WATER USE EFFICIENCY FOR SUSTAINABLE FOOD MANUFACTURING

EPSRC CENTRE FOR INNOVATIVE MANUFACTURING IN Food

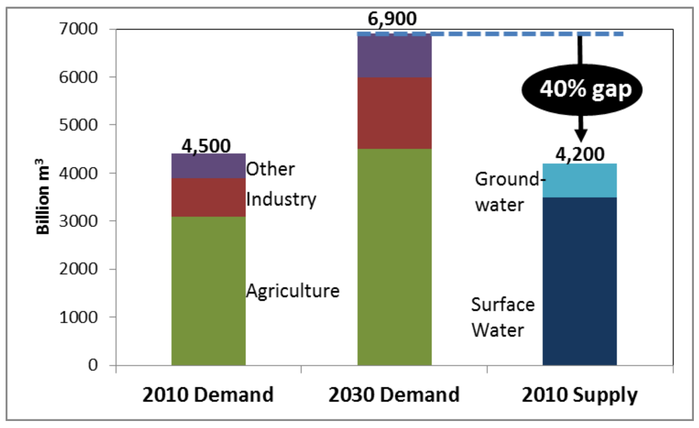
AIMS AND OBJECTIVES

The aim of water research in the Centre for SMART is to promote sustainable use of water in manufacturing, which has been treated by industry until recently as a superabundant resource. Initial work on categorisation of factory water use and water reduction strategies has highlighted a lack of detailed data on water usage. The objective of the current stage of the programme is to identify and prove minimally invasive techniques for water quantity and quality measurement at the unit process level, in particular for the food industry.

(1) GLOBAL PERSPECTIVE

Freshwater scarcity is likely to become a global issue to rival energy, as water requirements exceed local availability in more and more regions of the world. Global demand for freshwater is expected to increase to 6,900 billion m^3 in 2030. This is 40% above the water supplies currently available. Present demand from manufacturing industry accounts for 22% of global freshwater withdrawal, with food manufacturing being one of the largest users. Consequently manufacturing industry and the food sector in particular must become increasingly efficient users of water to ensure:

- Business resilience
- Reduction of future water supply costs
- Reduction of future effluent disposal costs
- Best practice in sustainable manufacture

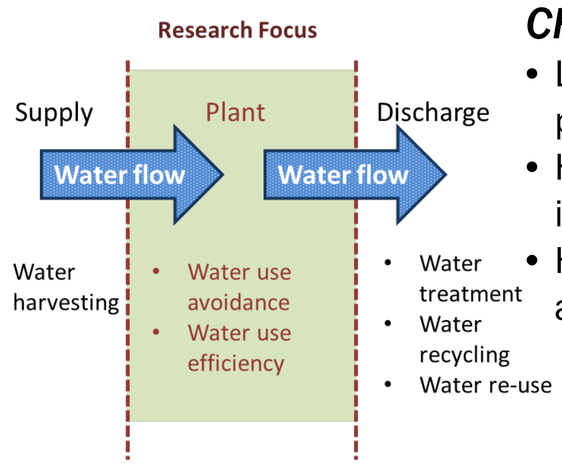


Predicted gap between water supply and consumption by 2030

(2) RESEARCH FOCUS

MANUFACTURING PLANT

The work focuses on water efficiency in the manufacturing plant itself. This area has been relatively neglected compared to supply side and discharge side measures, consequently there is unrealised potential for significant water efficiency improvements.



Water flow in manufacturing showing associated water efficiency measures and area of research focus

CHALLENGES

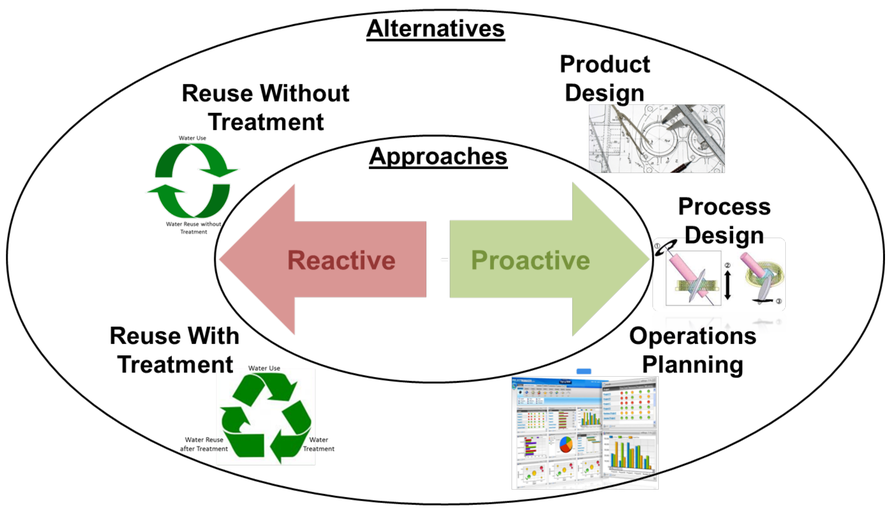
- Little data on water usage within plants
- Hygiene requirements limit instrumentation possibilities
- Highly dynamic water requirements across multiple time scales due to:
  - Batch manufacturing
  - High variety manufacturing
  - Highly variable scheduling

(3) APPROACH OF RESEARCH

WATER MINIMISATION METHODOLOGY

A methodology to minimise manufacturing water usage has been developed. The methodology centres around classification and description of the water flows in a production facility, identifying critical processes for intervention and conducting what-if modelling for water minimisation.

Proposed interventions can be divided into reactive and pro-active approaches. What-if modelling allows cost benefit evaluation of proposals if good data on existing water flows can be obtained.



Reactive and proactive approaches to water minimisation

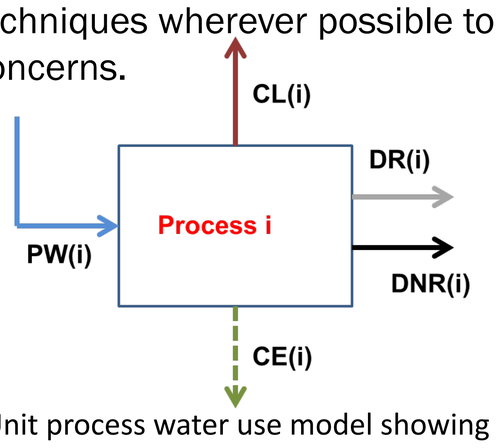
(4) CURRENT ACTIVITY

KEY REQUIREMENTS

For the methodology to be successful time resolved data on water flow quantity and quality is required at the **unit process level .** Currently available water data is typically aggregated across the plant and in time (e.g. monthly or quarterly statistics). Direct measurement of water flows is required to remedy the deficit.

INSTRUMENTATION STRATEGY

The current challenge being addressed is to define the most efficient and cost-effective instrumentation strategy for a given plant and production profile. A key issue is to use non-invasive techniques wherever possible to address hygiene and food safety concerns.



Unit process water use model showing flow variables requiring quantification

Image courtesy of Buchi GmbH

Near infrared spectroscopy is a candidate technique for non –invasive in-line water quality monitoring

BENEFITS

In addition to enabling water efficiency improvements, better data on and control of water using processes can lead to near term spin-off benefits including process improvements, better quality control, reduced energy consumption and reduced legislative compliance and reputational risks.

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