



EPSRC CENTRE FOR INNOVATIVE  
MANUFACTURING IN



# Water Sustainability for the Food Manufacturing Industry



The University of  
Nottingham

UNITED KINGDOM • CHINA • MALAYSIA



Loughborough  
University

UNIVERSITY OF  
BIRMINGHAM



# Overview

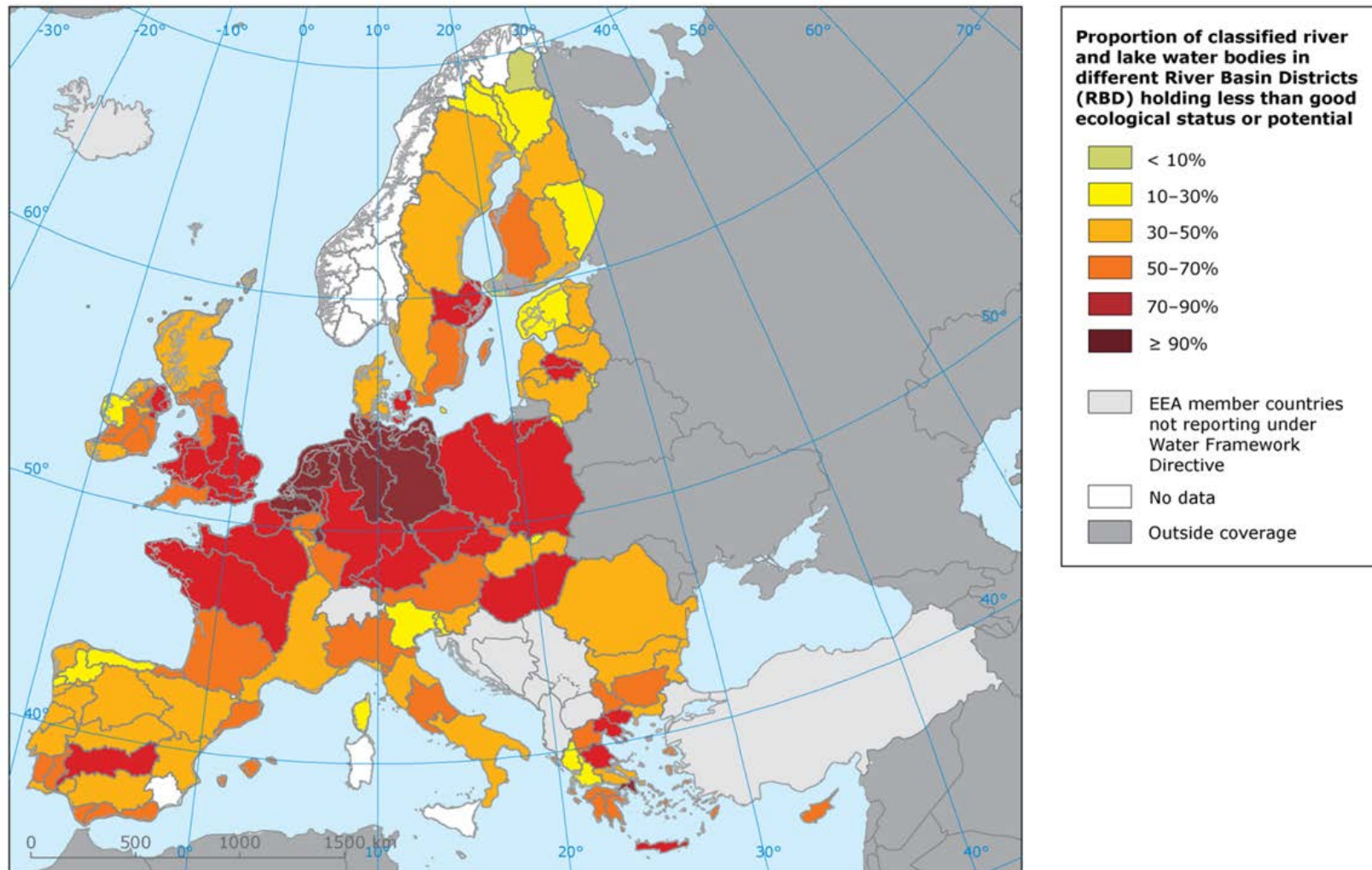
- **Introduction**
- **Monitoring of water using processes**
- **Surface cleaning analysis**
- **Water content monitoring**
- **Applications**
- **Summary**



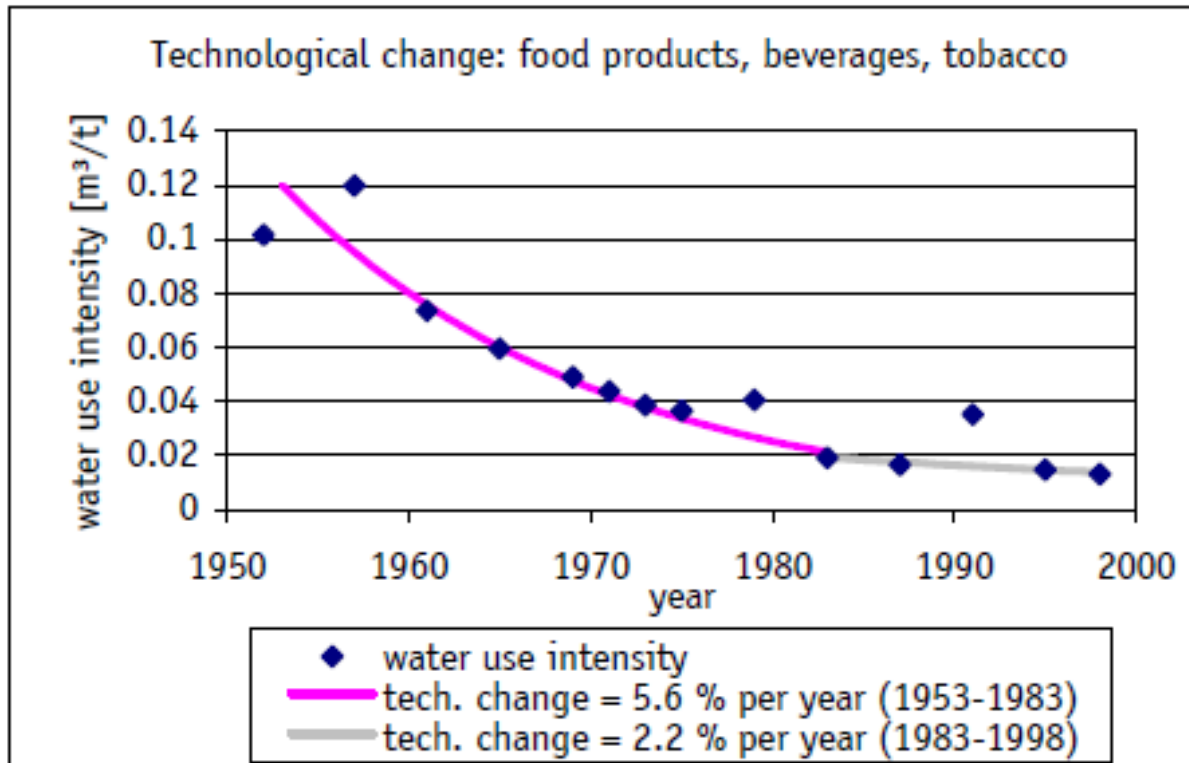
# INTRODUCTION

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# Impact of Water Use

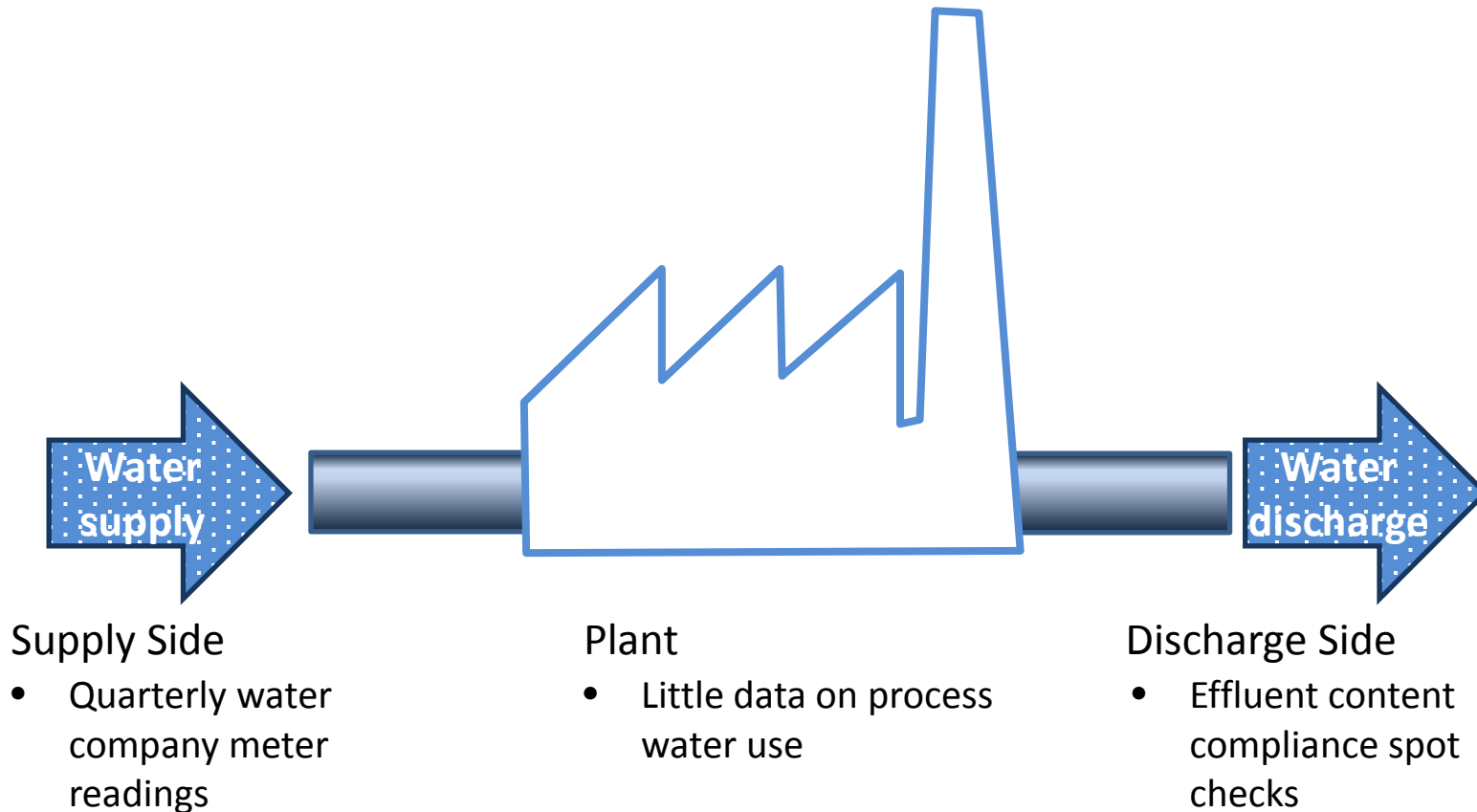


# Water Use Intensity Trends



Flörke, M., and Alcamo, J. (2004) European Outlook on Water Use, Center for Environmental Systems Research - University of Kassel, Final Report, EEA/RNC/03/007

# Lack of Data on Factory Water





# MONITORING OF WATER USING PROCESSES

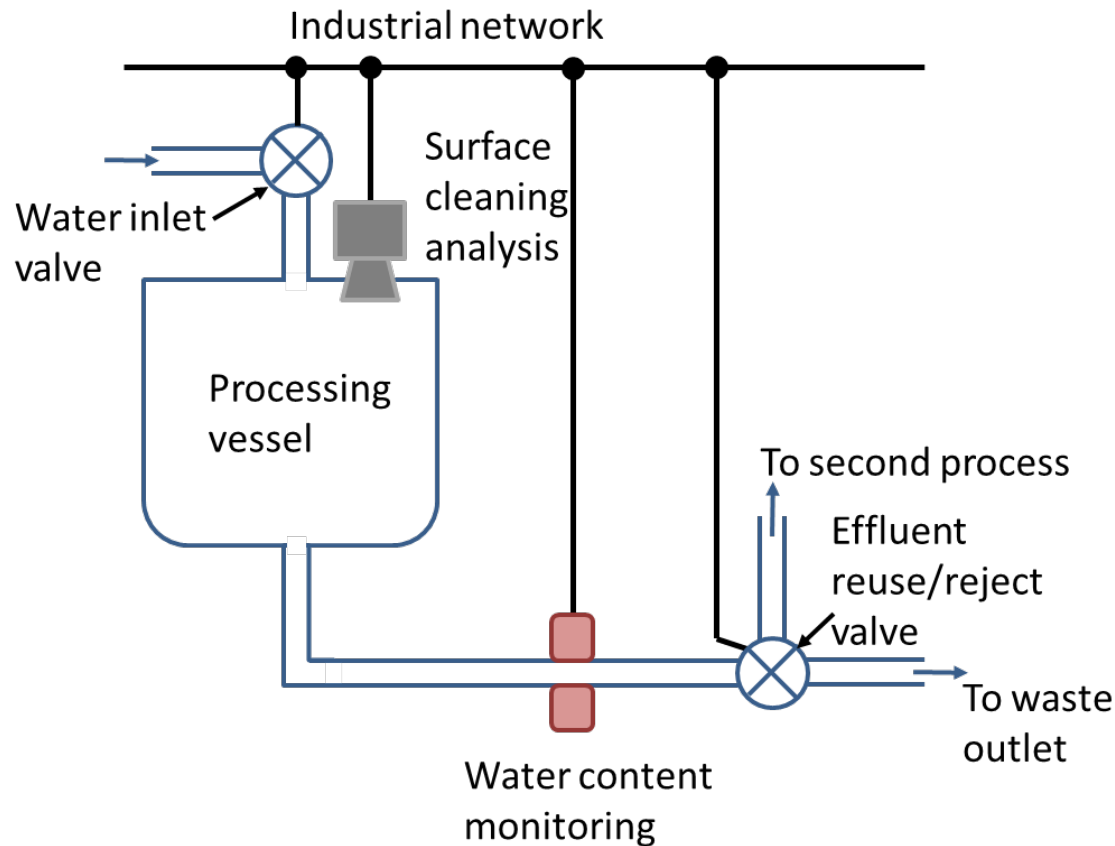


# Desirable Features

- In-line
- Real time
- Continuous
- Non-invasive
- Low maintenance



# Proposed System





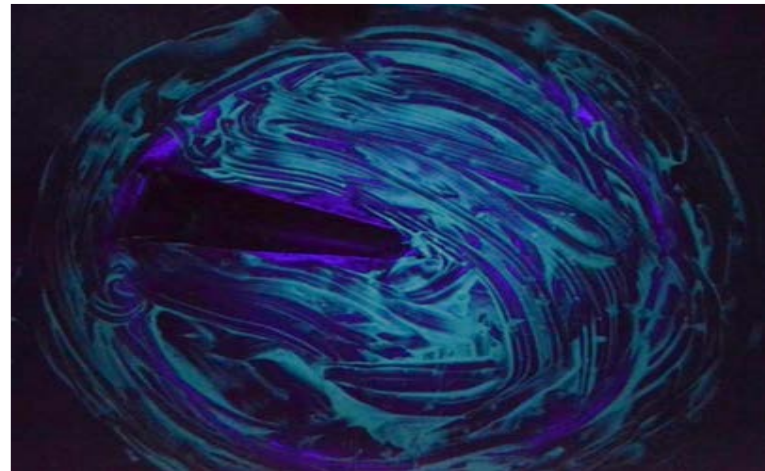
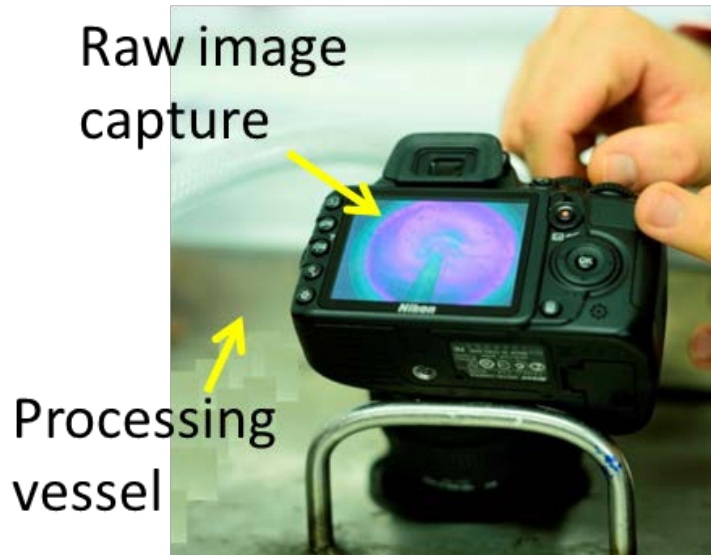
# SURFACE CLEANING ANALYSIS

# UV illumination of food soil

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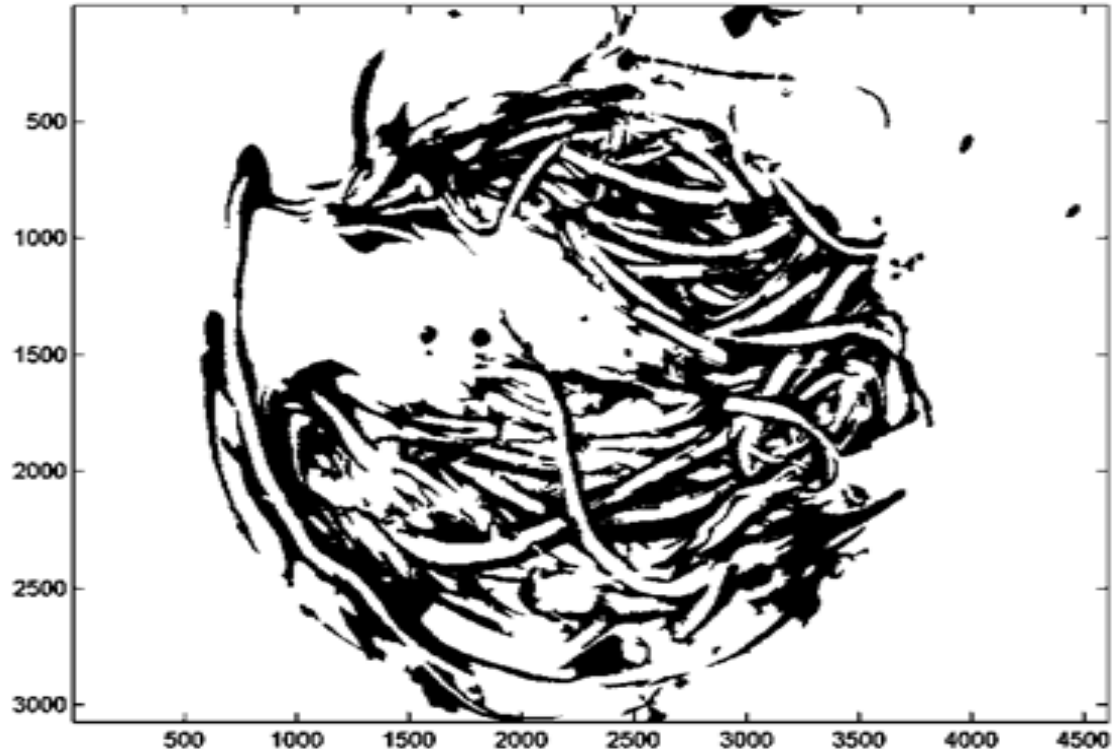


# Fluorescence of soiling



# Image processing and analysis

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# WATER CONTENT MONITORING

# Multi-analyte Sensor Kit (MASK)



Sensor Type	Measurement Range	Units	Notes
Turbidity	160 - 2400	NTU	
Colour	Red, Green, Blue, Infra-red		
Conductivity	0.02 - 650	mS/cm	+/-5%
pH	0-12	pH	Temperature compensated
Temperature (of product)	0-106	°C	

Stainless steel pipe

Conductivity  
4 point probe

Optical measurement  
module

Optical measurement  
module

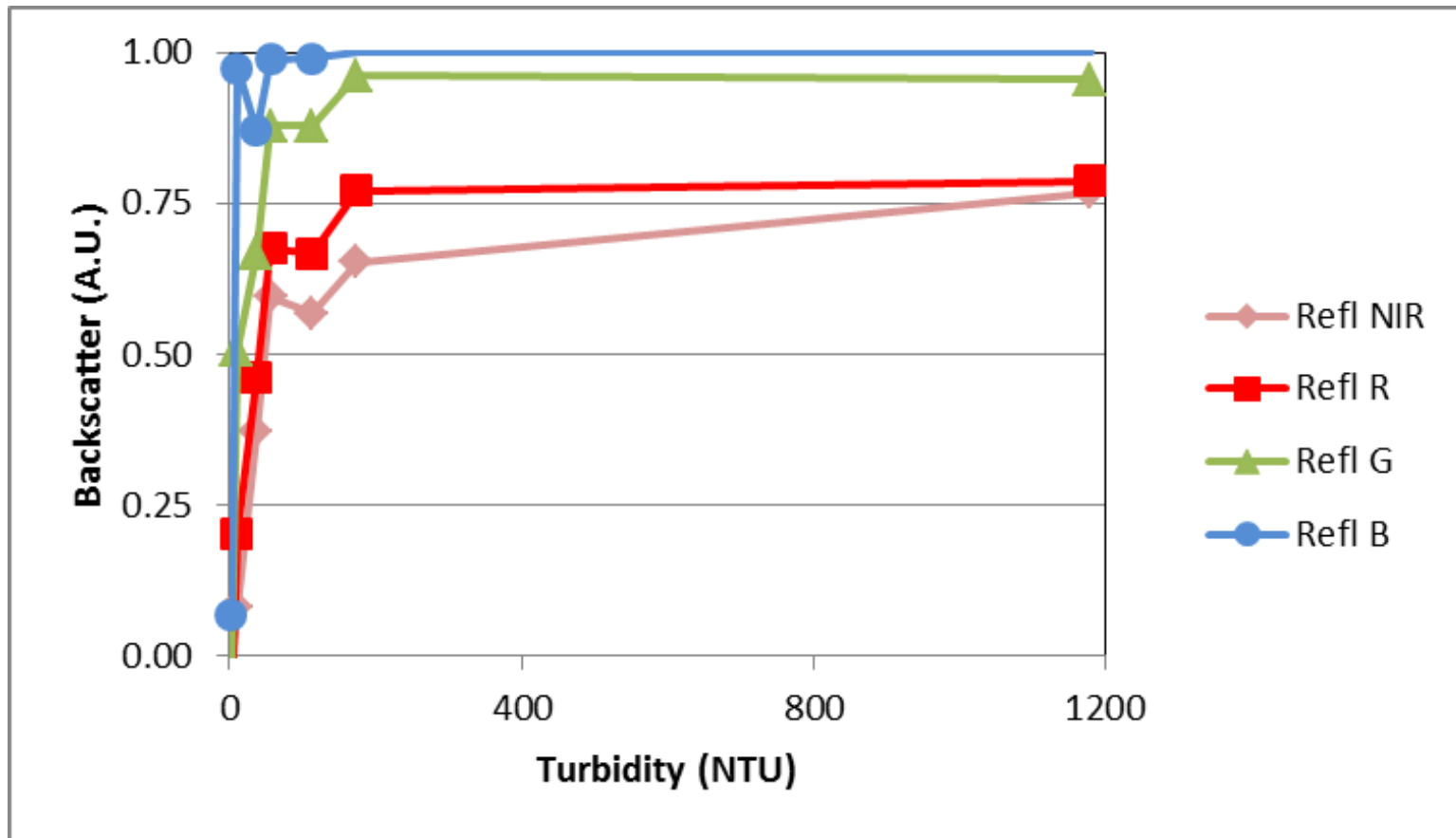
pH sensor and  
thermometer

Discharge valve

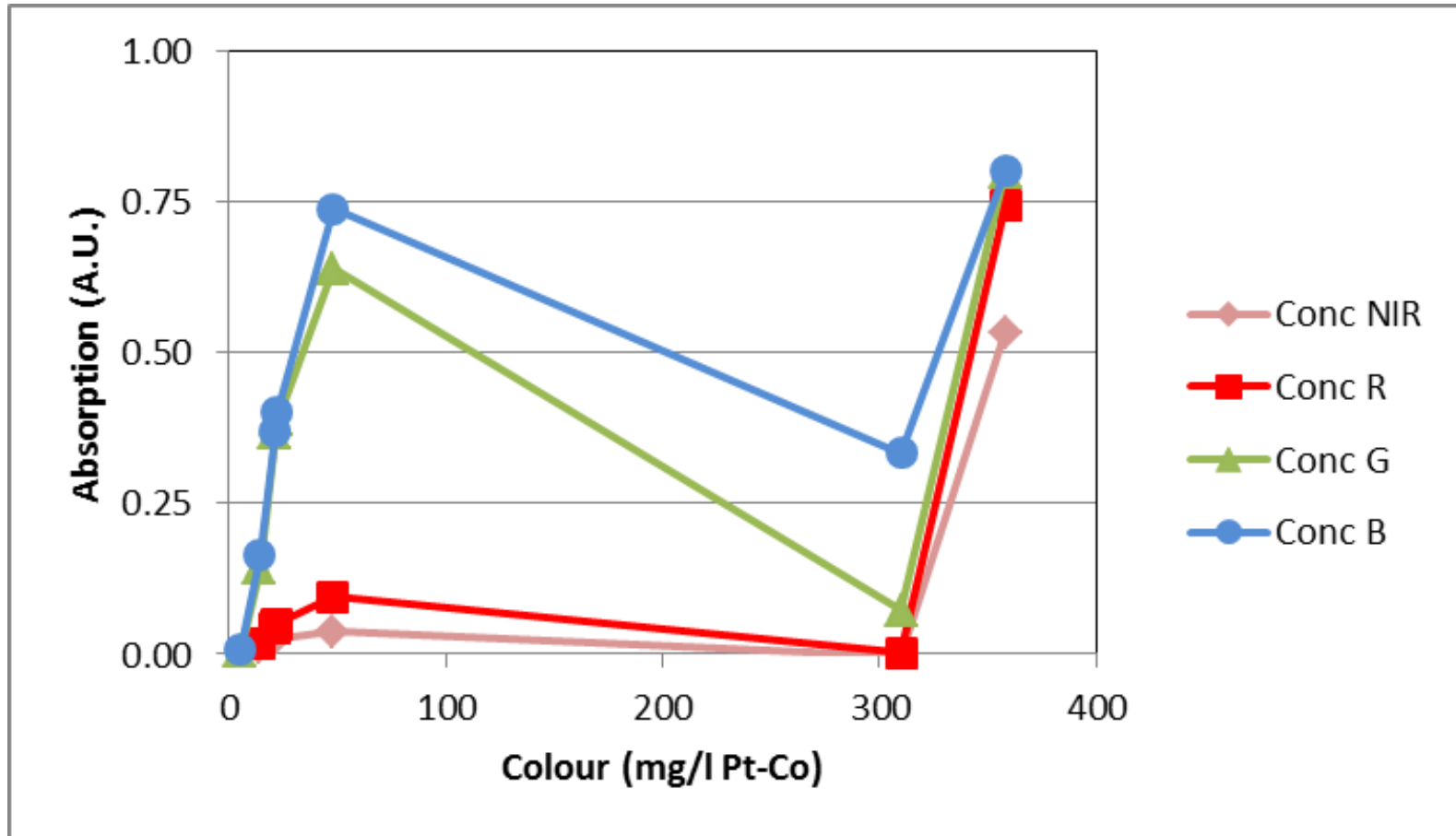




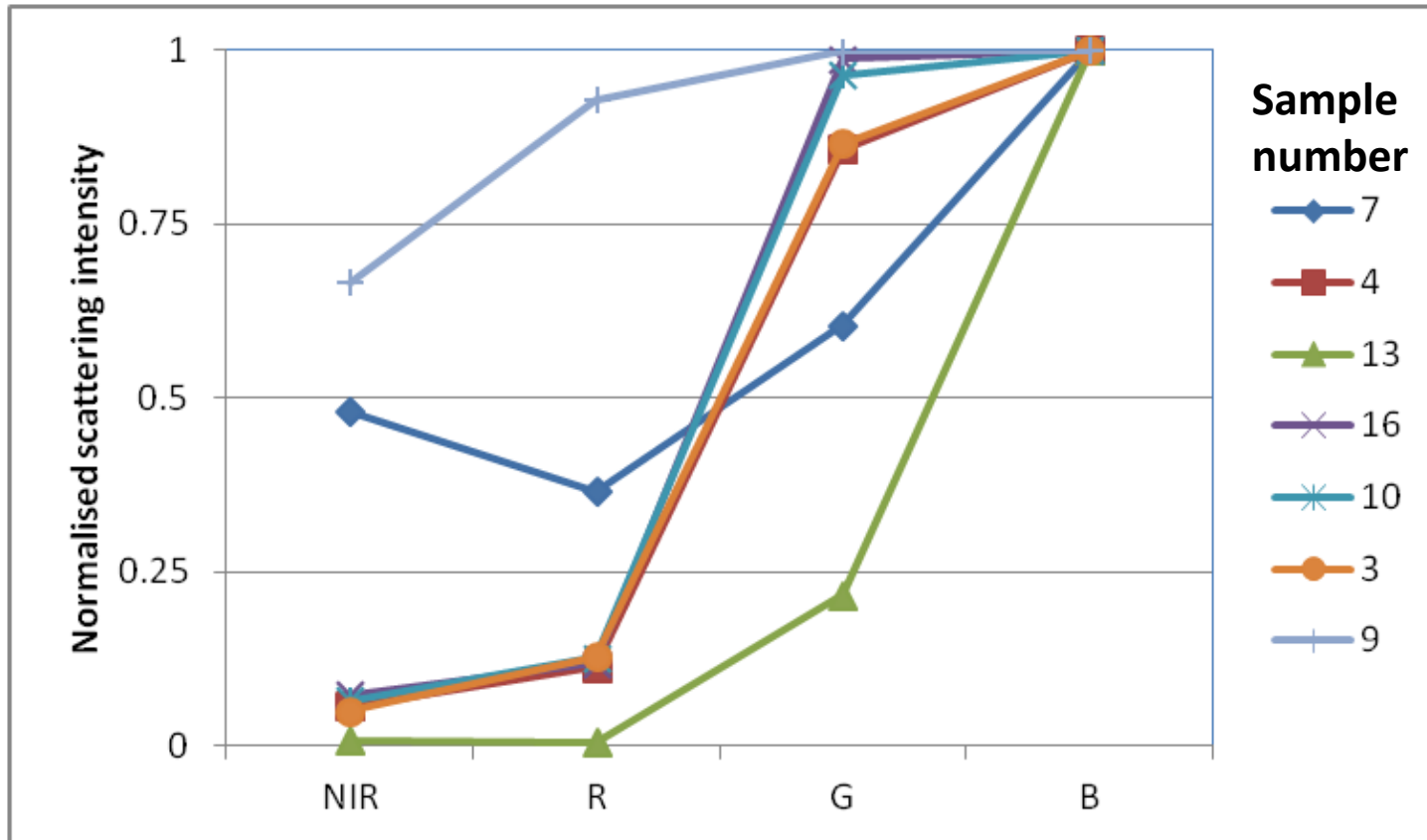
# Correlation with turbidity



# Correlation with colour



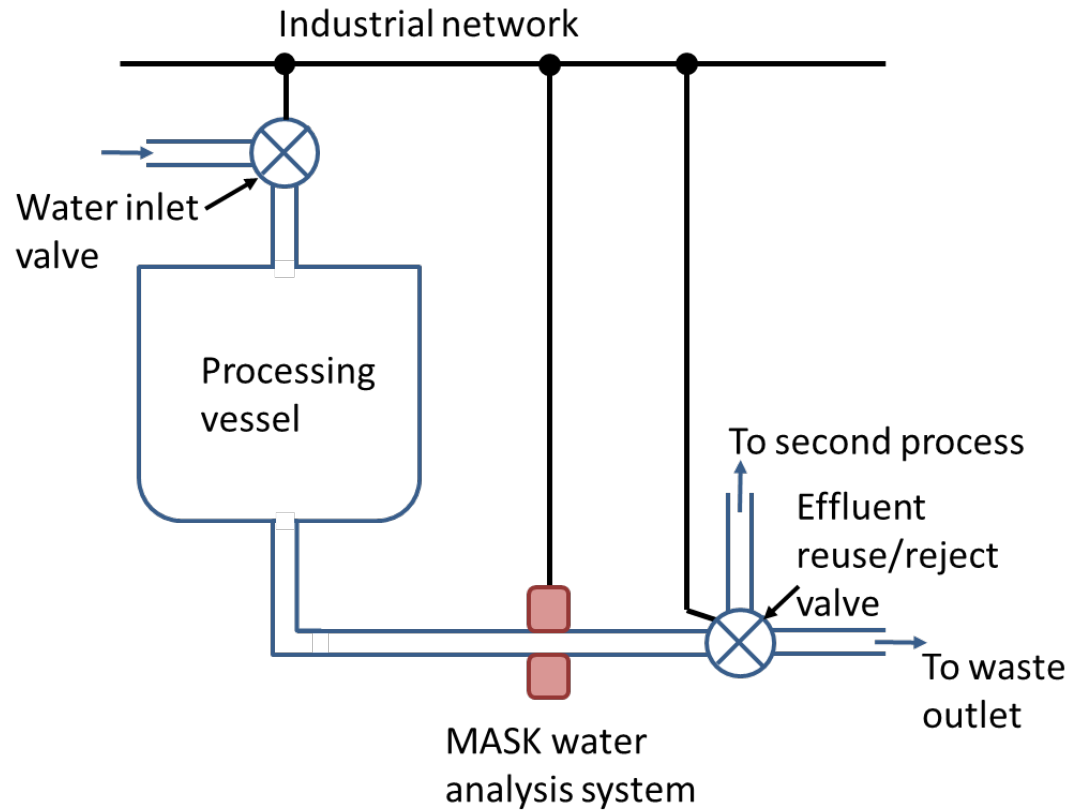
# Fingerprinting of wastewater



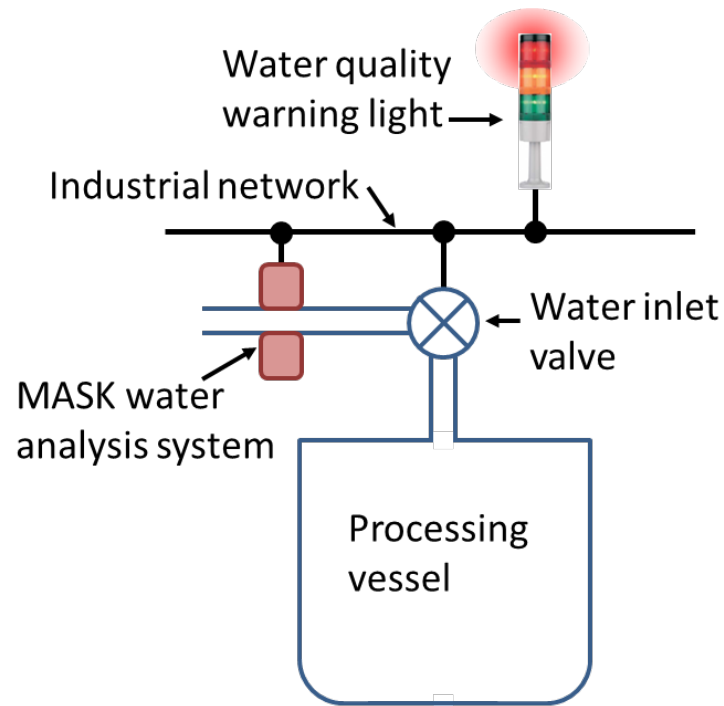


# APPLICATIONS

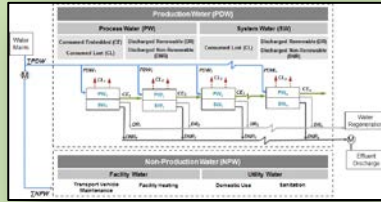
# Feedback control of wastewater routing



# Input water quality assurance



# System improvement



**Model of production system**

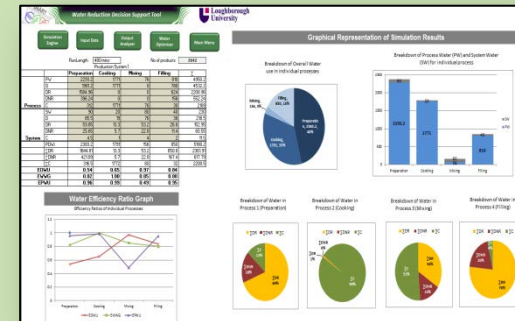


**Measure water usage and content**

**Model**

**Monitor**

**Manage**



**Analysis of production system**



# Summary

- Data on individual water using processes is needed (and lacking) for effective water sustainability improvement
- Instrumentation to monitor water using processes must be capable of real-time and continuous measurements
- Surface cleaning analysis and water content monitoring instrumentation has been developed and tested
- The instrumentation can be used for active control of water sustainability, as well as for system redesign





# Acknowledgements

- Elliot Woolley
- Aunt Bessies (Michael Jackson Food Group)  
for the water samples