



# Using zeta potential measurements for coagulation control:

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# Objectives

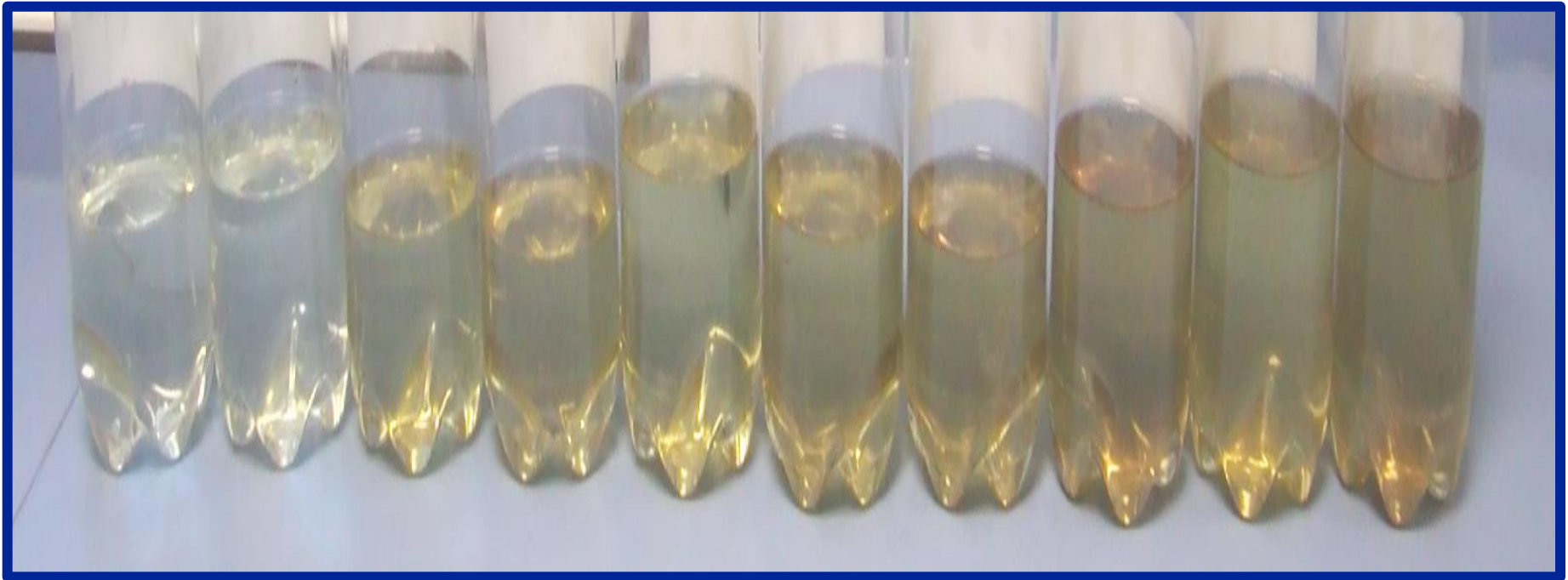
- **Raw water challenges facing Severn Trent Water**
- **Water treatment process**
- **Historical methods for optimising coagulation**
- **Application of Zeta Potential in water treatment**
- **History of Zeta Potential in Severn Trent Water**
- **The online Zetasizer – The First in the UK!**
- **Plans for the future**



# Raw water challenges facing Severn Trent Water



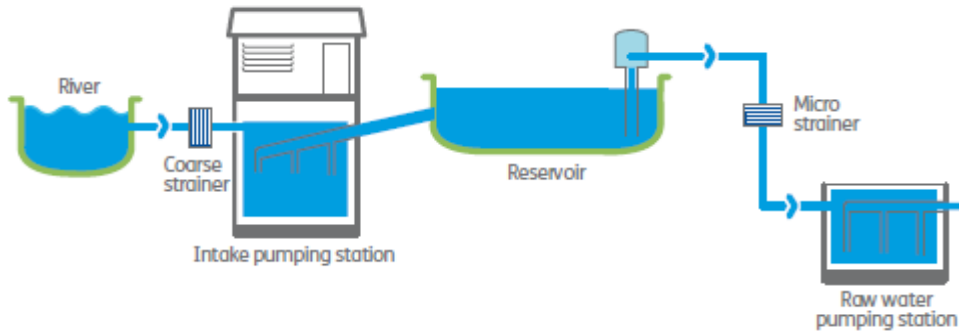
# The problem with NOM



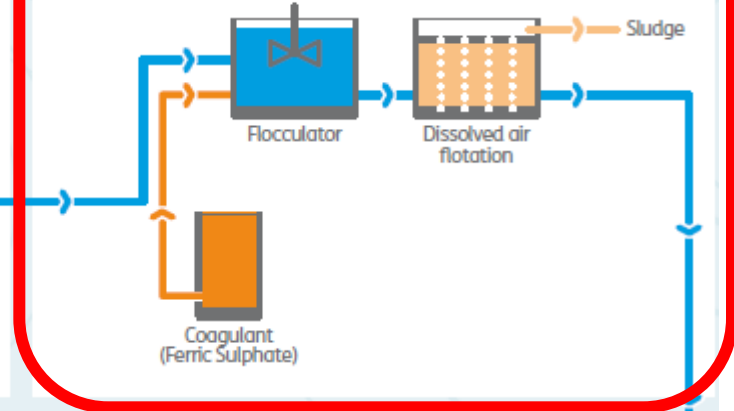
Organics vary with Source, Season, Run-off events.....

# Water Treatment Process

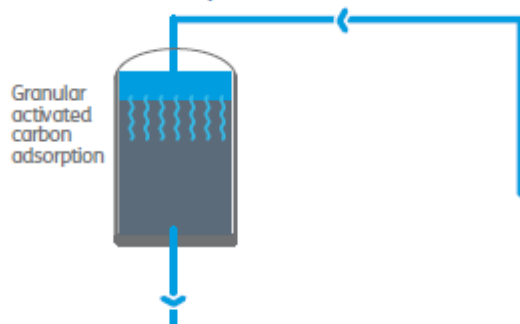
## Abstraction



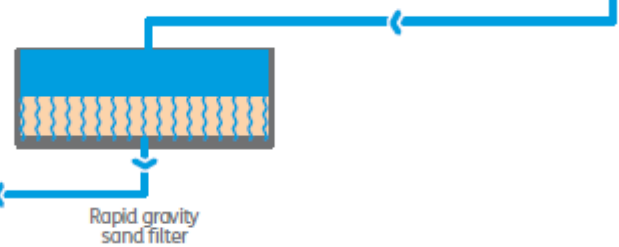
## Clarification



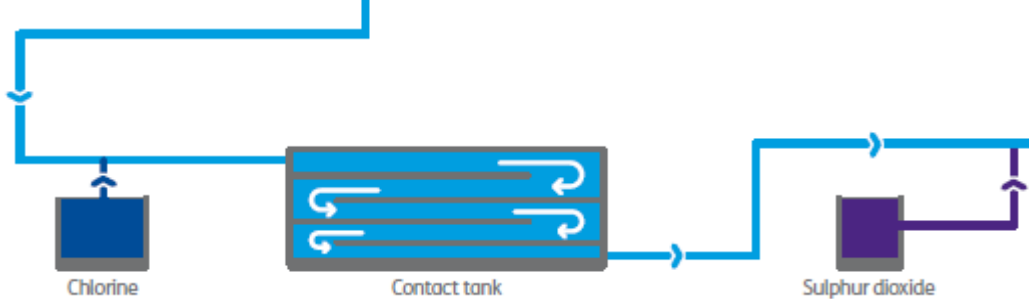
## Granular Activated Carbon Adsorption



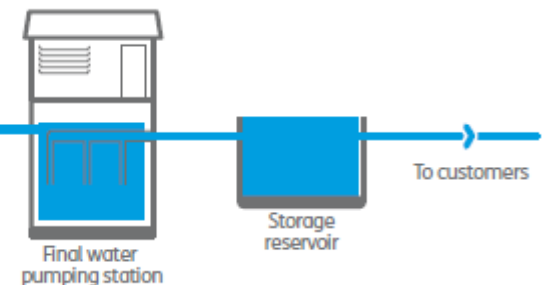
## Filtration



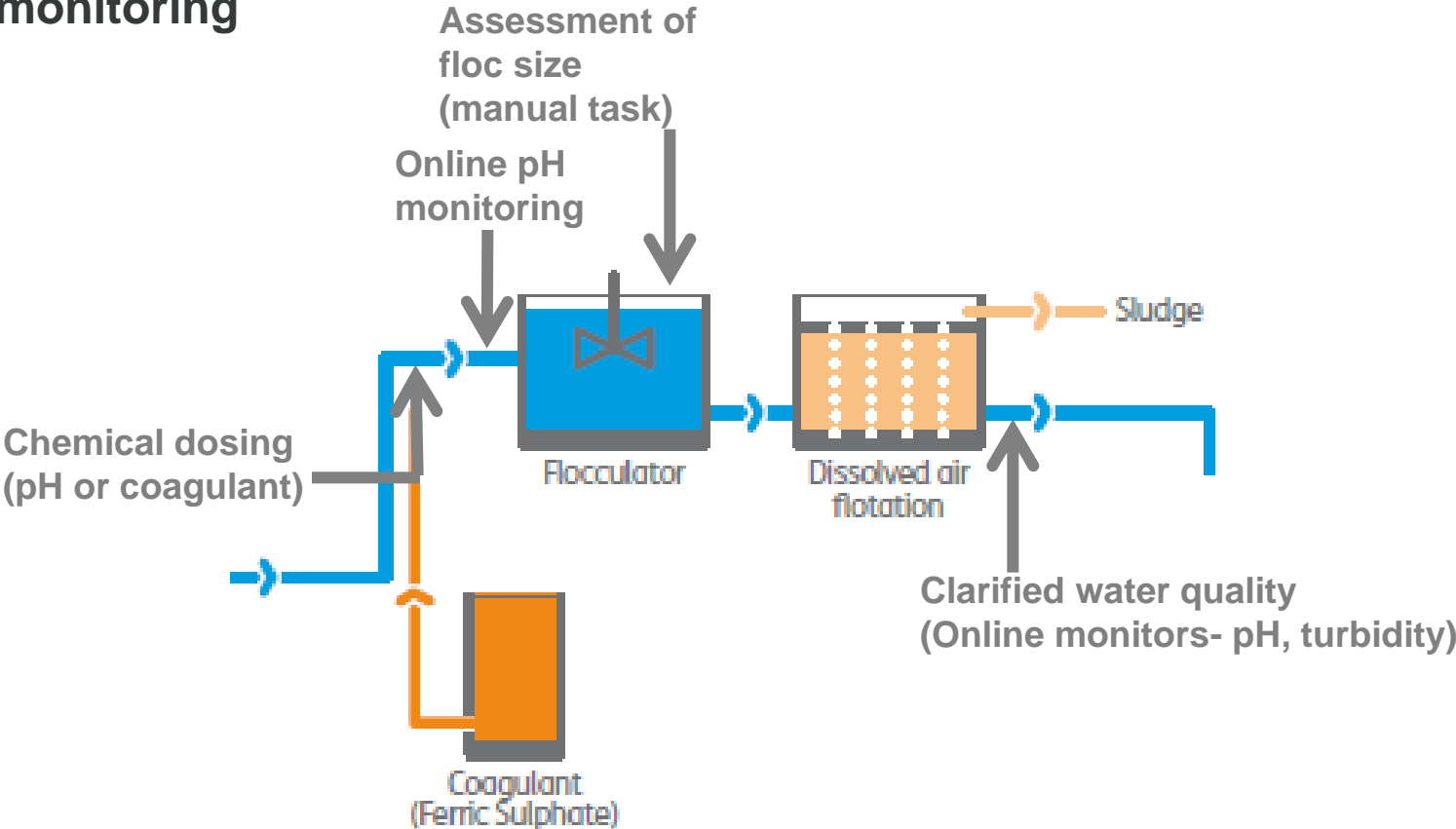
## Disinfection



## Distribution

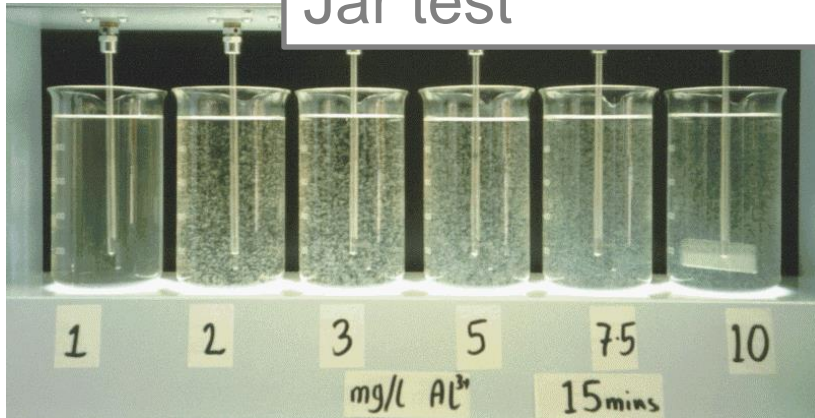


# Coagulation and Clarification- Traditional methods of monitoring

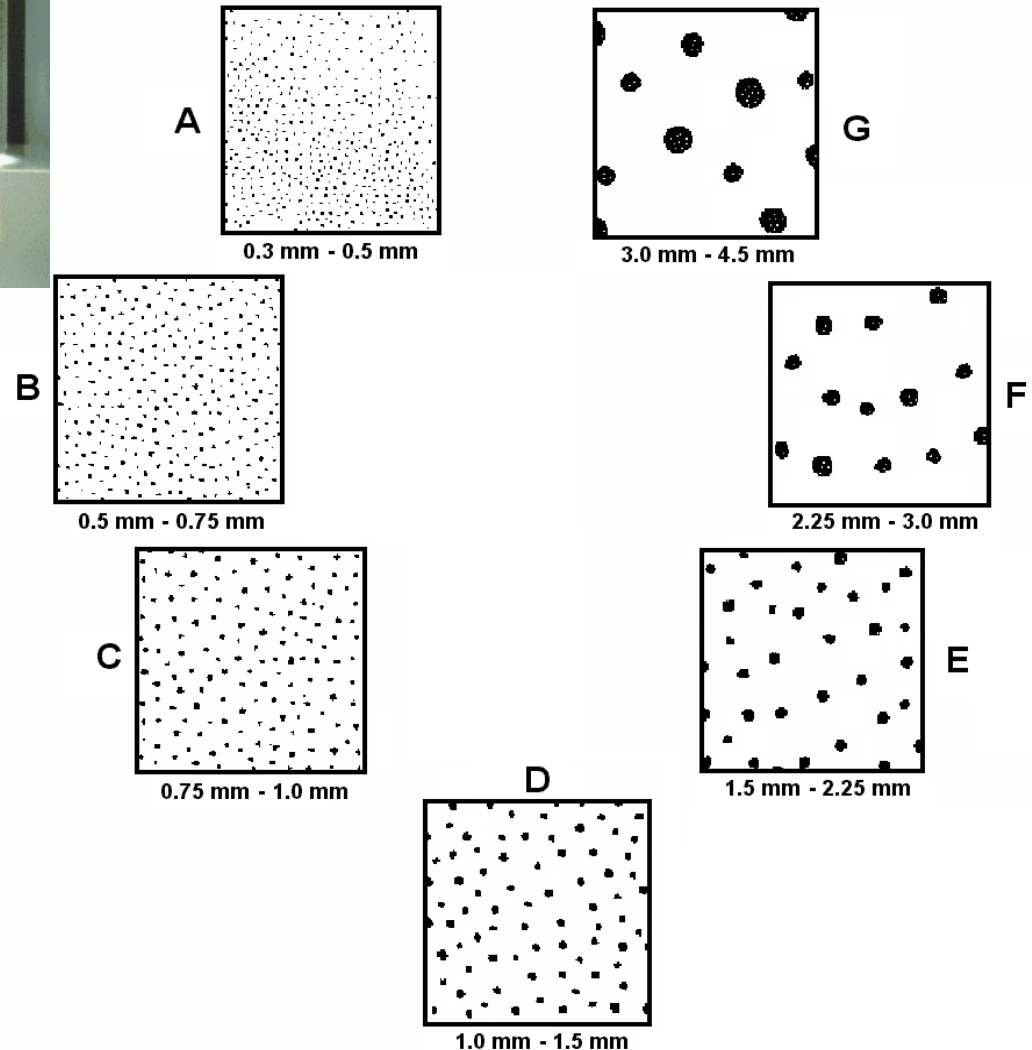


# Coagulation and Clarification- Traditional methods of optimising

Jar test



Floc test



Operator interpretation

On site test

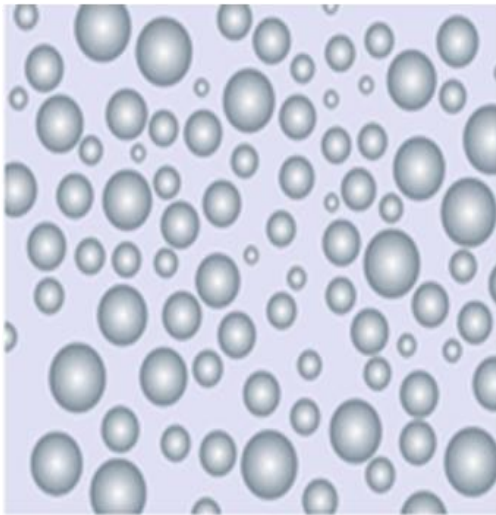
Time delay

No clear guidelines

Tendency to overdose

# Coagulation and Clarification – Link with Zeta Potential

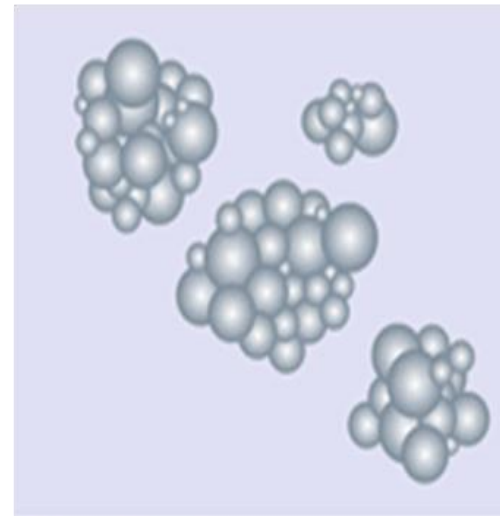
**High** Zeta Potential



**Stable suspension**



**Low** or **Zero** Zeta Potential

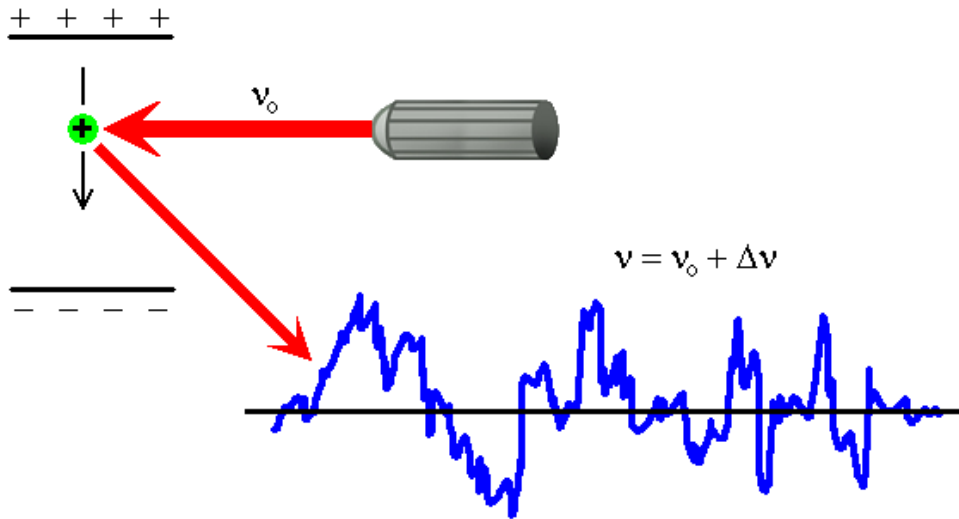


**Unstable suspension**

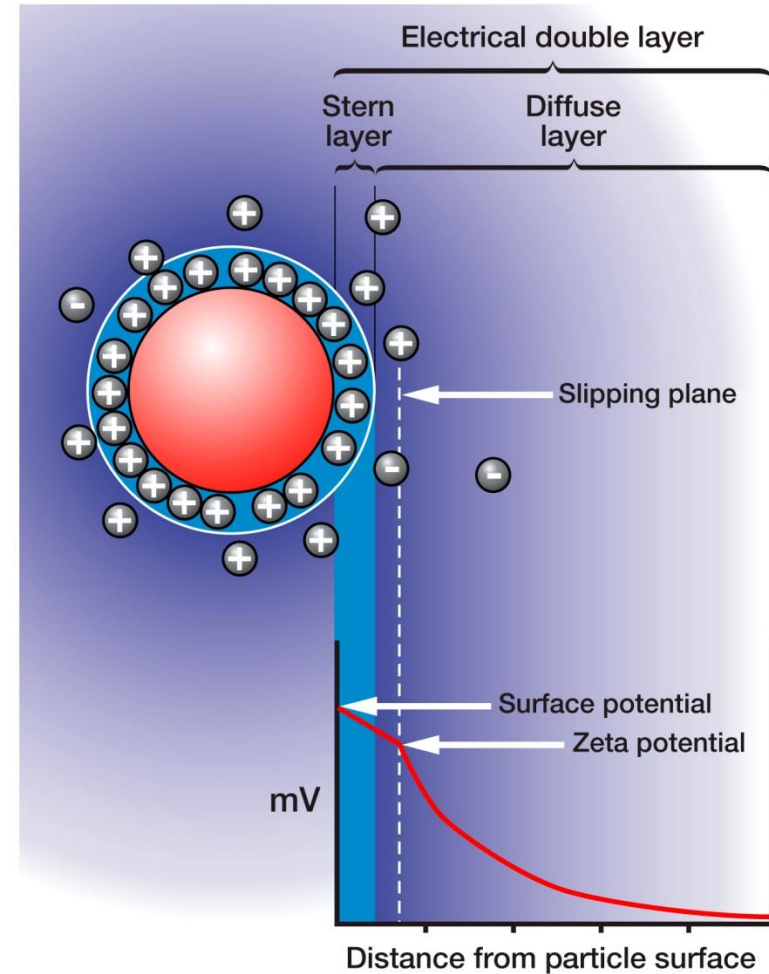


# Electrophoretic Light Scattering (ELS)

Measured parameter is the frequency shift of the scattered light.

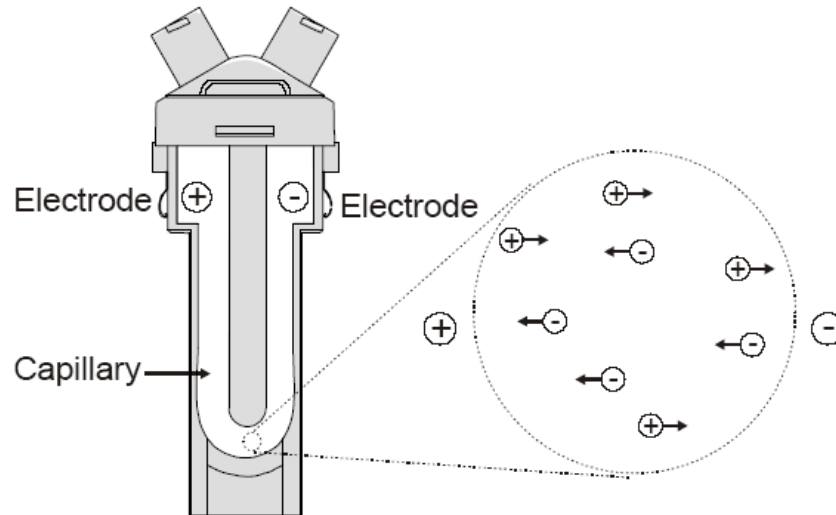


The frequency shift is proportional to the electrophoretic mobility, which is a function of the particle surface potential. Hence ELS gives us information regarding the charge on the particle.



# Measuring Zeta Potential

- › **Electrophoresis** = movement of a charged particle relative to the liquid it is suspended in under the influence of an applied electric field



Particles velocity dependent on:

- ❑ **Zeta potential**
- ❑ Field strength
- ❑ Dielectric constant of medium
- ❑ Viscosity of the medium

# Laser Doppler Electrophoresis

- › Scattered light is frequency (Doppler) shifted
- › Frequency shift

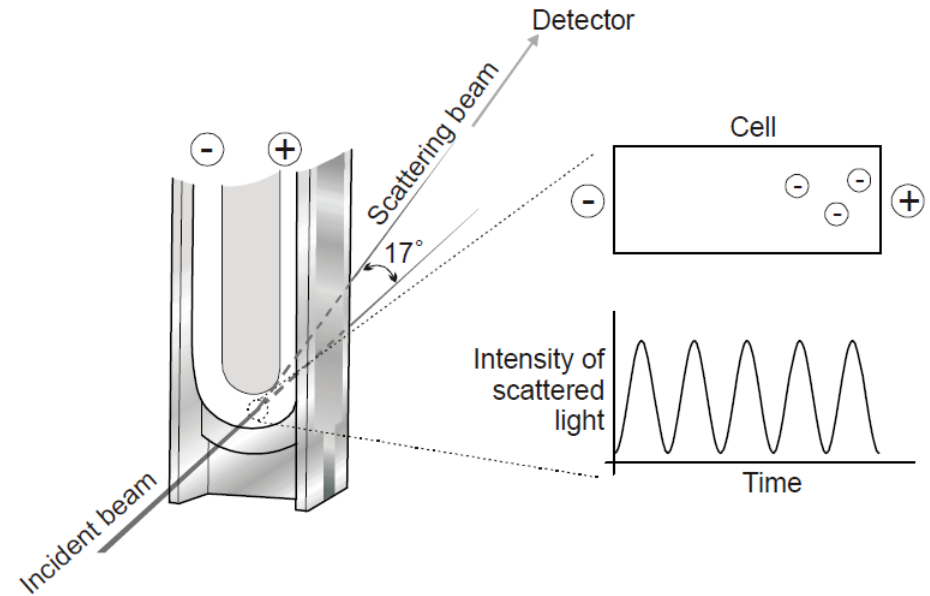
$$\Delta f = 2v \sin(\theta/2)/\lambda$$

$v$  = the particle velocity

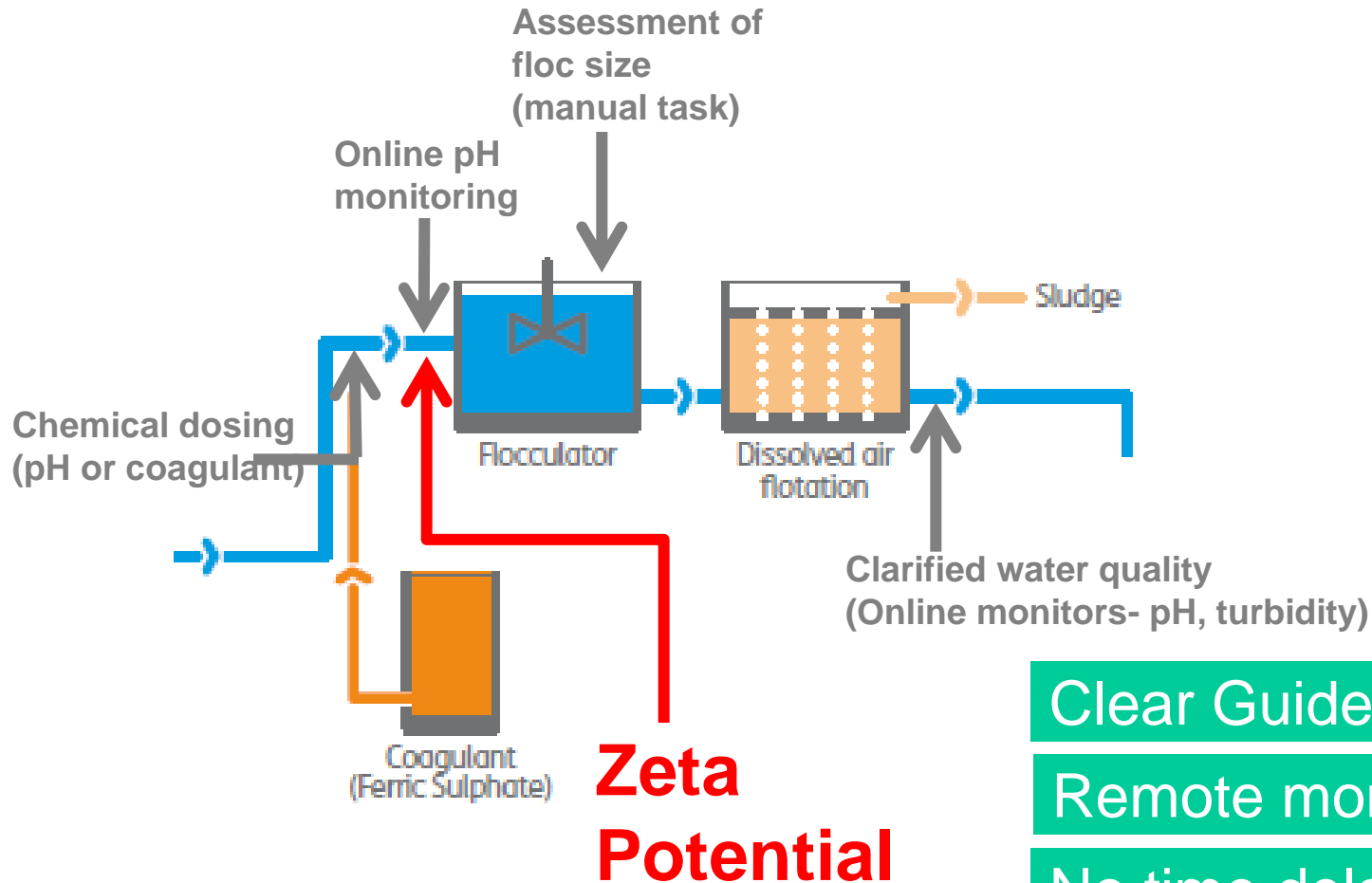
$\lambda$  = laser wavelength

$\theta$  = scattering angle

- › Frequency shifts determined by Fourier transformation and phase analysis light scattering
- › Measured electrophoretic mobility converted into zeta potential using Henry's equation



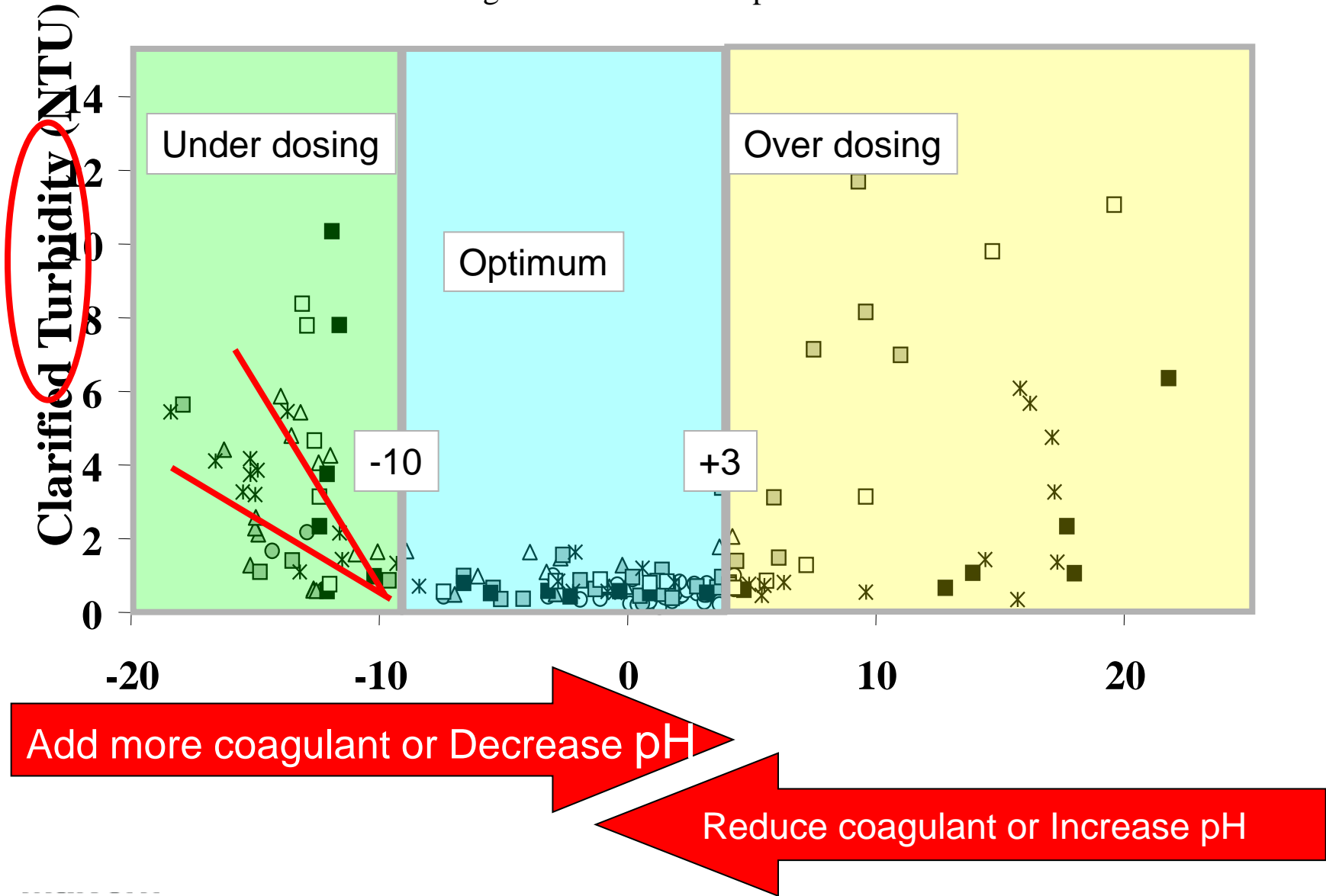
# Coagulation and Clarification - Using zeta potential



- Clear Guidelines
- Remote monitoring
- No time delay
- Efficient process

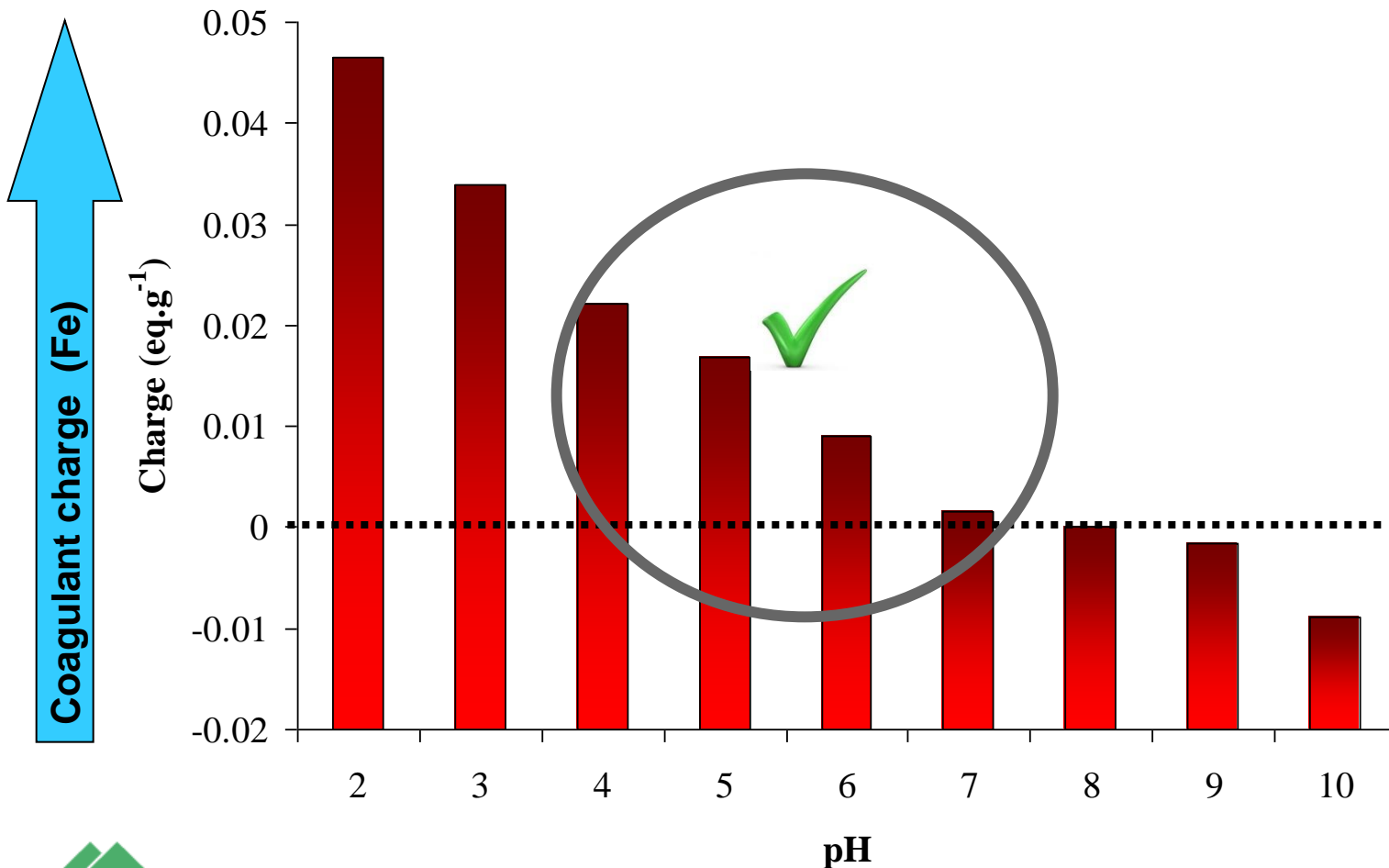
# Application of Zeta Potential in water treatment

Do we need to reduce all the charge? Is the relationship universal?



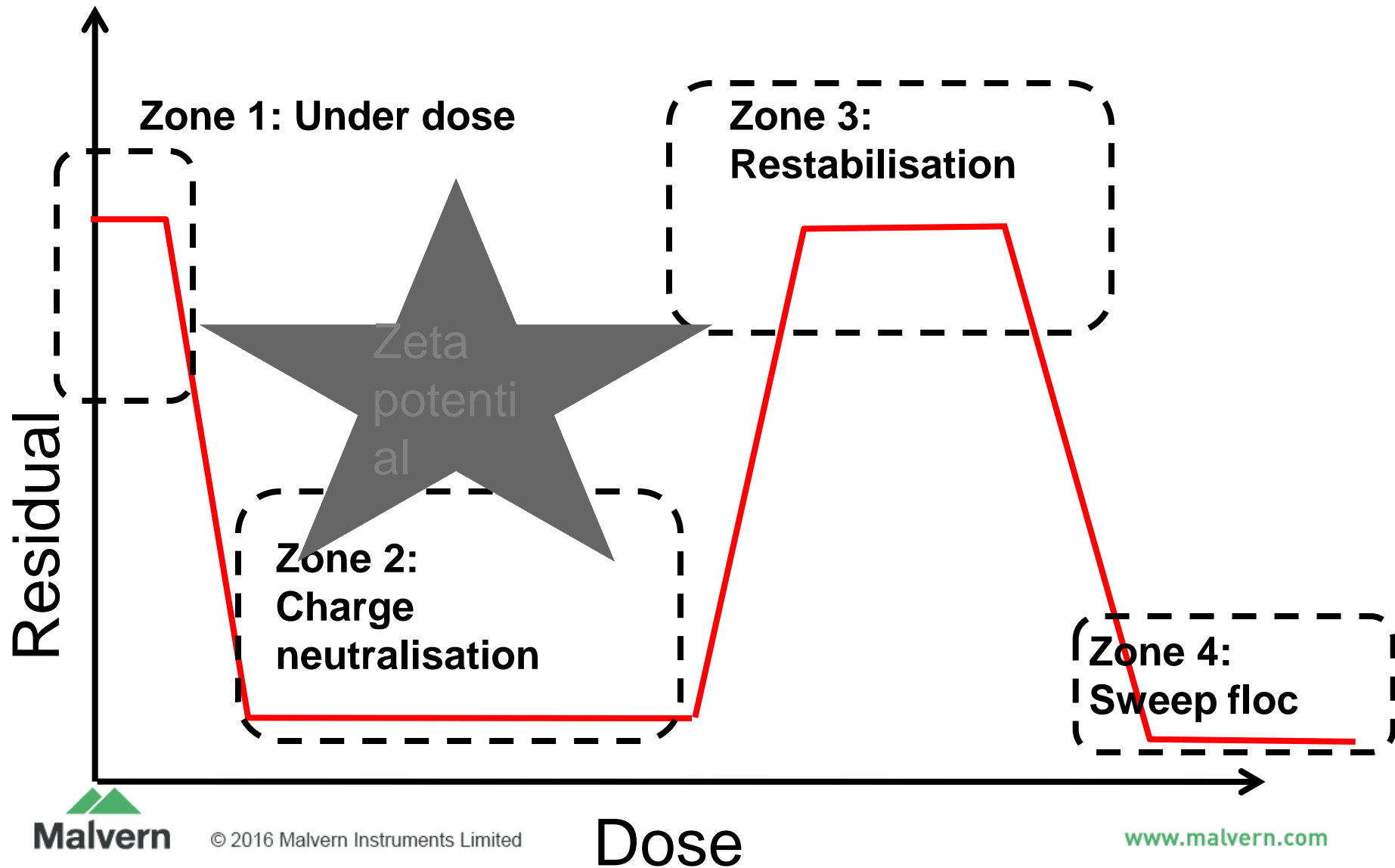
# Application of Zeta Potential in water treatment

Is there an optimum pH?



# Application of Zeta Potential in water treatment

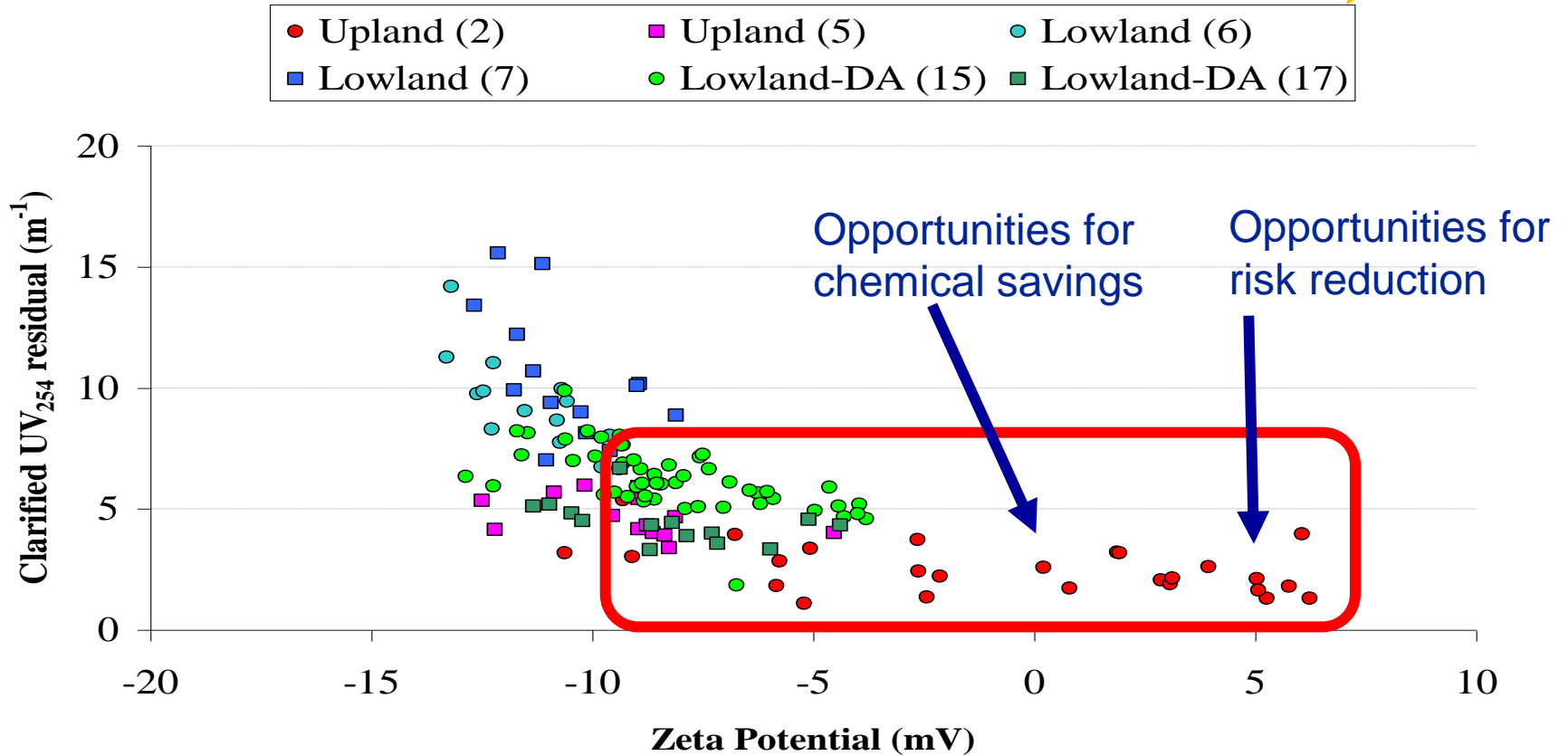
Coagulation mechanisms



# History of Zeta Potential in Severn Trent Water

2007

## Surface Water Treatment Works

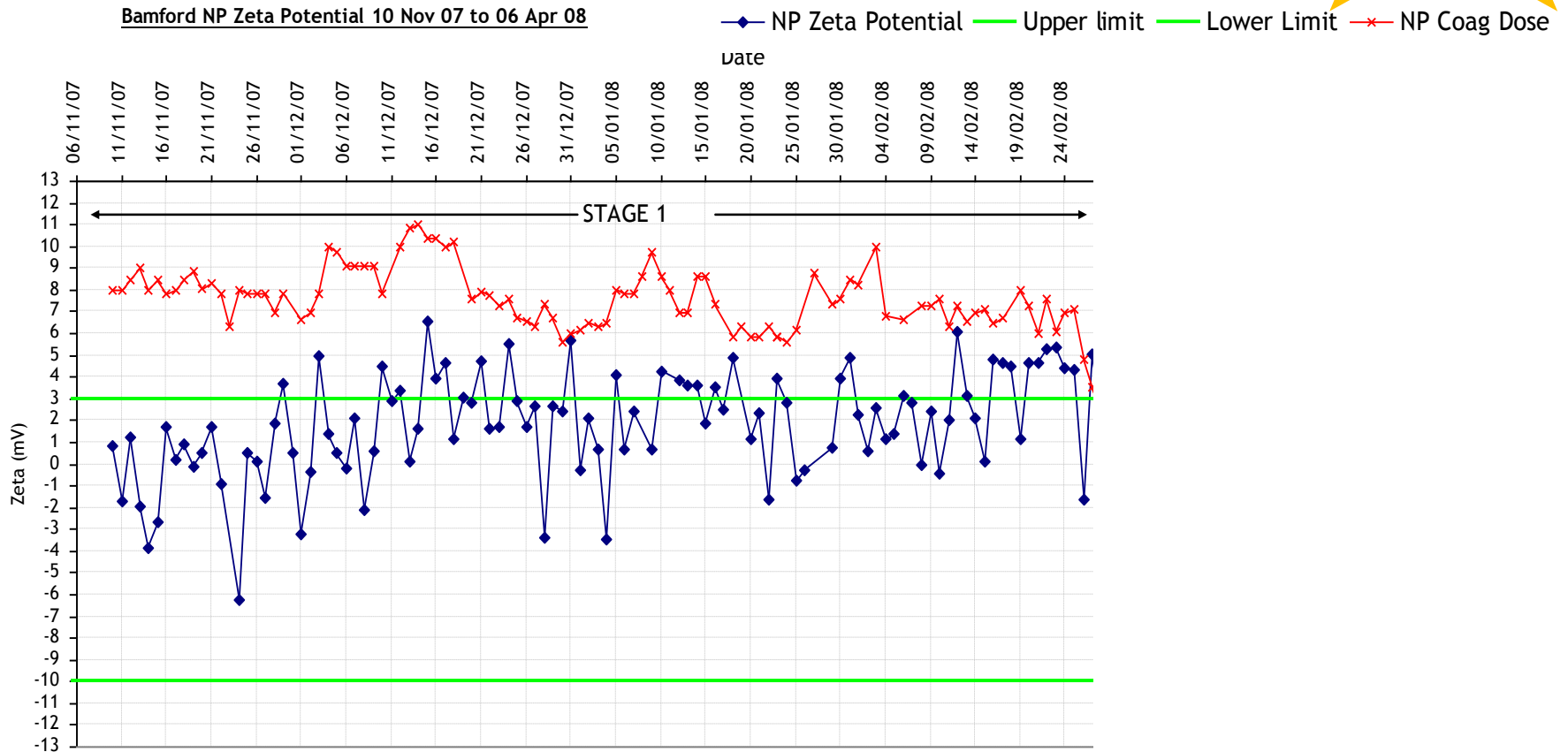




# History of Zeta Potential in Severn Trent Water

2008

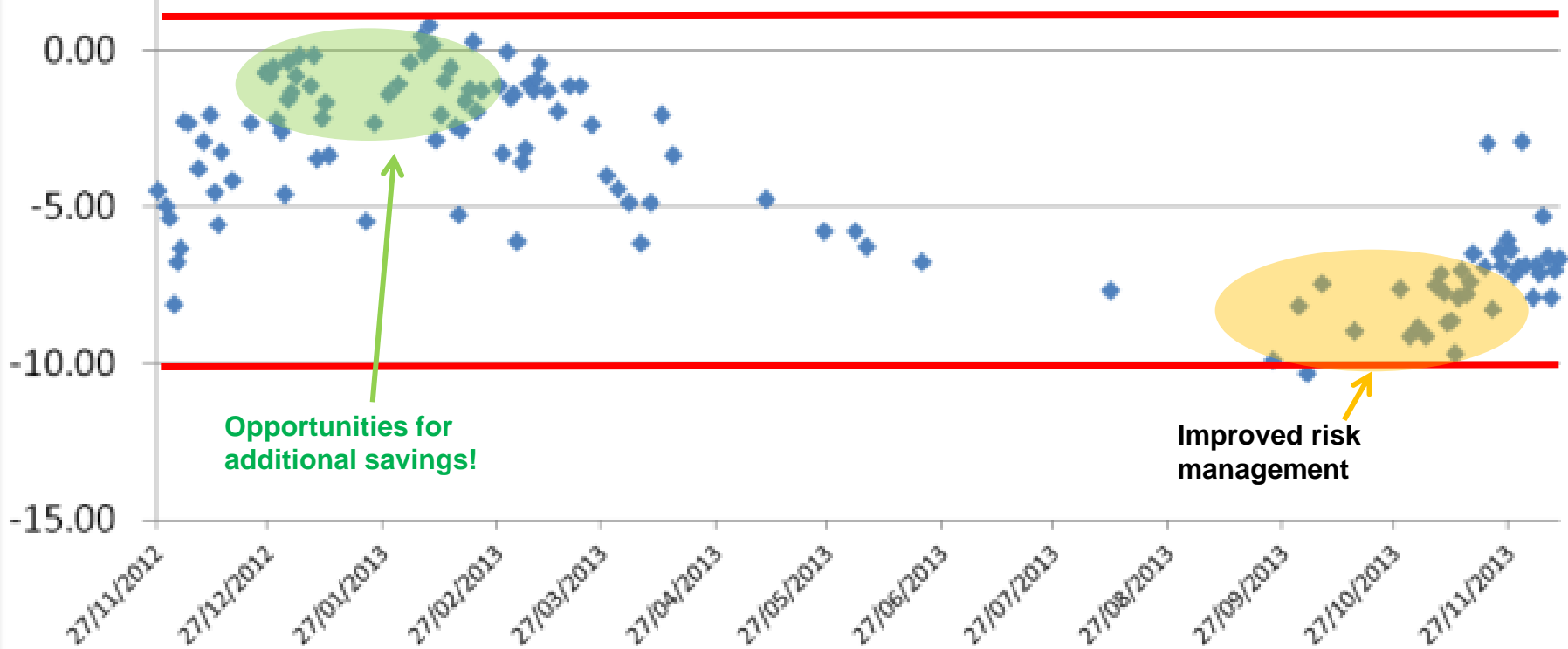
## Bamford



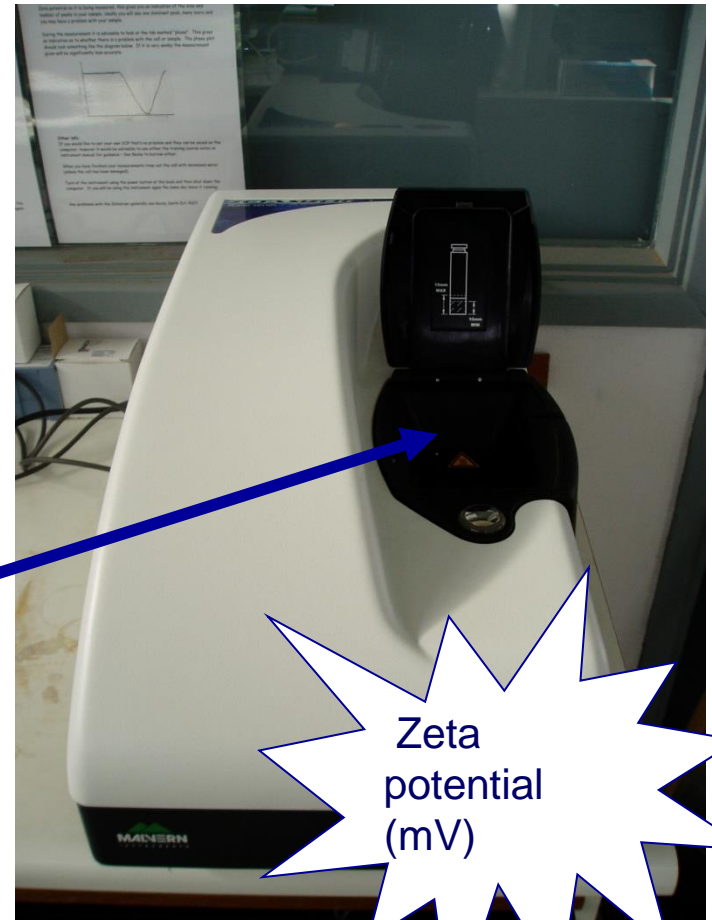
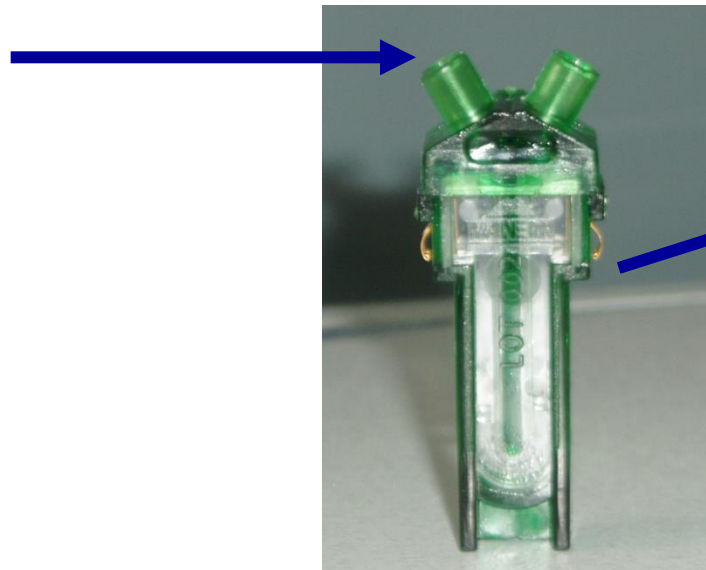
# History of Zeta Potential in Severn Trent Water



Tittesworth



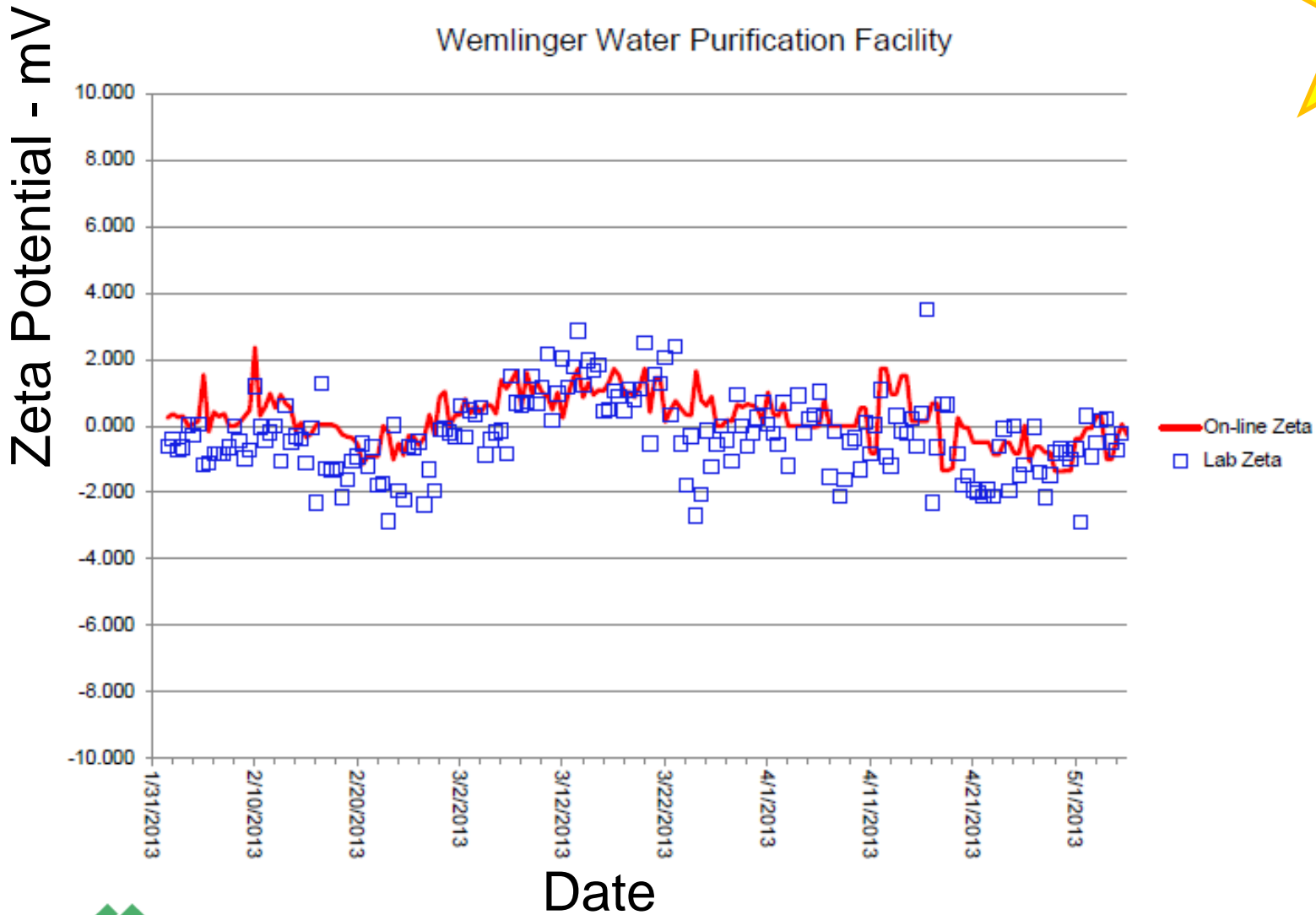
# History of Zeta Potential in Severn Trent Water



# The Online Zetasizer



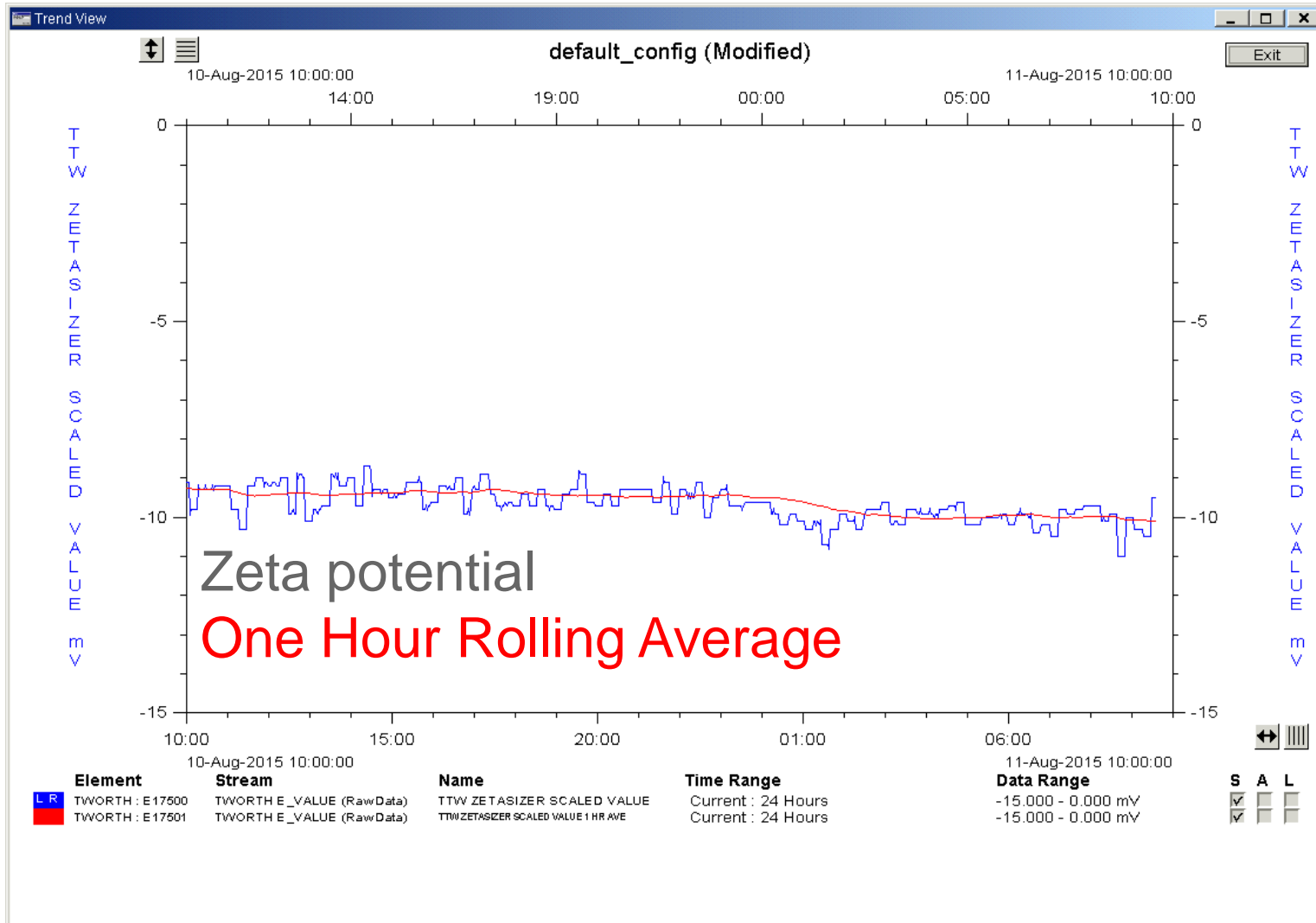
# The Online Zetasizer - Colorado



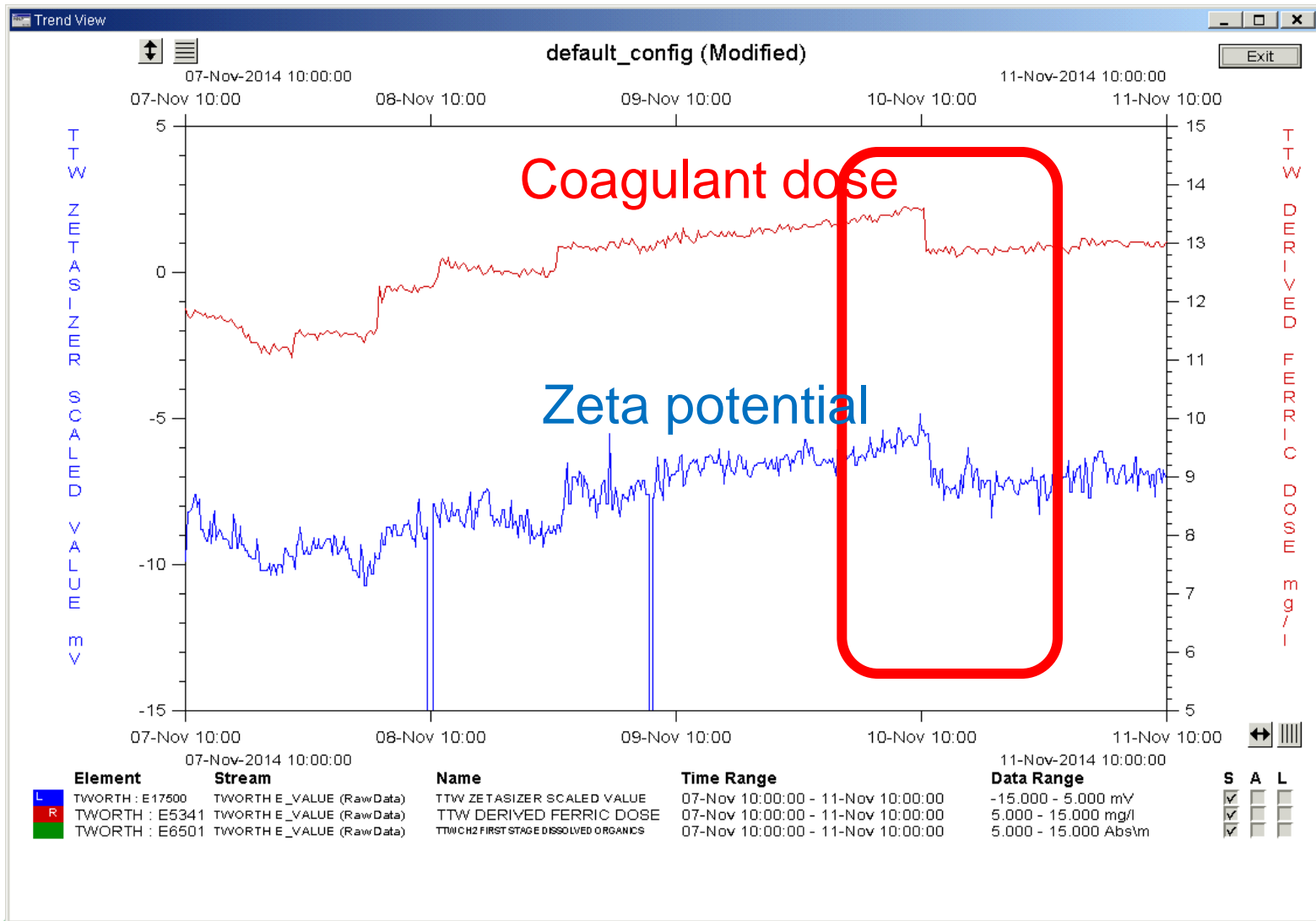
# The Online Zetasizer - Tittesworth



# The Online Zetasizer - Tittesworth

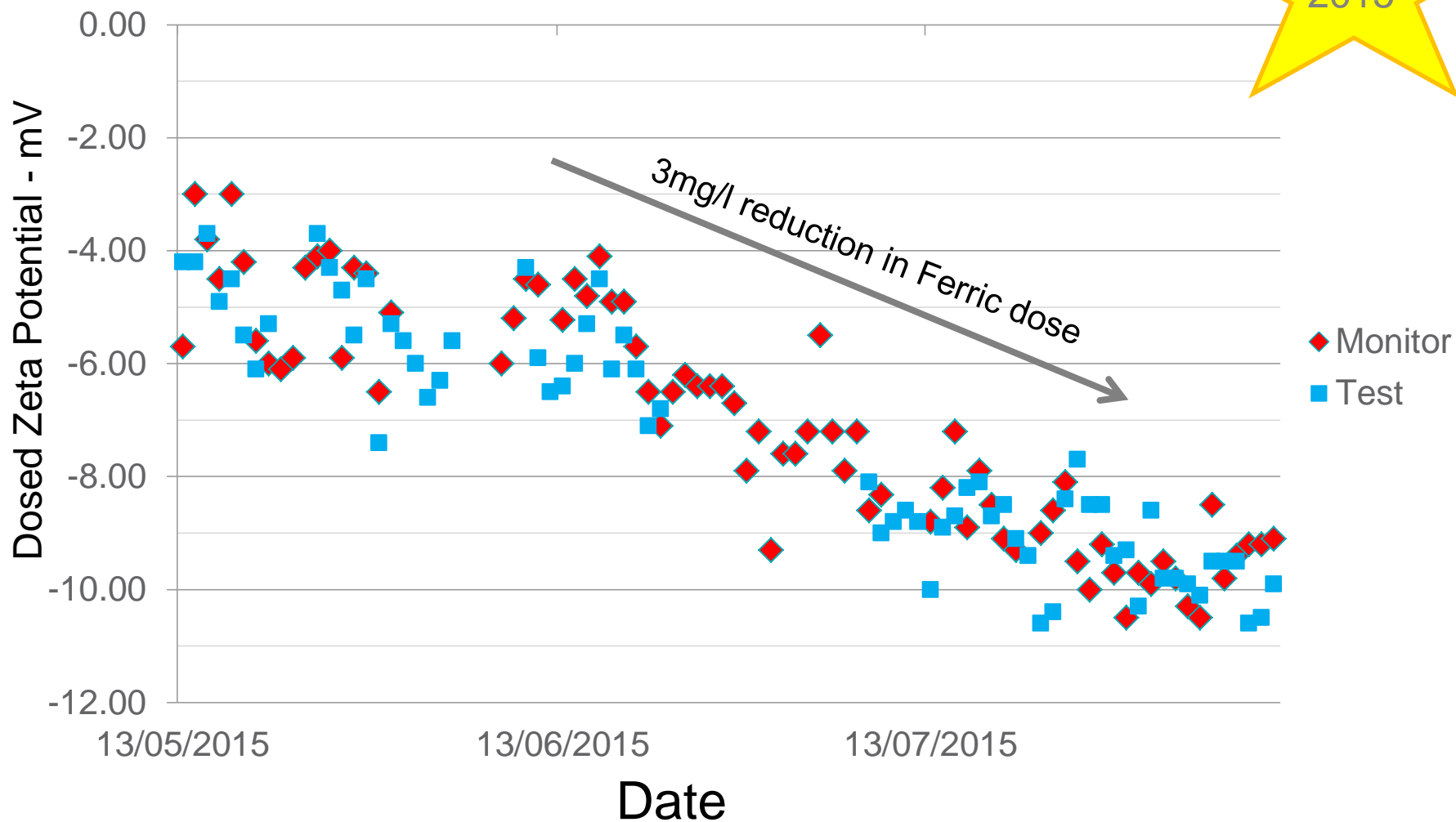


# The Online Zetasizer - Tittesworth





# The Online Zetasizer - Tittesworth



# Summary

- › Zeta potential for coagulation control works!
- › Online Zeta Potential measurements are reliable
- › The system allows for constant zeta potential monitoring with alarms
- › Lead measure of clarification performance
- › Its easy to use and understand
- › Reduces risk and generates efficiencies
- › Real potential for reliable automated coagulation control!

# The Future

Automated coagulation control!



**Thank you for your attention  
-Any Questions?**

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