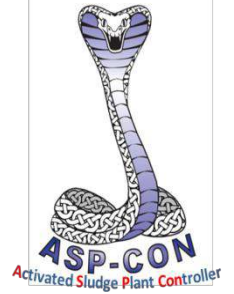


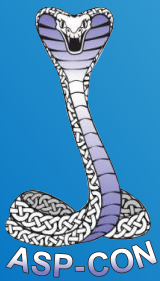


# ASP-Con

**Activated Sludge Plant Controller**



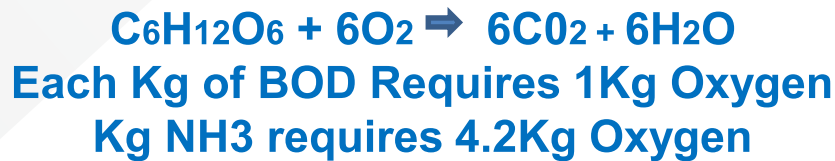
**The Best Way to Control a WWTP is with Respirometry**  
**The Best Way to Control Respirometry is with an ASP-Con**



# The Activated Sludge Process

## 1914 to Infinity ... and Beyond

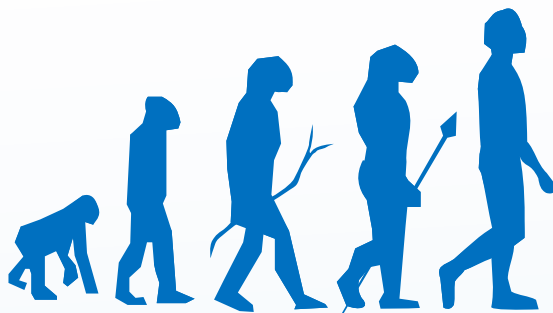
The Activated Sludge Process has been around for over 100 years. It has developed a lot in that time, but the basic principles have remained fairly constant. We give the bacteria sufficient oxygen and decent living conditions and they give us nice clean water. Simple? ...well Yes and No!! The equations are relatively simple –



In practice things are more complex. The bacteria in the Activated Sludge are biological entities living in continuous upheaval – changing food sources – feast or famine, dissolved oxygen levels ranging from Aerobic to Anaerobic, changing temperature, pH, alkalinity, population density, toxic conditions, Hydraulic Retention Time (HRT), Sludge Retention Time (SRT) and septicity. When you think of it like that then perhaps we shouldn't be surprised we get the occasional blip – untreated load in the discharge, solids overspill, odours etc etc.

Even less surprising is the fact that Engineers build in huge safety factors in plant design, control strategy and even more safety factor allowances within the operating set points. So the challenge which has been ever present since 1915 but is becoming more critical in regard to compliance and increases in energy costs, is therefore to improve visibility of what is going on in the bacterial process and to then translate that into real-time, effective and efficient control of the treatment – thus creating the catalyst and real need for the **ASP-Con**.

Strathkelvin have been optimising the activated sludge process since 2006. Our development was market driven. From the minute we launched our Strathtox Laboratory Respirometer in 2004 we were asked to make it an online device. When we launched our process optimisation software to determine Critical Oxygen points and % Nitrification, we were quickly asked to work alongside our customers to reduce aeration energy costs. We then put all the learning from having optimised over 60 Wastewater Treatment facilities to develop the **ASP-Con** – combining state of the Art Respirometry with automation of lab testing and Self-Cleaning/Self-Calibrating sensors for the measurement of DO, Ammonium, pH, ORP, Nitrate and Conductivity.



Strathtox  
2004



AS Bioscope  
2007



ASP-Con  
2014

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**Strathkelvin - Continually Evolving, Continually Improving**

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# Respirometry

Strathkelvin are one of the World Leading suppliers of Respirometry equipment. We have taken this expertise and knowledge and developed it to produce the most advanced instrument available in the market, providing advanced real-time control with total visibility of the Activated Sludge Process.

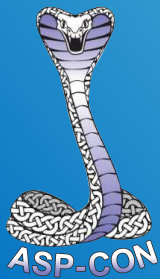
The **ASP-Con** brings automated measurement of all the required parameters for Respirometry, combining this advanced technology with tailored software programming to completely demystify Respirometry, giving the Operations Team all of the data they require to make tailored decisions for each individual plant. With Strathkelvin's vast experience in troubleshooting and optimising a whole range of WWTP's, in cooperation with the Operations Team, a plant specific protocol is agreed to ensure optimum operating parameters/ranges for each **ASP-Con** to operate within.



---

**“Next Step Change in the Activated Sludge Process”  
– Frank Rogalla – Director of Innovation, Aqualia  
WEX Innovation Awards -2014**

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# ASP-Con Can Measure 20 Key WWTW Control Variables

Unique to  
ASP-Con

## Automating Routine Lab Analysis

Settlement  
SVI / SSVI  
TSS - Predicted

## Basic WWTW Control Parameters

Dissolved Oxygen  
Ammonium  
MLSS  
pH  
Temperature

## Advanced WWTW Control Parameters

Toxicity  
OUR  
SOUR  
Critical Carbonaceous DO  
Critical Nitrifying DO  
F:M pseudo  
% Nitrification

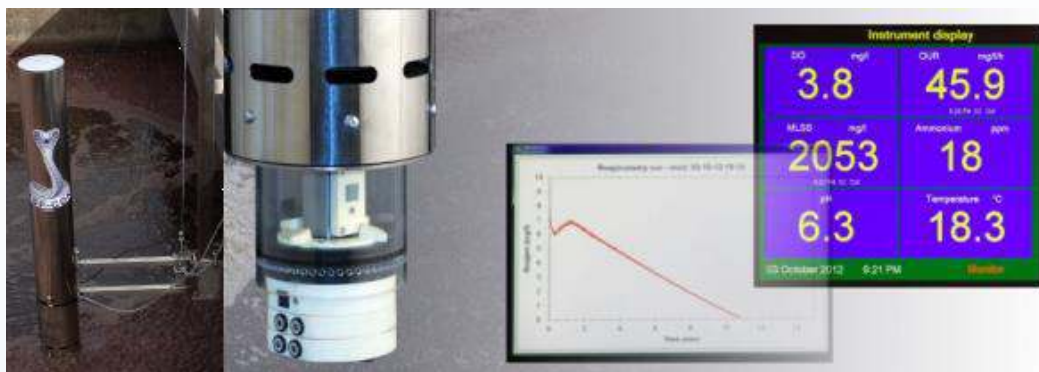
## Advanced Online Influent Analysis

HRT Required  
Readily available COD  
Recalcitrant COD  
Denitrification Capacity

## Additional Parameters

Potassium  
Conductivity

Bacteria are a living, breathing biological mass that can be difficult to predict, depending on load, effluent stream, temperature etc. Our systems are currently being used in many different types of facilities – chemical, leachate, winery as well as many utility companies. Ranging from SBR's to plastic lined makeshift facilities. But regardless ...

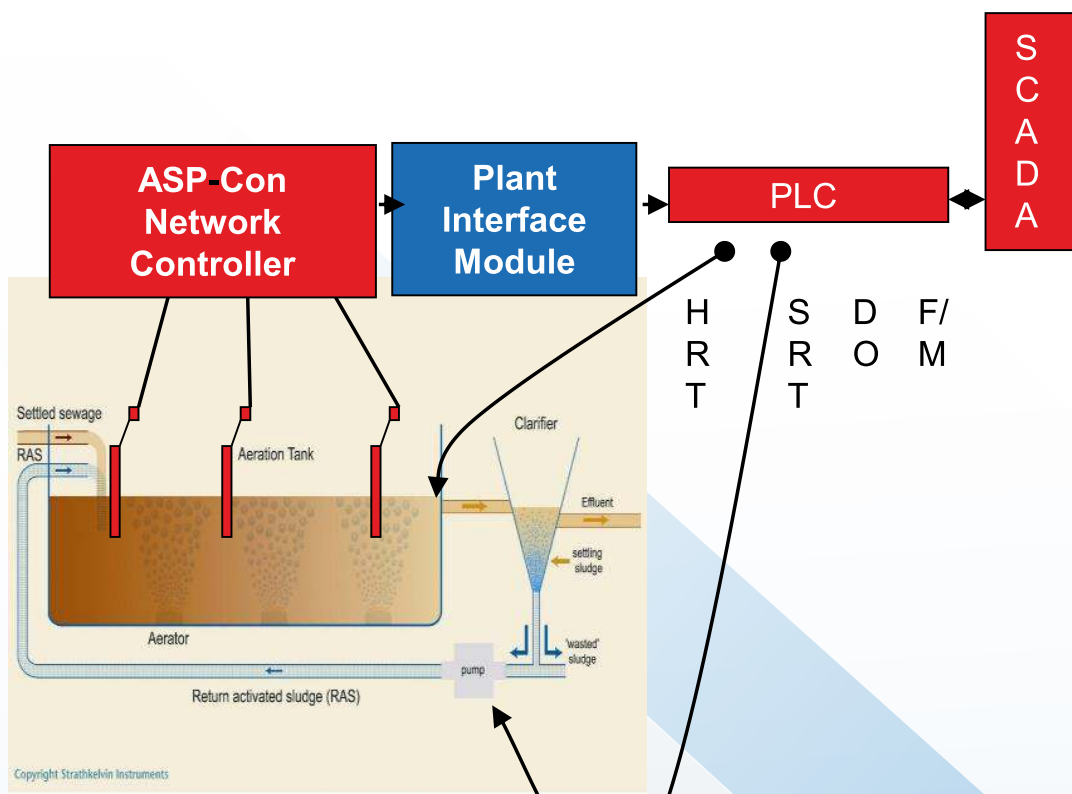


**Our ASP-Con Provides Predictive Load Control  
& Compliance Monitoring**

**The Ability to see a problem emerging whilst still having  
time to deal with it!**

# Our Purpose

- Give Total Visibility of the Biological Treatment Process.
- Simplify Respirometry to Fully Harness the Range of Measurements Available in Making a Real Difference to Your Plant Understanding and Control of the Plant.
- Using Real-Time Data to Ensure Absolute Compliance at Minimum Operating Costs.



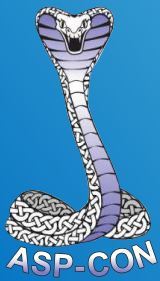
## Feed-Forward

- Ammonium
- OUR – BOD
- SOUR
- Critical DO
- Toxicity

## Feed-Back

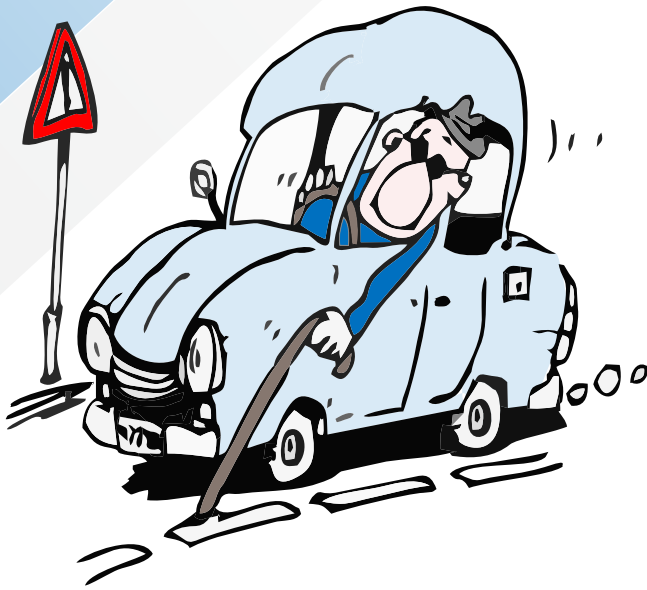
- Ammonium
- OUR/SOUR
- Settlement, SVI, SSVI
- TSS Predicted
- MLSS

***'It's Like Having Your Best Operator on Site 24/7!'***



# Aeration Energy Optimisation

## Compliance is King but at What Cost?



**Aeration is Typically**  
30-70% of a WWTP's  
Energy Consumption.

Poor visibility of operations  
leads to increased safety margins being adopted,  
leading to increased costs!

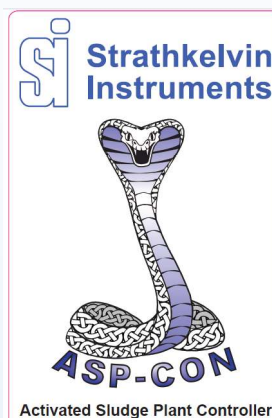
**ASP-Con** – Delivers  
Feed Forward / Feedback Control Capability

Safety Margin Built  
in to Set Points

Safety Margin  
Engineering in

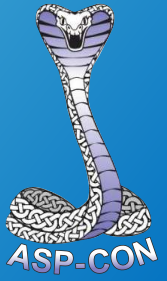
Plant Running  
Cost

+



=

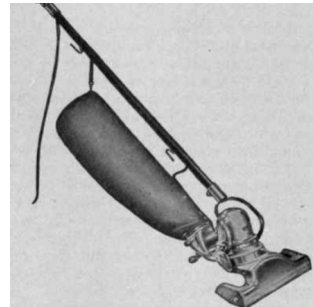
Targeting 40%  
Aeration Energy  
Reduction  
100% Compliance  
& Tonnes of CO<sub>2</sub>



# Technology Moving On

The **ASP-Con** can assume full Control of the WWTP, having been specifically programmed to make sense of all measurements within its unique software.

*Moving from Abacus to Scientific Calculator!*



**Efficiency Through Innovation**



Simple Integration into your Plant Control System via Profibus/Modbus SCADA etc. If you have limited expansion options within your existing Control system - Strathkelvin have a solution - you can install several **ASP-Con's** to communicate with each other, which are then linked to your Blower/Aerators via our expandable I/O system.



# Managing Aeration Optimisation Risk

## Load Profiling.

- Ammonia Reduction.
- OUR – Total Load.

**PLC/SCADA**

## Modelling Performance

- HRT required
- Denitrification capacity.
- Critical DO concentrations



## Process Control

- Dissolved Oxygen
- Conductivity
- MLSS
- ORP
- Nitrate

## Baselines

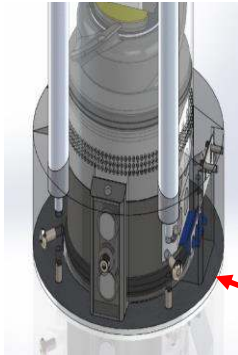
- kWhr/m<sup>3</sup>
- SOUR
- Toxicity
- RbCOD

## Bacterial Health

- Specific Oxygen Uptake Rate (SOUR)
- % Nitrification Activity.
- % Settlement / SVI / SSVI
- Predicting outlet TSS.

# Self-Cleaning

**Reducing Operator time  
improving accuracy**



ISE sensor wiper

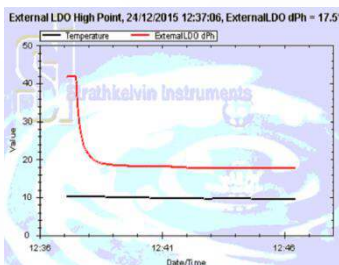


Sensors clean  
after 12 weeks  
operation.

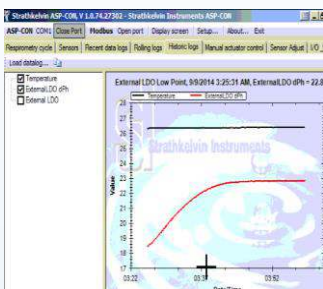
# Self-Calibrating

Reducing Operator time  
improving accuracy,  
reducing aeration costs.

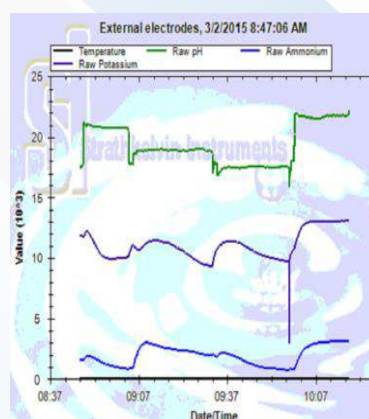
- Computer controlled and scheduled calibration sequence.
- Test output available to review.
- Full system remote access.



DO high point  
calibrated  
automatically in air.



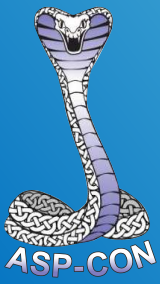
For automatic zero DO  
calibration we use the  
respiration of the bacteria  
to strip out the oxygen.



ISE sensor output trace

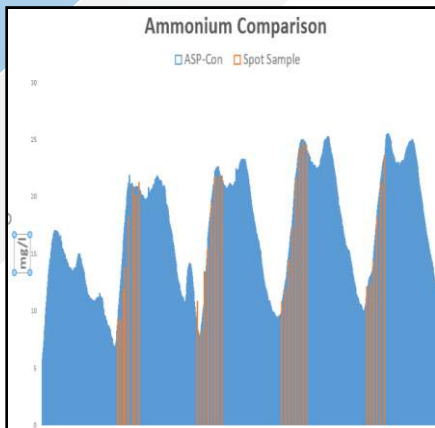


Sensors are drawn into  
calibration garage – fluids  
injected under computer  
control and end points  
automatically detected.

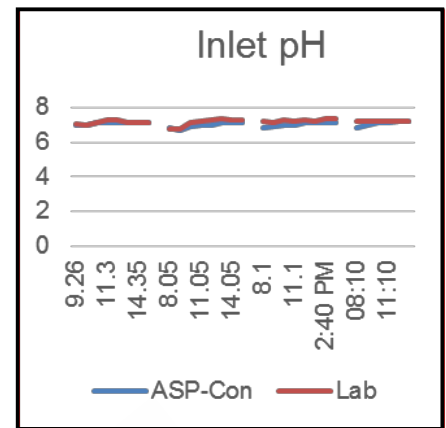


# Validation of Sensor Accuracy

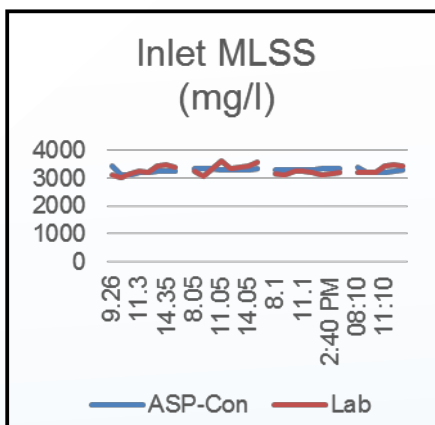
An independent trial was undertaken on a UK wastewater treatment plant. An **ASP-Con** was installed at the inlet to the treatment process. After 6 months operation, the system was automatically calibrated and an independent 2 hour composite sampling and lab based testing regime was established. All access to the **ASP-Con** was locked out by the plant operator and the comparative results between the **ASP-Con** and the certified lab results are shown below. The comparative data results were also assessed by WRc (Water Research Council) UK who verified that the results confirm the accuracy of the **ASP-Con** system.



*These graphs show trial outputs for inlet Ammonium and pH over a 5 day period. Ammonium traces clearly show expected diurnal variation.*



The lab results took 10 days to turn-around and it cost over £4k for the sampling, transport and testing costs. Several issues were noted with the samples control and storage.



*Here are the results from MLSS grab samples Over the 5 day period*

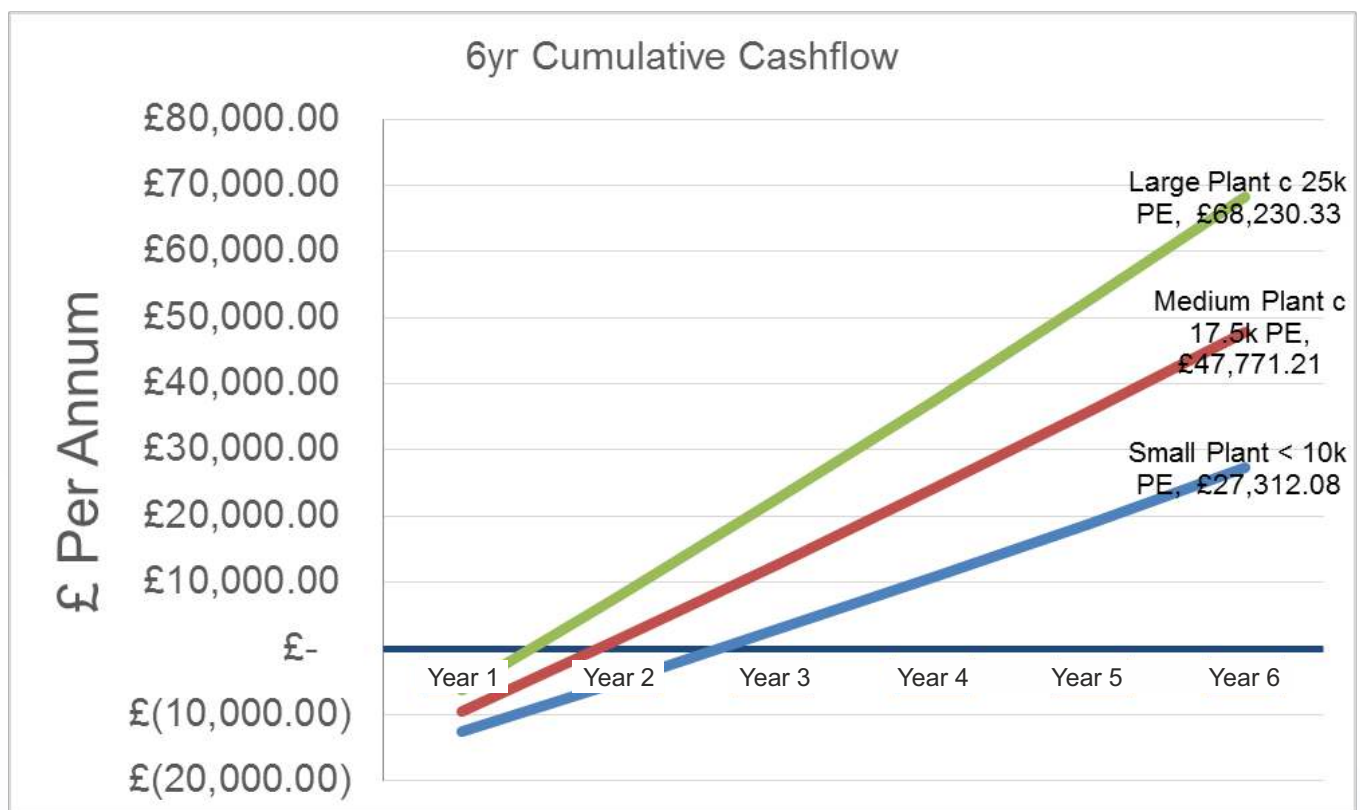


By comparison **ASP-Con** results were immediately available and provided to site PLC/SCADA systems for control purposes. **The daily cost of running an ASP-Con system, including all consumables, maintenance, servicing and depreciation charges (calculated over 5 years) is £23 per day for 16 parameters compared to the lab based testing on this occasion at £800 per day for 6 parameters.**



# Cashflow Projection Model

The cumulative cashflow payback model (below) has been developed for 3 different Activated Sludge Plant sizes. For more information or to have a Return on Investment assessed on your plant, please use the contact details on the last page.

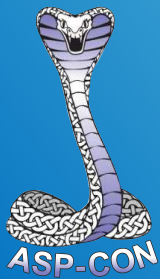


The savings above are calculated on achieving 30% average aeration energy savings and saving Operator time of 0.5hrs per day. Figures are estimated from average savings based on Strathkelvin Consultancy achievements and actual figures will vary from plant to plant.

On this conservative basis a payback on investment and ongoing running costs can be achieved in under 2 years on plants as small as 10,000 population equivalent.

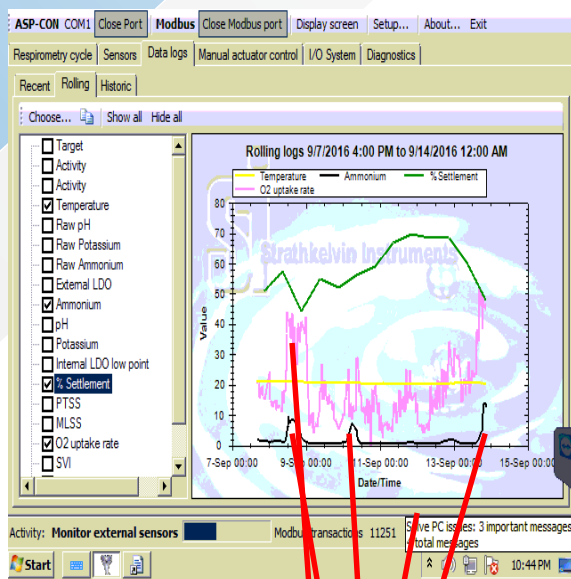
\*\*\*The daily cost of running an ASP-Con system, including all consumables, maintenance, servicing and depreciation charges (calculated over 5 years) is £23 per day for 16 parameters, compared to the lab based testing, on this occasion, at £800 per day for 6 parameters.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Small Plant < 10k PE	- 12,587	- 4,991	2,792	10,767	18,939	27,312
Medium Plant c 17.5k PE	- 9,384	1,495	12,643	24,067	35,774	47,771
Large Plant c 25k PE	- 6,181	7,981	22,494	37,367	52,610	68,230



# Remote Access for Monitoring, Maintenance and Plant Control

The below screenshot was taken in our offices in Scotland from an **ASP-Con** working in Spain.



- Full remote access over internet.
- Diagnostics, remote recalibration and trending.
- Data download and reporting.
- Changing testing schedules.
- Identification of maintenance issues.

## The Managing Compliance Story

The Rolling Log results above show readings from a live in the field **ASP-Con**, that is located close to the outlet of a treatment works in Spain. In this real example we can see that the Ammonium levels are spiking high and the Oxygen Uptake Rate is confirming that the untreated load is very high. This normally would go unnoticed but has been picked up by the **ASP-Con** well in advance of discharge.

The **ASP-Con** can be programmed with an automated, appropriate response, tailor made for each individual plant. An automated response for an issue such as this could be to increase the blower pressure and raise the DO set-points until a root cause analysis of the 'spiking' is identified.

\*\*\*Therefore the **ASP-Con** is acting as a "smoke detector"/early warning system for any issue, so that the site WWTP Team can take corrective action, or in the case where a site has linked the **ASP-Con** directly to the PLC/SCADA system, the **ASP-Con** can automate immediately the correct programmed response for such as incident.

# Improving Operator's Lives

With the unique access to all of the WWTP information remotely the Operational Team manager can decide how to deploy scarce operational resource. Remote unmanned sites can be prioritised for site visits – according to actual need rather than a timed schedule. This also leads to optimisation of travelling and fuel consumption. Further improving the Carbon Footprint of all organisations using their finite resources to cover multiple sites.

The in-situ **ASP-Con** eliminates the need for Operators to go out on plant and grab MLSS (Mixed Liquor Suspended Solid) and settlement samples. Depending on site size and layout this can save up to 2 hours of valuable time and ensuring consistent sampling techniques and measurement practises. If an issue occurs the **ASP-Con** can be programmed to grab another sample or programmed to collect samples more frequently, regardless of the time of day, day of the week, holiday schedule and regardless of adverse weather conditions. The samples are then tested in-situ – so avoiding the requirement to send off to the lab and wait a week on results, not knowing how well samples are stored and for how long before a lab technician is free to test any particular sample – **ASP-Con** results are Real-Time.

The **ASP-Con** will also cut down the requirement of operator time for routine cleaning of probes. All the probes are on one instrument, that runs through a cleaning and calibration programme as dictated by the Operations Team. Cleaning is built-in to the normal operating procedures of the instrument. This also can be altered if and when required, even remotely, by the Site Team.

The demand on an Operator's time for Maintenance of numerous probes on a site is huge. The fouling and ragging of "old generation" probes is a significant health and safety issue. The sheer physical requirement at times, to lift some probes out of the treatment plant due to excessive ragging should not be under-estimated. In contrast, the **ASP-Con's** Self-Cleaning regime eliminates ragging completely. The regular cleaning regime automatically implemented significantly reduces fouling, improving accuracy reliability and repeatability of measures. Also health & safety risks to Operators in cold, wet and lone working conditions.

Operators reduced maintenance requirements for the **ASP-Con** consist of -

- Changing 4 bottles of calibration fluids every 3 months (fluids supplied by Strathkelvin)
- Changing sensor heads at their end of life, potentially every 6 months, but Strathkelvin believe with our superior cleaning capabilities, sensors lifespan should increase dramatically and lifespan should exceed the guaranteed 6 months currently afforded, due to the **ASP-Con's** patented cleaning regime
- Maintenance of the **ASP-Con** has been designed with the Operator in mind, to ensure minimum effort and intervention is required, in adverse conditions or not!

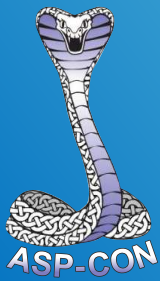


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**The Best Way to Control a WWTP is with Respirometry**  
**The Best Way to Control Respirometry is with an **ASP-Con****

**No Need to Understand Respirometry When You Have an ASP-Con**

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# Case Studies

## ***Kelda Water Services – Cardiff***

We achieved annual savings of £380,000 per annum for this client in relation to aeration energy optimisation. These savings were generated on an SBR system. We have now optimised over 60 SBR basins using the Strathkelvin SCO2PE process. SBR operation is particularly suited to optimisation using the **ASP-Con** system as we can automatically detect the aeration cycle end-point.

## ***Celtic Anglian Water – Dublin***

We achieved annual savings of 240,000 euros per annum for the aeration energy optimisation. Once again an SBR site

## ***Northern Ireland Water***

14 sites were optimised in 2012/13 with a further 18 sites being optimised for compliance in aeration energy optimisation in the financial year to March 2015. NIW are also leading the industry with the adaptation of the **ASP-Con** product, with 2 sites aiming for full feed-forward/feed-back control (first visibility of this kind anywhere in the world) of the treatment process planned for July 2015.

The 3 case studies above were carried out using our Strathtox and Bioscope, which are off-line instruments. With the **ASP-Con** being on-line, we believe vastly greater savings can be predicting and we are in the process of validating this information with our Trial at Welsh Water.

## ***Veolia Water PFI Scotland***

We have established an on-going, very close working relationship, spanning 6 years, combining treatment plant troubleshooting, as well as aeration energy optimisation. Veolia are also seeking to adopt a treatment plant control module based on the **ASP-Con** product.

## ***Calachem Effluent Treatment Plant – Grangemouth***

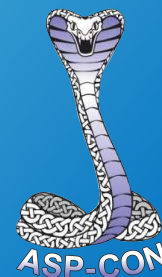
We have been the Lead Consultant for the Calachem Plant leading to being appointed Lead Contractor for replacement of their aeration systems, including aeration system design, installation and commissioning.

We designed, programmed and installed the PLC / SCADA upgrade and provide ongoing maintenance and support both remotely and on-site.

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**The ASP-Con has been trialled in the  
harshest WWTP conditions –  
in Leachate Treatment, Meat Processing,  
Oil Refinery and Pulp & Paper Applications**

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## ASP-Con Specification Sheet

### Self-Cleaning / Self Calibrating Multi-Sensor

Weight			
Sensor array	15	kgs	
Hoist System	60	Kgs	
Control Panel and Calibration Unit	30	Kgs	
Voltage Supply	110 - 240	Vac	
Operating Temp range	Low	-20	C
	High	60	C

## Sensor Specification

Dissolved Oxygen - LDO		
2 off sensor installed for continuous in basin measurement and simultaneous respirometry measurement		
Range		
0 - 100	%Saturation	
Response Time		
Respirometer	0-90% full range	15 seconds
In-Basin	0-90% full range	90 seconds

pH		
Single Glass		
Range		
0 - 14		
Response Time		
0-95% full range		5 seconds
Potassium		
Single ISE electrode		
Range		
0 - 10,000mg/l		
Response Time		
0-90% full range		120 seconds

External Comms Capability
P&Id loop control capability - 4-20mA
RS 482
GSM based communications
Modbus protocol
Profibus protocol (optional extra)

Ammonia	
Single ISE electrode	
Range	
0 - 10,000mg/l	
Response Time	
0-90% full range	120 s

Solids Measurement Sensor	
Transmitted and Reflected light sensor	
Range	
0 - 24,000mg/l	
Response Time	
0-90% full range	1 second

## Development of the ASP-Con

Strathkelvin first developed a simple to use, rapid laboratory respirometer in 1999 which was designed primarily for toxicity assessment of wastewater influents to the WWTP facility.

In 2006 Process Optimisation and Control capability was built into the Strathtox respirometer, and in 2007 we launched our AS Bioscope, a portable respirometer, which could be used to profile the OUR (Oxygen Uptake Rate) across the treatment process. Our vision to be able to use Respirometry as both an investigative tool and as an Energy Optimisation tool was finally born. Customer reaction to these technologies was very encouraging and we started to work in partnership with our clients to deliver practical energy optimisation projects (some of which are detailed in the Case Study section of this brochure).

Customer feedback and our own experiences encouraged us to develop an online version of these products, which was significantly enhanced to provide all the critical control parameters of the Biological Activated Sludge Process. Early prototypes were tested on Leachate treatment sites from early 2011, and since then we have been continuously developing the capability of the instrument.

We are fully committed to the ongoing development of the system's capability but with the added guarantee that all upgrades can be easily retrofitted to units that have already been purchased.

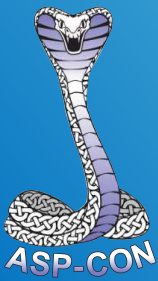
It has always been critical to the system development that we have a very effective self-cleaning and self-calibrating system and this has been proven over several years in the field, in some of the most demanding operating conditions.

We are committed to the full integration of the ASP-Con into customer plant control systems and Optimisation strategies. The ASP-Con has therefore been designed, and is supplied as standard with full remote access capability as well as industry standard communications capability via Ethernet, RS482, MODBUS and PROFIBUS. We have in-house expertise in Automation and PLC. Our engineers can either program the systems at a customer's premises or assist the customer's own team to develop a bespoke system.

Our experience in having optimised over 60 different biological wastewater treatment plants, averaging 26% energy reduction, whilst improving compliance, is available to any customer who wishes to access it.

# Award Winning





# For Further Information

If you are responsible for the Operation of an Industrial or Domestic Waste Water Treatment Plant and would like to discuss Revolutionising your Biological WWTP Control, please contact us using the details below.

The **ASP-Con** system provides remote monitoring and access in real-time that maximises an Organisation's Expert Manpower/Personnel skills, being able to deploy these skills in relation to not just one, but all of its WWTP assets.

Strathkelvin Instrument Ltd are more than just instrumentation suppliers. We have been consultants in the Wastewater market for over 10 years focussing on Energy Optimisation and trouble shooting compliance issues.

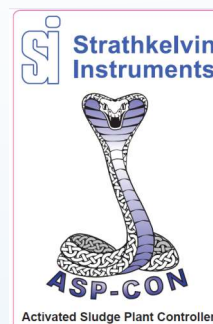
The **ASP-Con** is a unique tool for gathering all the vital WWTP information and Strathkelvin have created an accompanying Strathkelvin's bespoke 5-step Plant Control Plan to ensure greater energy and carbon savings whilst improving compliance. The **ASP-Con** has been created from hands-on WWTP experience, and has seen an amazing R&D program over the past 7 years to ensure the instrument reliably delivers on its promises.

Significant annual cost savings are available whilst ensuring compliance.



Mark Smith CEO of WRc limited  
presenting Michael Dooley, MD of Strathkelvin,  
with an innovation award for the **ASP-Con**

## Please contact us on



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info@strathkelvin.com  
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