



# REWARD

*REuse of WAteR in the food and bioprocessing inDustries*

”Bæredygtig anvendelse af procesvand”

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# REWARD

2014-2019

BUDGET: 26,2 mio DKK



DET STRATEGISKE  
FORSKNINGSRÅD

17.8 Mio



4.5 Mio



0.5 Mio

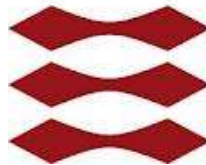
**ALECTIA**

0.5 Mio



0.5 Mio

DTU



TUM

TECHNISCHE  
UNIVERSITÄT  
MÜNCHEN



## REWARD Summary

**REWARD will establish a research community that provides the knowledge to bring Danish industry closer to self-sustainability - the closed factory principle - where water intake is diminished by re-using production streams.**

This will provide the Danish food and bioprocessing industry, challenged by productivity and outsourcing problems, with a leading edge and will put Danish processing and measurement equipment businesses at the forefront of modern process water management practice.

REWARD focuses on process water cases from the food and bioprocessing industries with multi-product lines and includes technology providers working with generic principles adaptable to other industries with related challenges such as the brewing industry, vegetable/fruit processing, bio-refineries and the fermentation industries



strategiskforskning.dk

Strategisk forskning løser samfundsudfordringer

### Projects

Aktive filtre:

reward

Vælg visning:



Viser nummer 1 af 1 projekter

#### REWARD - Genbrug af vand i fødevarer- og bioprocesserings-industrien

Vand er ikke en udtømmelig ressource, og det kan betale sig at rense og genbruge vand, der har været brugt i industriel produktion. Dette projekt udvikler højteknologiske sensorsystemer og nye måder at rense vand på.

Ideen om at vand udgør en udtømmelig ressource tilhører fortiden. Fødevarer- og bioprocesseringsindustrien er nogle af de største forbrugere og udledere af procesvand. Dette vandspild udgør en alvorlig miljøbelastning, samtidigt med at det repræsenterer en stor udnyttet ressource, der med fordel kan genbruges i produktionen.

REWARD projektet (Reuse of water in the food and bioprocessing industry) vil forsyne dansk fødevarer- og bioprocesseringsindustri med grundlæggende ny teknologi og viden, som vil muliggøre en langt mere effektiv udnyttelse af vand og dermed bringe producenterne tættere på en 100% bæredygtig produktion. REWARD vil anvende de effektive principper bag Process Analytical Technology (PAT) og Quality by Design (QbD) samt Hazard Analysis and Critical Control Points (HACCP) til at minimere forbruget af drikkevand og øge genbrug af proces- og rengøringsvand.

REWARDs mål er: (A) at udvikle og implementere nye højteknologiske sensorsystemer, der kan monitorere de kemiske og biologiske komponenter i procesvandstrømme og vandbehandlings effektivitet samt (B) at udvikle en helt ny fremgangsmåde til at optimere rensning af procesvand. Det overordnede mål er at udvikle ny teknologi der kan skabe et konstant vidensbaseret pres rettet mod at minimere industriens vandforbrug og -spild.

# WP 1: Real-time monitoring of water quality and equipment fouling

Leader: Frans van den Berg (FOOD.KU) ● Søren Balling Engelsen (professor) ● Klavs Martin Sørensen (post doc) ● Peter Bæk Skou (PhD student) ● Iuliana Madalina Stoica (PhD student) ● Bekzod Khakimov (post doc)



- Development of spectroscopic and chromatographic measurement methods which are able to ***fingerprint process water streams and biofilm formation*** on membranes and process equipment
- Establishment of a real-time monitoring system for control of process water, cleaning water and filters
- Adapt the principles behind Process Analytical Technology (PAT) to maximize reuse of process water and minimizing intake of potable water
- Advanced analytical and spectroscopic technologies (UV, NIR, IR, RAMAN, Fluorescence, GC-MS, ICP-OES, HSI) and testing of new analytical equipment and methods
- Chemometrics (multivariate data analysis; big data; dynamic modelling)

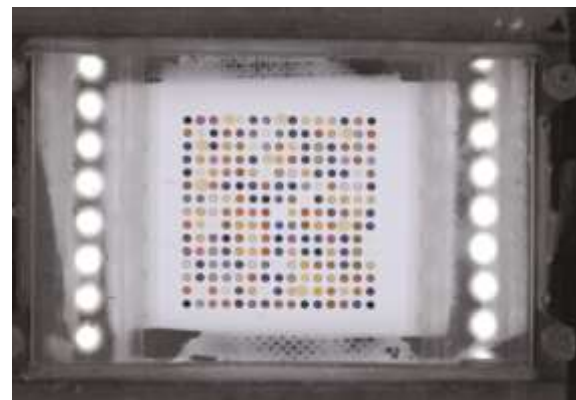


## WP 2: New Sensors for Water Quality Monitoring

Leader: Mogens H. Jakobsen (DTU.NANO) ● Basil Uthuppu (post doc) ● Master students



- Development of **new advanced nano-based sensors** which are sensitive enough to detect trace amounts of impurities in water
- Development of and implementation of new sensors based on *microfluidics* og *colorimetric arrays* which are designed to measure specific impurities in process water streams
- Colorimetric sensor arrays
- Modular microfluidic technology for SERS



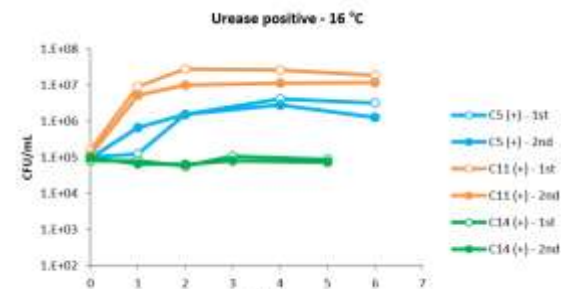
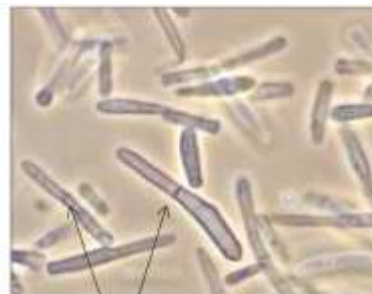


## WP 3: Microbial safety evaluation of process water

Leader: Susanne Knöchel (KU.FOOD) ● Stina Dissing Aunbjerg (post doc)



- Characterization of **microbial water quality** of selected industrial process water streams intended for use and reuse
- **Survival investigations** of bacterial indicators and pathogens in process water
- Development of on-line methods for process water quality characterization
- Microbial assessments – microbial growth potential of water streams
- Mathematical risk assessment models; conversion of on-line microbial measurements into on-line microbiological risk assessments at critical control points

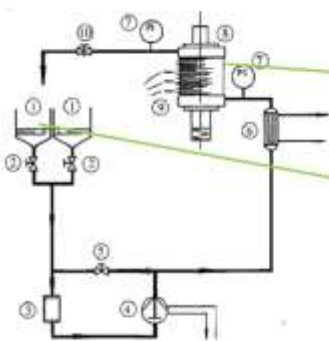


## WP 4: Design-space Modeling of Process and Cleaning Water

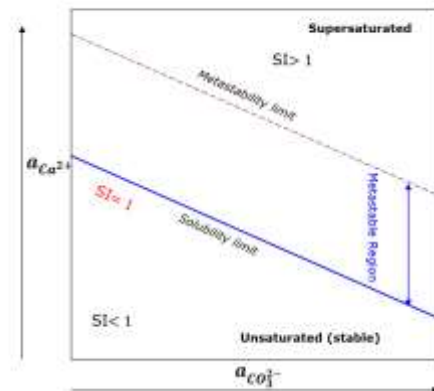
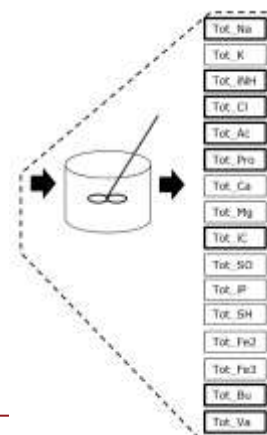
Leader: Krist Gernaey (DTU.PROCESS) ● Aleksandar Mitic (post doc) ● Xavier Flores Alsina (post doc)



- Design of suitable **in-line risk-based decision tools** for control of water quality in industry
- Characterization of **existing process parameters**
- Define **process design-spaces** in real production scale
- **Design space modelling** and **Quality by Design**
- Advanced (stochastic) analysis tools - Variation of process parameters will be propagated through mathematical models and related to the water's chemical and microbiological composition



1- feed tank, 2 - valve, 3 - filter, 4 - high pressure pump, 5- valve for recirculation control, 6 - heat exchanger, 7 - manometers, 8 - membrane module, 9 - permeate outlet, 10 - pressure control

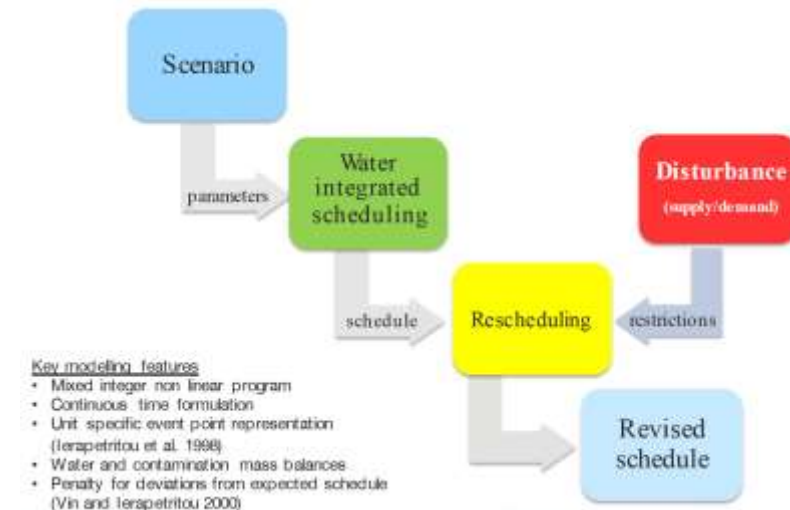


## WP 5: Water Supply Chain Management in food and bioprocessing industry

Leader: Renzo Akkerman (TUM) ● Jishna Pulluru (PhD student)



- Development **decision support tools** (prototypes) for water reduction and reuse based on the water detection and risk evaluation tools established.
- Develop tools and methods to **manage and control** the water reuse in the **supply chain**
- Both reduction and reuse of water resources will be investigated including (a) reuse **within the process**, (b) reuse **within the factory** (the closed factory), and (c) reuse within the supply chain, going **beyond the single factory**
- Supply chain management
- Focus on legislation and environmental requirements for reuse of process water





## OUTREACH

- **Chemical and bacteriological characterisation of the water streams**
- **On-line monitoring of the quality of the water streams**
- **More intelligent and safe reuse of these streams to save groundwater**
- *REWARD now fully staffed*
- *Application studies at Novozymes (Steen Skærbæk and Linnea Rudolfsson)*
- *Application studies at Arla Food Ingredients (Hans Henrik Holst and Dorrit Thaysen)*
- *Looking for good industrial case studies within **supply chain management***

