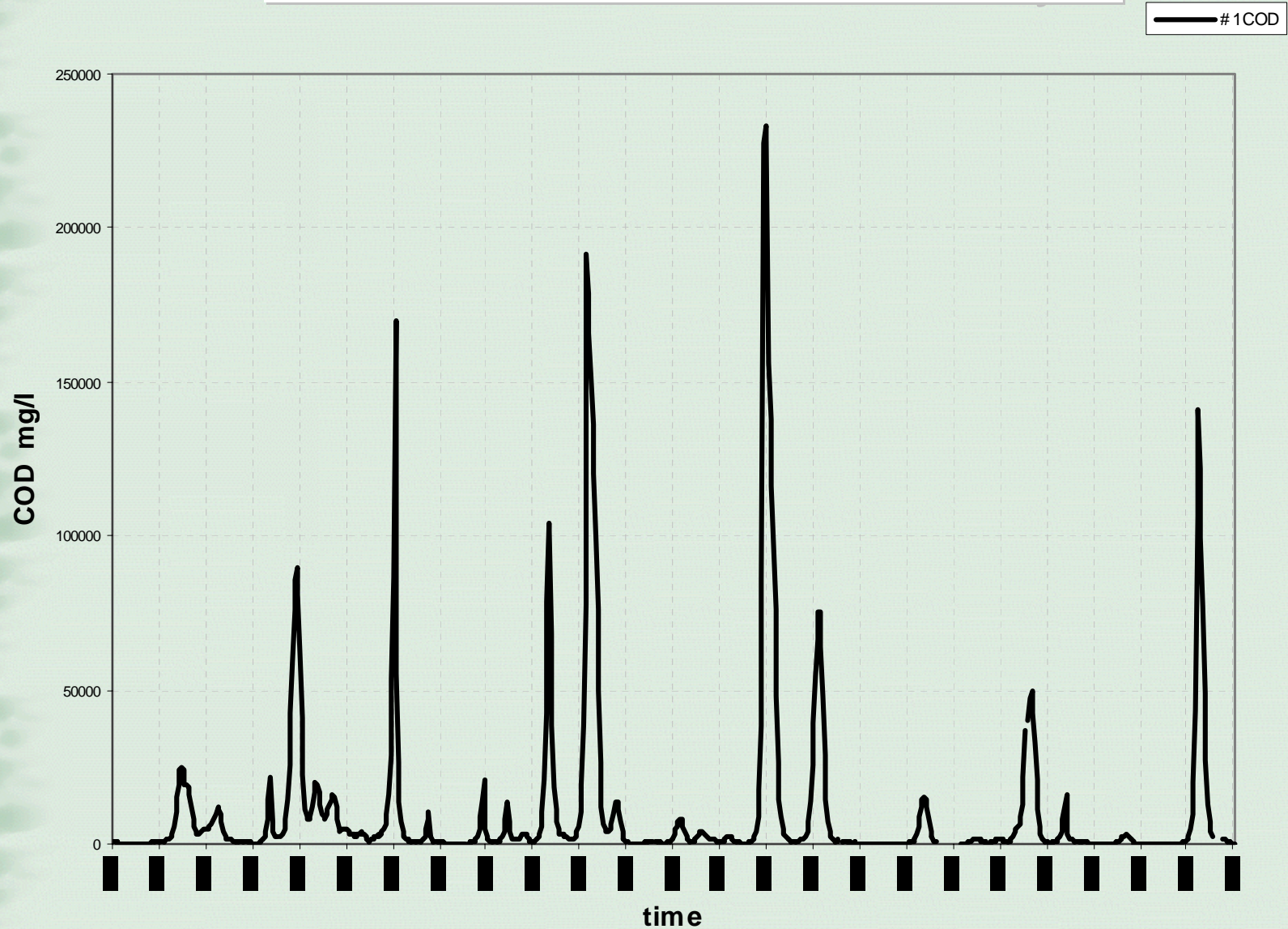
\$18,000 annual savings



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Product loss detection -COD of Ice Cream Effluent over 1 day –



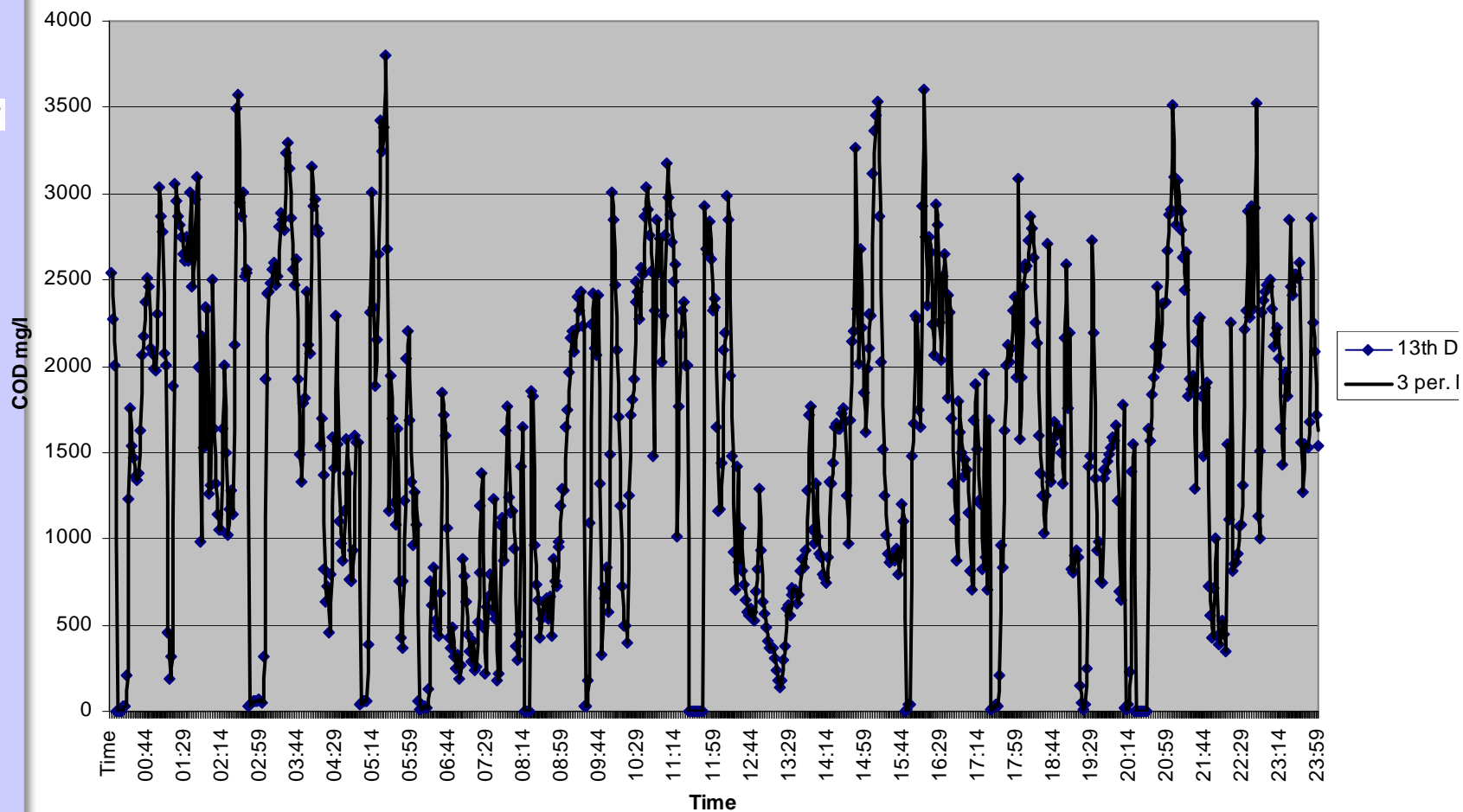


Brewery Effluent Monitoring COD

13th Dec 04 -brewery outfall 01

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Envitech-STIP Process Analysers

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TYPICAL On-line BOD APPLICATIONS

Application :-

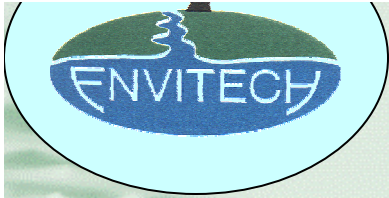
- Surface water runoff
- Product Loss detection
- Consent Monitoring
- Intake to WWTP
- EA consent
- Load Control

Industry :-

- Airports
- Food / Drink
- Paper
- Pharmaceutical
- Refinery effluent
- Municipal

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IN SITU .



3 In Situ Buoys – 10 parameters:



NH_4



NO_3 , TOC, COD, UV_{254} ,
SV, SS, SI, turbidity



PO_4



Advantages of In Situ Buoys

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- **No infrastructure necessary (pumps, lines, kiosk, environmental control)**
 - **Low cost and fast installation**
 - **Less maintenance**
 - **High flexibility**
- More accurate**

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Newly developed In-situ Analysers

Not just simple dip sensor (e.g. like pH) but full process analyser within wet end, including stocks of reagents, calibrants, etc.



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In-situ Ammonia monitoring

Applications:

- Compliance monitoring
- Feedback control of nutrient addition
- Process Control in SBR digested sludge liquor treatment plant
- Process Control in Activated Sludge Sewage Treatment plant

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In-situ Ammonia monitoring

1.Compliance monitoring:

Very large installation base for this application
Been implemented by some Water Companies as
UWWT Directive strategy
Allows demonstration of compliance record whilst
providing continuous measure and automatic
alarms to avoid breaches



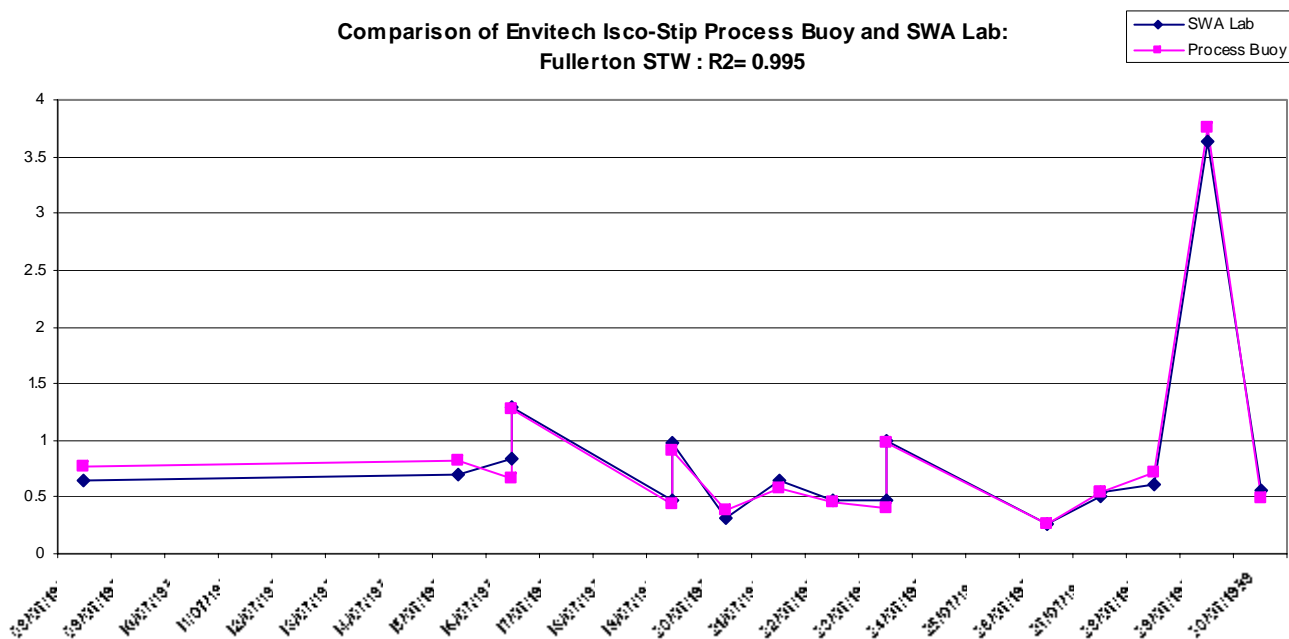
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In-situ Ammonia monitoring -Correlation

Comparison of Envitech Isco-Stip Process Buoy and SWA Lab:
Fullerton STW : R2= 0.995



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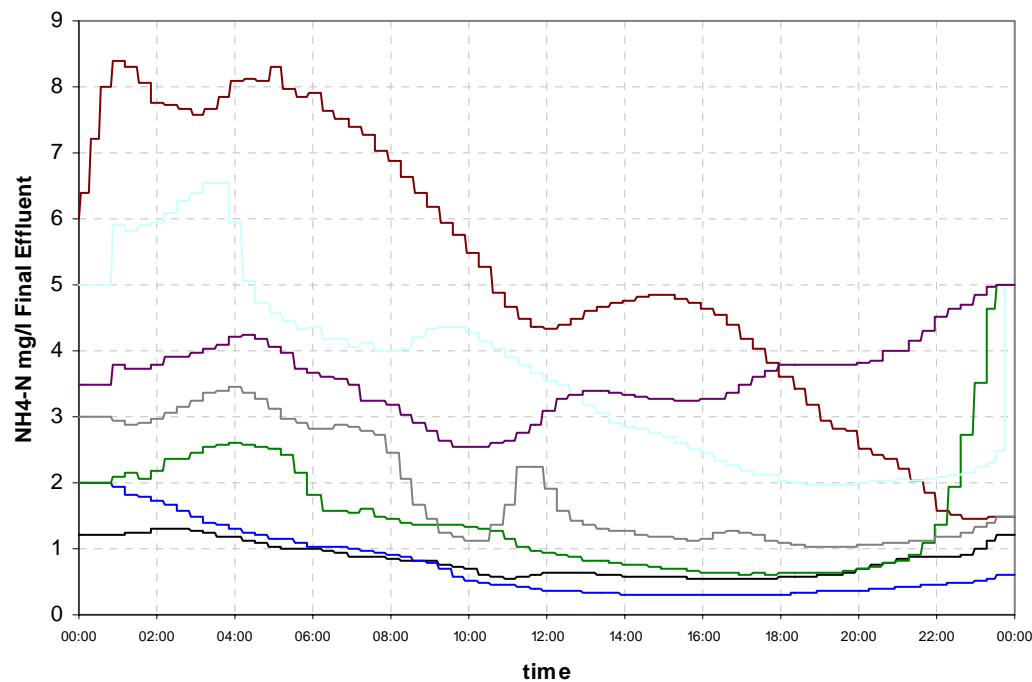
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In-situ Ammonia monitoring –example data

parallel view 21/01/2002 to 28/01/2002



— 21/01/02 — 23/01/02 — 24/01/02 — 25/01/02 — 26/01/02 — 27/01/02 — 28/01/02

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In-situ Ammonia monitoring

2.Feedback control of nutrient addition

Applications where effluent is nutrient deficient, e.g. paper making effluent

Measurement made “in-process”, i.e. within aeration lane

Output control from analyser controls NH_4 addition system to maintain adequate residual concentration, typically 0.3 mg/l.

Allows operation at optimum conditions without overuse of chemicals

Avoids high levels of ammonia in effluent, and hence consent compliance



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In-situ Ammonia monitoring

3. Monitoring and control of SBR Digested Sludge Treatment plant

System is fill-treat-settle-decant process
Sludge liquor has approx. 500 mg/l ammonia
Objective is to achieve residual NH_4^+
concentration of around 20 mg/l to aid further
treatment

Potential difficulties:

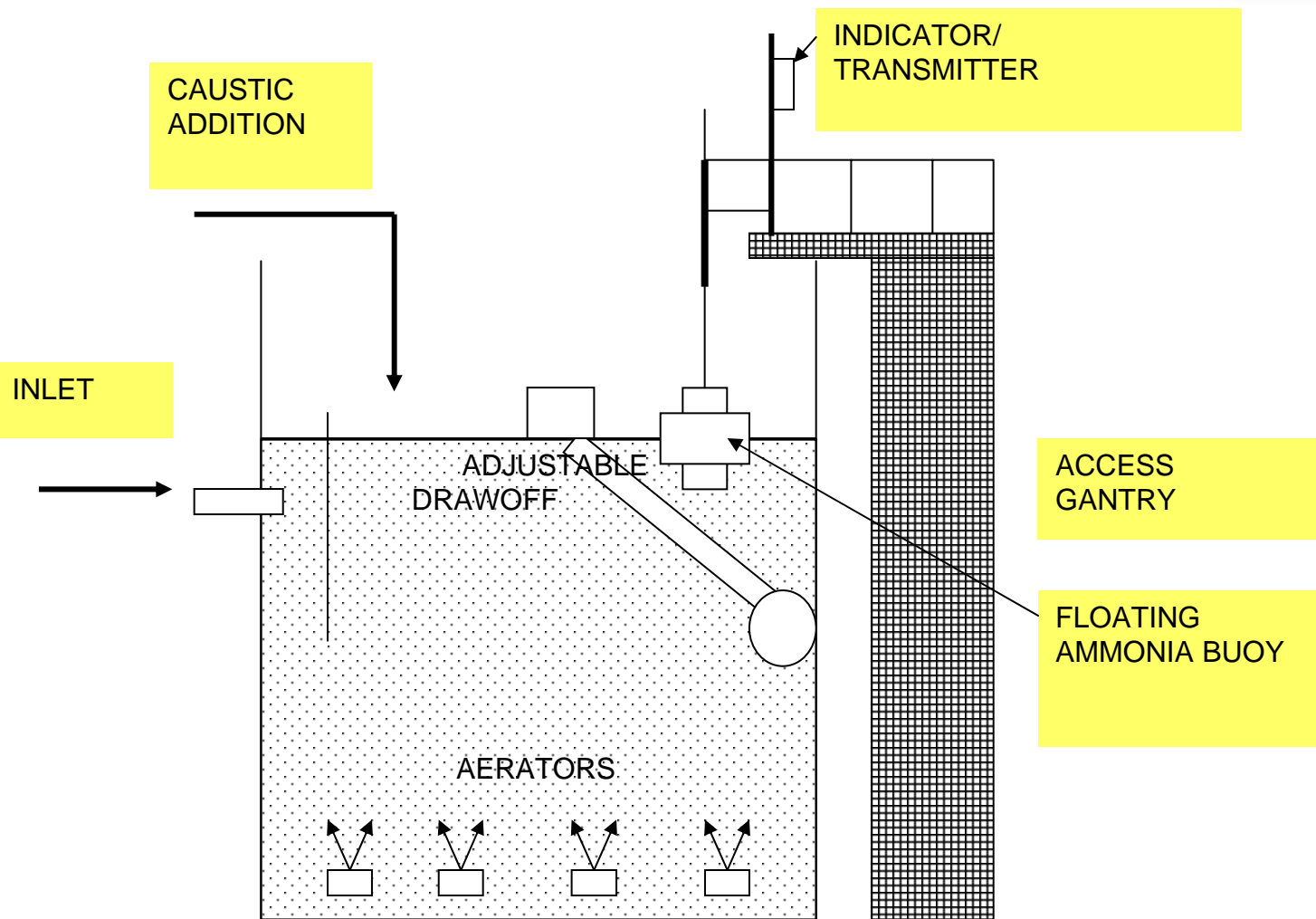
Very high solids in process
Rise and fall of liquor level as stages of process
proceed



SBR APPLICATION

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SBR INSTALLATION

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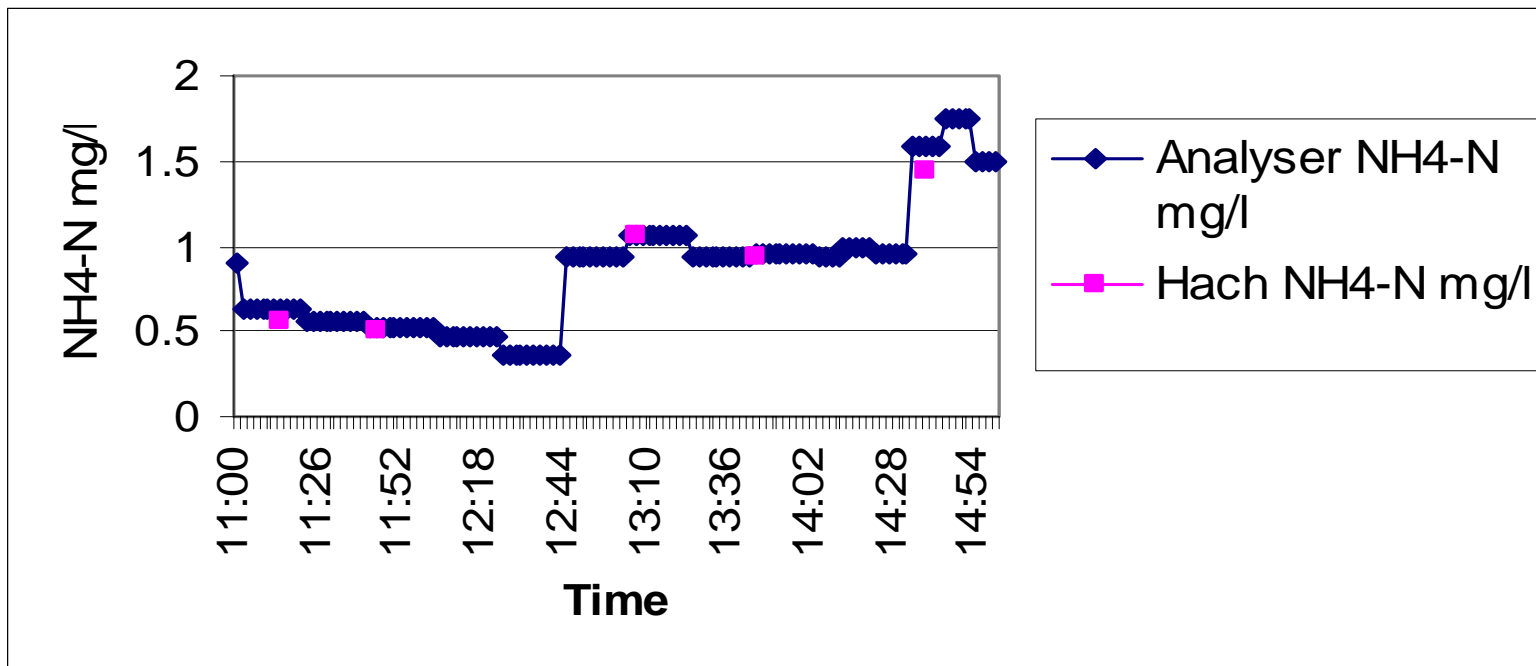
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DOES IT WORK?

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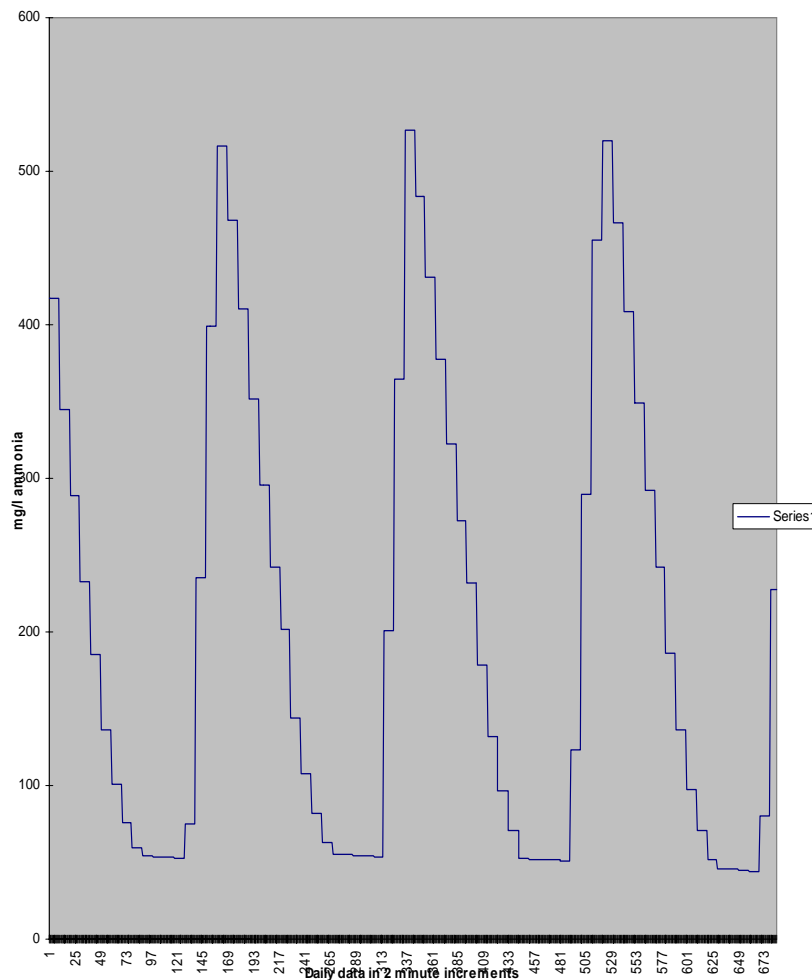
Landfill Leachate Plant

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Ammonia in leachate ML



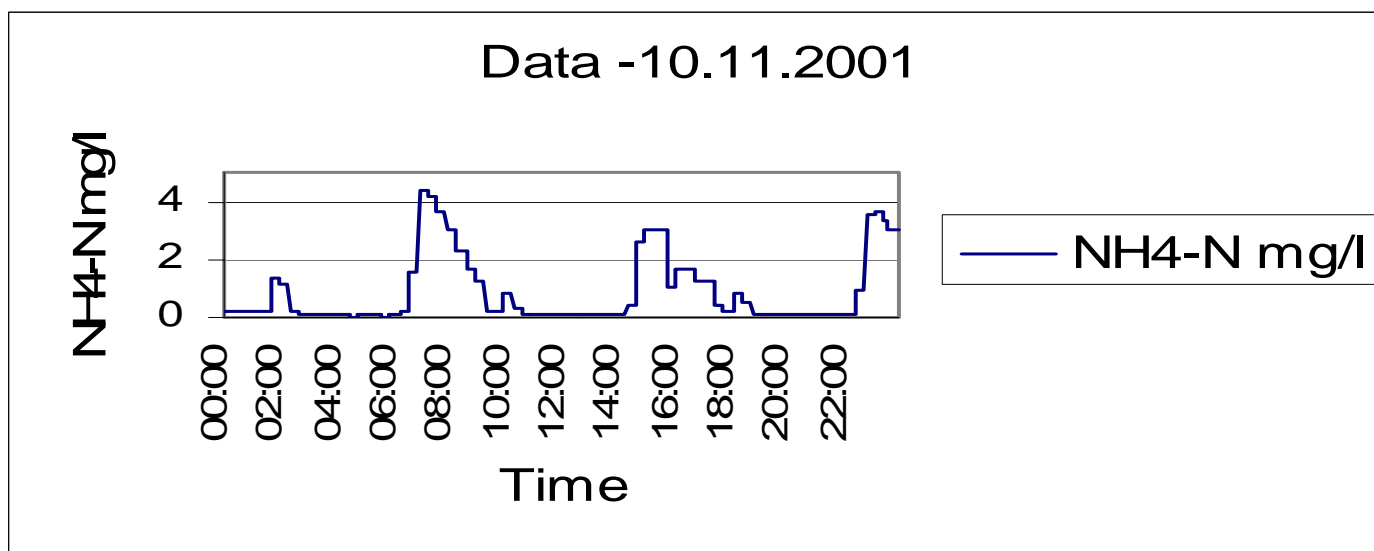
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TYPICAL TREATMENT CYCLES

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AMMONIA MUCH LOWER THAN EXPECTED OR WANTED

SPARE CAPACITY AVAILABLE –load on plant could be greatly increased, output from instrument could control loading by feedback control

➤ AERATION TIME MAY BE REDUCED

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EVENTS

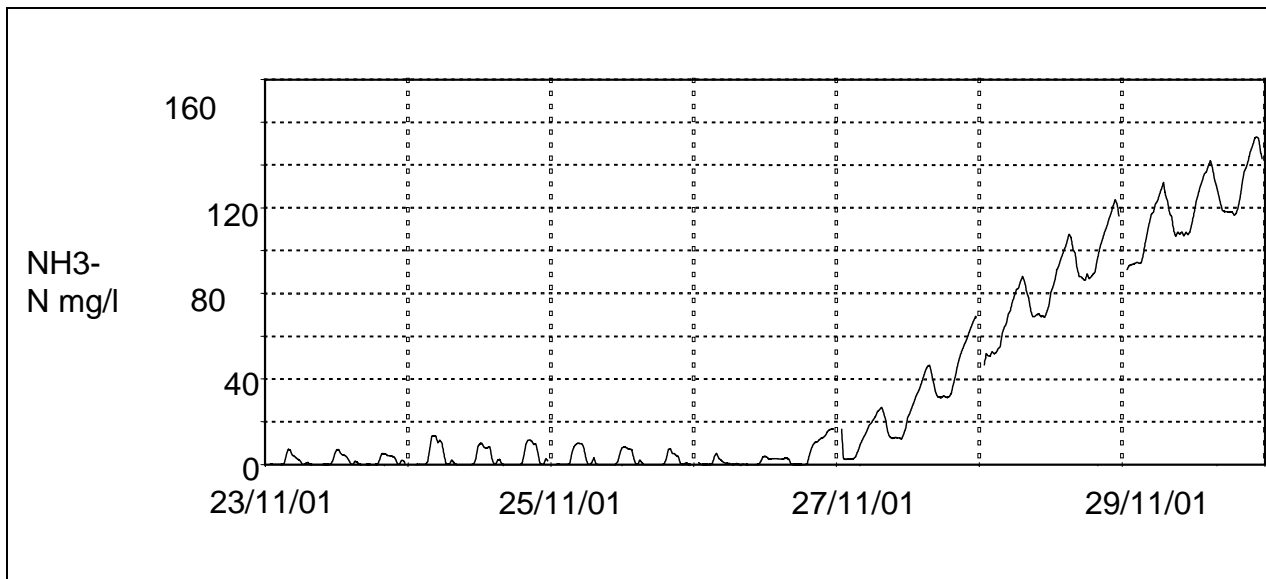
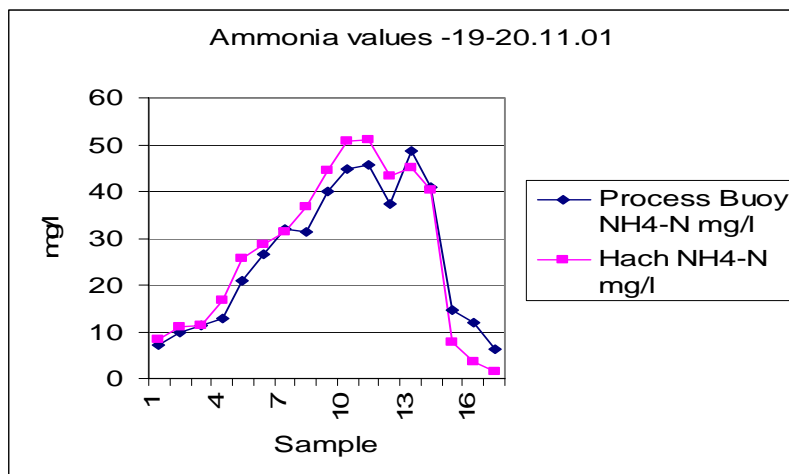
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CAUSTIC FAILURE

➤ ANTIFOAM OVERDOSE + ?



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Experience and benefits

Control system based on this measured level of ammonia would allow more efficient operation

Through-put could be greatly increased as treatment times could be reduced

Energy input could be greatly reduced per batch of liquor treated

Very significant financial savings achievable, initial estimate £15k p.a.

Process stability enhanced and early warning of problems provided

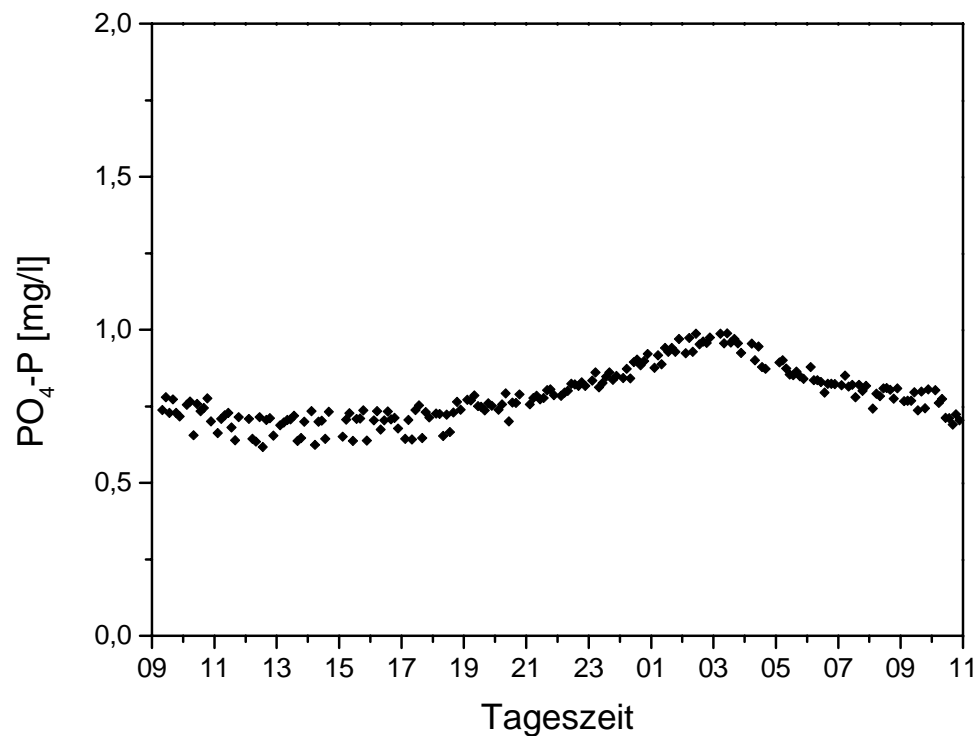
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In-situ Phosphate monitoring



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In-situ Phosphate monitoring

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Applications:

- Compliance monitoring
- Feedback control of nutrient addition
- Process Control in Chemical Phosphate removal process
- Process Control in Biological Phosphate removal process



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In-situ Phosphate monitoring

Feedback control of nutrient addition

- Important where effluent deficient in nutrients e.g. paper making effluent.
- Customer is using an in-situ P monitor via feedback control to regulate additions of Orth-phosphate to match the organic load in the influent to his AS treatment system
- Allows safer control ensuring sufficient P available whilst avoiding exceeding his consent limit
- Savings in chemicals also being made

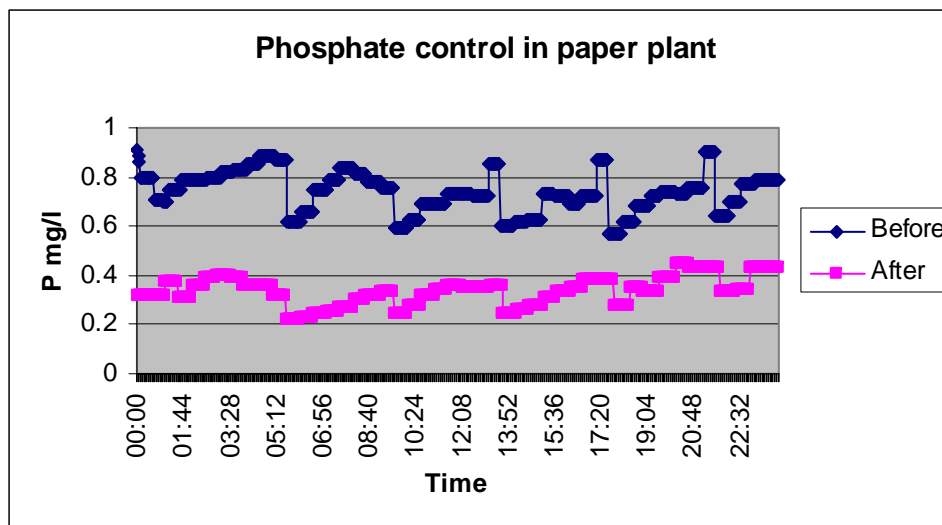
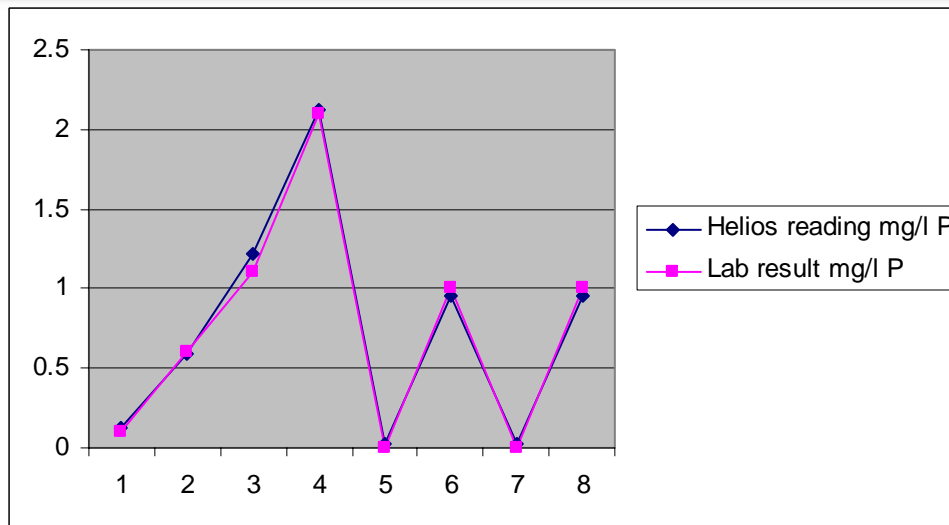
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In-situ Phosphate monitoring

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Summary



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- Key to being able to control a process is being able to know what is going on
- New instrumentation should make such information easier to obtain reliably
- This should allow new process control systems to be developed and proven
- Hopefully this will help the industry to achieve improved standards required

EXISTING D.O. MONITORING TECHNOLOGY

- CLARK CELL SENSORS w/ MEMBRANE
- POLARGRAPHIC
 - GALVANIC





IMPLEMENTING FLUORESCENCE TECHNOLOGY IN A FIELD SENSOR





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Thank You...

Questions.....?

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