Determination of microbial total cell concentrations in drinking water with FCM

Introduction

Assimilable organic carbon (AOC) is a collective term describing the fraction of labile, dissolved organic carbon (DOC) that is readily assimilated by microorganisms, resulting in growth. AOC is linked to bacterial regrowth and biological stability of drinking water, and hence, the ability to measure AOC accurately and fast would be of great benefit to drinking water distributors and researchers alike.

Approach

We have developed and standardised a method for measuring AOC, based on batch growth of a natural microbial community at 30 °C, coupled with fluorescent staining and flow cytometry for enumeration of grown cells. The aim was to have a method which is fast, reproducible and which measures all the AOC in a sample accurately.

Result

The Eawag method requires 24 -48 h for measurement of AOC, which renders is faster than most methods currently available. The rapid time period is predominantly due to the use of elevated incubation temperatures (30 °C). The use of fluorescent staining and flow cytometry allows for rapid and accurate enumeration of the growth of the natural microbial community. This in turns allows for large sample numbers to be processed together. The method has an average error below 10 % and a bottom detection limit of about 10 ug AOC/L. This method has already been tested extensively on full scale and pilot scale drinking water treatment and distribution systems.

More information

Full details on this deliverable can be found under D3.3.1. 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	x	- Settlement		- Raw water (source)		- Recycle	
- Groundwater	x	- Bankside storage	x	- Thickening		- Treated water	x		
- Surface water	x	**Pretreatment**		- Dewatering		**Chemical**			
- Spring water	x	- Screening		- Disposal		- Organic compounds	x		
- Storm water		- Microstraining		**Chemical dosing**		- Inorganic compounds			
- Brackish/seawater		**Primary treatment**		- pH adjustment		- Disinfection by-products	x		
- Wastewater		- Sedimentation		- Coagulant		- Corrosion			
Raw water storage		- Rapid filtration	x	- Polyelectrolyte		- Scaling			
- Supply reservoir	x	- Slow sand filtration	x	- Disinfectant		- Chlorine decay			
- Bankside storage	x	- Bank filtration	x	- Lead/plumbosolvency		**Microbiological**			
Water treatment		- Dune infiltration	x	**Control/instrumentation**		- Viruses		**Consumers / Risk**	
- Pretreatment	x	**Secondary treatment**		- Flow		- Parasites			
- Primary treatment	x	- Coagulation/flocculation		- Pressure		- Bacteria	x	**Trust**	
- Secondary treatment	x	- Sedimentation		- pH		- Fungi		- In water safety/quality	x
- Sludge treatment		- Filtration	x	- Chlorine		**Aesthetic**		- In security of supply	x
Treated water storage		- Dissolved air flotation(DAF)		- Dosing		- Hardness / alkalinity		- In suppliers	x
- Service reservoir		- Ion exchange		- Telemetry		- pH		- In regulations and regulators	
Distribution		- Membrane treatment	x	**Analysis**		- Turbidity		**Willingness-to-pay/acceptance**	
- Pumps		- Adsorption		- Chemical	x	- Colour		- For safety	
- Supply pipe / main		- Disinfection	x	- Microbiological	x	- Taste		- For improved taste/odour	
Tap (Customer)		- Dechlorination	x	- Physical		- Odour		- For infrastructure	
- Supply (service) pipe	x	**Treated water storage**						- For security of supply	

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

TKI Categorisation (continued)

Contains		**Constraints**		**Meta data**					
Report	x	Low cost		*Author(s)*		Frederik Hammes			
Database		Simple technology		*Organisation(s)*		EAWAG			
Spreadsheet		No/low skill requirement		*Contact name*		Frederik Hammes			
Model		No/low energy requirement		*Contact email*		Frederik.hammes@eawag.ch			
Research	x	No/low chemical requirement		*Quality controller name*					
Literature review		No/low sludge production		*Quality controlerl organisation*					
Trend analysis		Rural location		Source					
Case study / demonstration		Developing world location		*Date prepared*		26-06-2007			
Financial / organisational				Date submitted (TKI)		28-06-2007			
Methodology	x			Date revised (TKI)					
Legislation / regulation									
Benchmarking									