



Introduction

Biofouling is a large problem in environmental membrane separation processes for several reasons: it leads to higher operating pressures, frequent need for chemical cleanings, membrane deterioration, and compromised water quality. Biofouling is more complicated than other membrane fouling types e.g. non microbial colloidal and particulate fouling, which can be controlled by effective pre-treatment. Microorganisms can reproduce on the membrane even if their numbers in the water is reduced by pre-treatment.

Importance

Biofouling mitigation and control is a necessity for sustainable operation of membrane processes in drinking water treatment. Both reduction of fouling development and membrane cleaning are central elements. Understanding biofouling behaviour and responses will enable choice of optimal operating conditions, e.g. flux rates, cleaning protocols, backwashing strategies. The conventional approach for membrane fouling monitoring is the use of normalised pressure development (NPD). It is assumed that cleaning can be more efficient when biofouling is in an early stage of colonisation. NPD is not specific for biofouling or sensitive.

Approach

We will develop a toolbox that can be used to understand and predict the behaviour of membrane filtration reactors when exposed to different conditions, i.e. how measured variables are related to controlled variables, in order to control biofouling processes. To obtain this objective, a protocol has been developed for characterisation of biofouling in drinking water treatment, by use of sacrificial membranes in an at-line/by pass test unit.

Result

An at-line/bypass test unit has been constructed and operated for more than one year. A protocol has been developed for identification and quantification of important biofoulant components such as polysaccharides and cells by confocal laser scanning microscopy (CLSM) analysis, and for fluorometric enzyme activity assays to assess active biomass. Procedures for sampling, staining of biofouling components, CLSM and enzyme activity measurements have been established. The software CMem developed in the project enables a refined analysis of different components on curved surfaces, applicable to tubular/hollow fibre membranes.

More information

Full details on this deliverable can be found under D3.3.4. Further information can be requested from:

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TECHNEAU Knowledge Integrator (TKI) categorisation

Categorisation of Knowledge Packages

Categorisation (i.e. classification, contains and constraints) of knowledge packages (KPs) can be carried out by 'checking' the appropriate boxes in the attached tables. For example, for a KP investigating point-of-use treatment suitable for a developing world country, the following might be checked:

Classification: Process chain – Tap (Customer) – Point-of-use (POU).

Contains: Report; Literature review.

Constraints: Low cost; Simple technology; No/low skill requirement; No/low energy requirement; No/low chemical requirement; No/low sludge production; Developing world location.

Note that only the lowest level classification needs to be checked, e.g. Point-of-use (POU) in the above example.

Meta data can be included under the 'More Information' section of the Executive Summary Report, i.e. Author(s), Organisation(s), Contact details (name and email), Quality controller (name and organisation) and Date prepared. (The TKI administrator can enter Source (= TECHNEAU), Date submitted (TKI) and Date revised (TKI)).

TKI Categorisation

Classification					
Supply Chain	Process Chain	Process Chain (cont'd)	Water Quality	Water Quantity (cont'd)	
Source	Raw water storage	Sludge treatment	Legislation/regulation	- Leakage	
- Catchment	- Supply reservoir	- Settlement	- Raw water (source)	- Recycle	
- Groundwater	- Bankside storage	- Thickening	- Treated water	x	
- Surface water	Pretreatment	- Dewatering	Chemical		
- Spring water	- Screening	- Disposal	- Organic compounds		
- Storm water	- Microstraining	Chemical dosing	- Inorganic compounds		
- Brackish/seawater	Primary treatment	- pH adjustment	- Disinfection by-products		
- Wastewater	- Sedimentation	- Coagulant	- Corrosion		
Raw water storage	- Rapid filtration	- Polyelectrolyte	- Scaling		
- Supply reservoir	- Slow sand filtration	- Disinfectant	- Chlorine decay		
- Bankside storage	- Bank filtration	- Lead/plumbosolvency	Microbiological		
Water treatment	- Dune infiltration	Control/instrumentation	- Viruses	Consumers / Risk	
- Pretreatment	Secondary treatment	- Flow	- Parasites		
- Primary treatment	- Coagulation/flocculation	- Pressure	- Bacteria	x	Trust
- Secondary treatment	- Sedimentation	- pH	- Fungi		- In water safety/quality
- Sludge treatment	- Filtration	- Chlorine	Aesthetic		- In security of supply
Treated water storage	- Dissolved air flotation(DAF)	- Dosing	- Hardness / alkalinity		- In suppliers
- Service reservoir	- Ion exchange	- Telemetry	- pH		- In regulations and regulators
Distribution	- Membrane treatment	x Analysis	- Turbidity		Willingness-to-pay/acceptance
- Pumps	- Adsorption	- Chemical	- Colour		- For safety
- Supply pipe / main	- Disinfection	- Microbiological	- Taste	x	- For improved taste/odour
Tap (Customer)	- Dechlorination	- Physical	- Odour	x	- For infrastructure
- Supply (service) pipe	Treated water storage				- For security of supply

- Internal plumbing		- Service reservoir			Water Quantity	Risk Communication
- Internal storage		Distribution				- Communication strategies
		- Disinfection			Source	- Potential pitfalls
		- Lead/plumbosolvency			- Source management	- Proven techniques
		- Manganese control			- Alternative source(s)	
		- Biofilm control			Management	
		Tap (Customer)			- Water balance	
		- Point-of-entry (POE)			- Demand/supply trend(s)	
		- Point-of-use (POU)			- Demand reduction	

TKI Categorisation (continued)

Contains		Constraints		Meta data			
Report	x	Low cost		<i>Author(s)</i>	Liv Fiksdal, Astrid Bjørkøy		
Database		Simple technology		<i>Organisation(s)</i>	NTNU		
Spreadsheet		No/low skill requirement		<i>Contact name</i>	Liv Fiksdal		
Model		No/low energy requirement		<i>Contact email</i>	liv.fiksdal@ntnu.no		
Research	x	No/low chemical requirement		<i>Quality controller name</i>			
Literature review		No/low sludge production		<i>Quality controller/organisation</i>			
Trend analysis		Rural location		<i>Source</i>			
Case study / demonstration		Developing world location		<i>Date prepared</i>	30-06-2007		
Financial / organisational				<i>Date submitted (TKI)</i>	10-07-2007		
Methodology	x			<i>Date revised (TKI)</i>			
Legislation / regulation							
Benchmarking							