



# Hvorfor er vi bekymret for biofilmdannelse i ledningsnett?

Lars J. Hem  
VAV/NMBU



# Biofilm formation



# Why focus on biofilm in distribution systems

- ▶ Survival and growth of pathogens
- ▶ Water quality deterioration (turbidity, plate count)

# Case study: Biofilm monitoring in Oslo

# Sampling points

- ▶ Raw water
- ▶ Filtered water (coagulation + sedimentation + filtration)
- ▶ Treated water (coagulation + sedimentation + filtration + UV-disinfection + pH adjustment)
- ▶ Furulund basin (2.5 h in distribution)
- ▶ Havnabakken pumping station (one day in distribution)

# Methodology

- ▶ BDOC
- ▶ BFP/BFR (ATP as parameter)
- ▶ Moulds
- ▶ Total no of bacteria
- ▶ Opportunistic pathogenic bacteria

# Sampling

Glass coupons in an acrylic pipe

Constant water flow

Sampling every 14<sup>th</sup> day in  
5.5 months for ATP  
measurement

Sampling for micro-biological  
analysis after 5.5 months

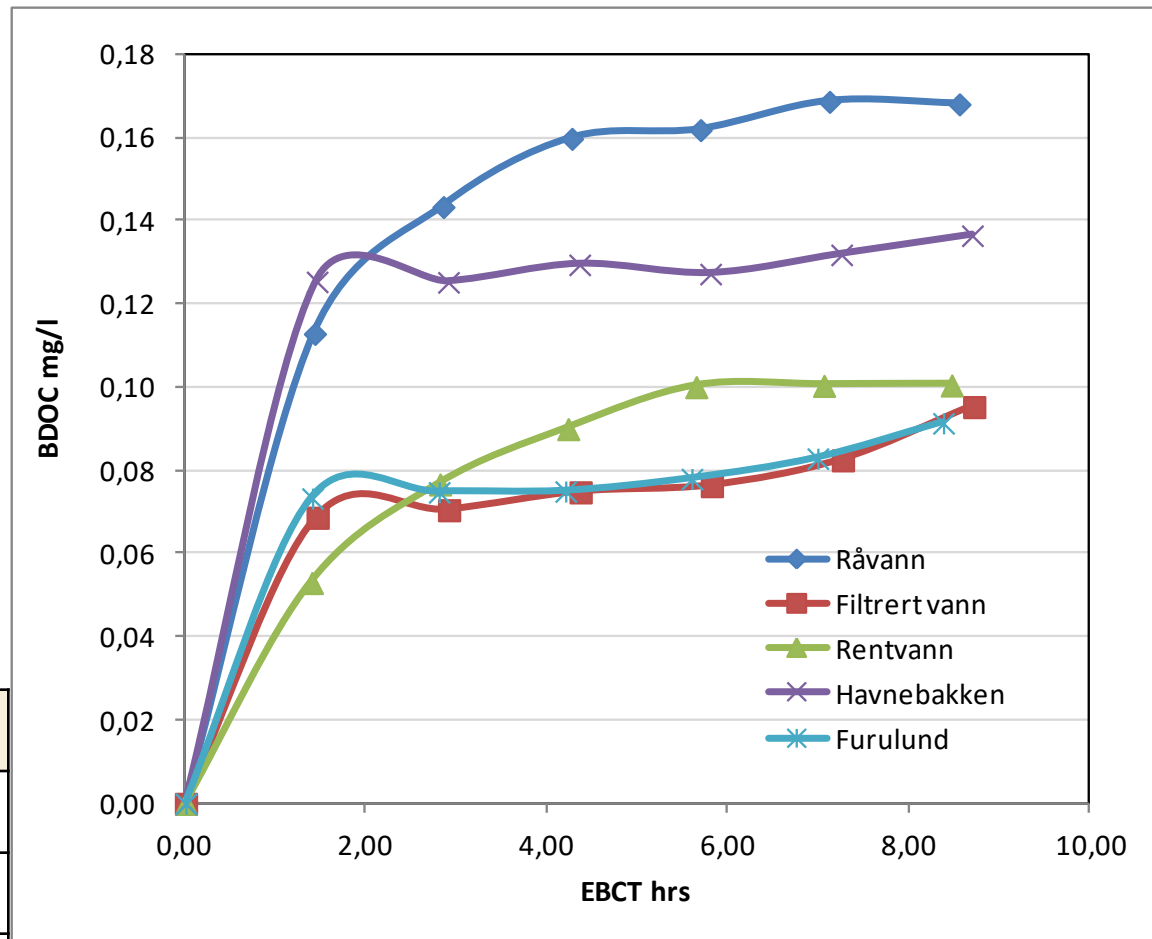




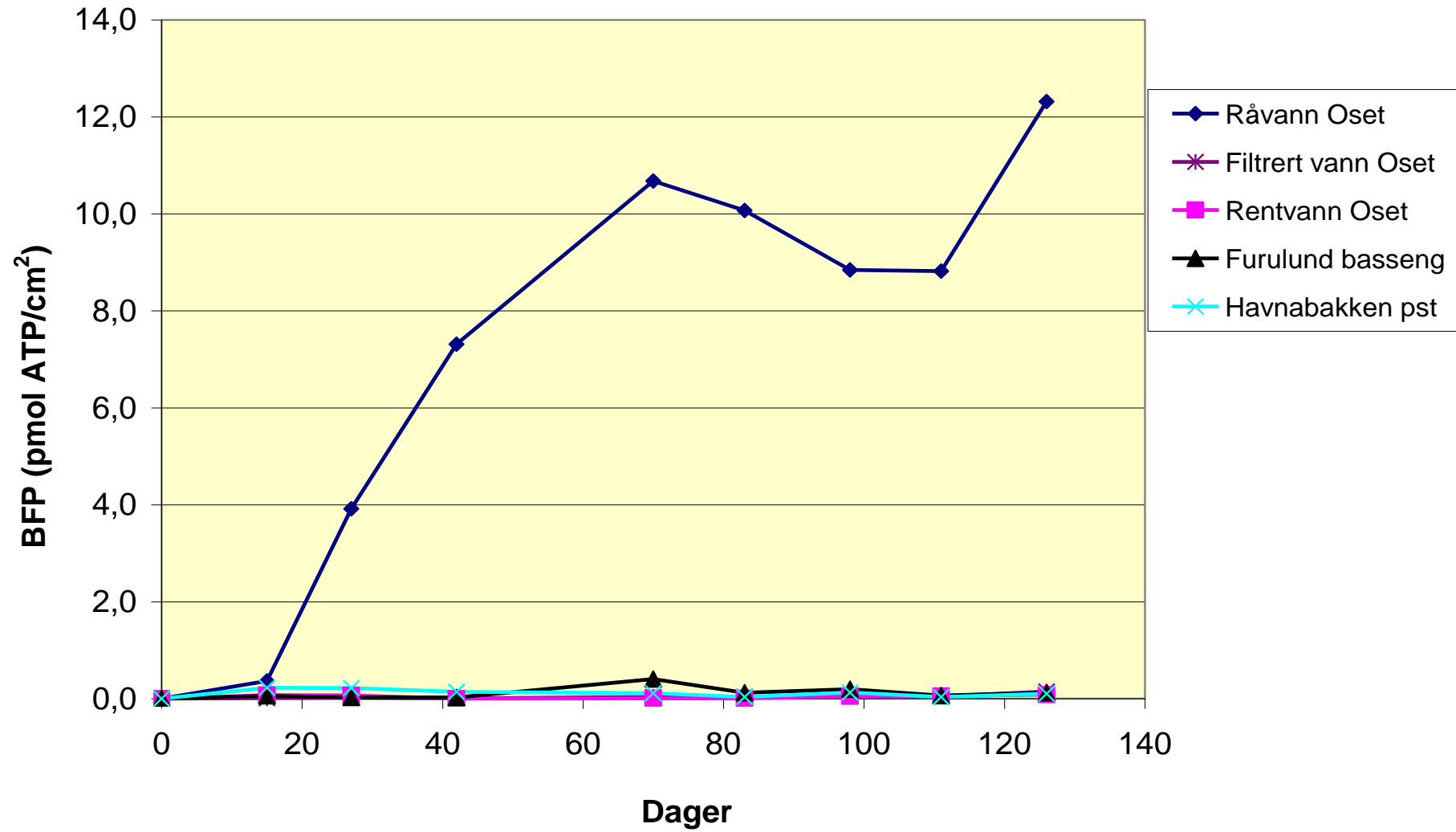


# BDOC

Prøvepunkt	BDOC (mg/L)
Raw water	0.17
Filtered vann	0.10
Treated water	0.10
Furulund	0.09
Havnabakken	0.14



# BFP



# Biofilm formation

<b>Sampling point</b>	<b>BFP(pmol ATP/cm<sup>2</sup>)</b>	<b>BFR (pmol ATP/cm<sup>2</sup>*d)</b>
Raw water	12.3	0.30
Filtered water	0.14	0.006
Treated water	0.09	0.005
Furulund	0.40	0.013
Havnabakken	0.22	0.015



# Moulds

	No of colonies		
	A	B	C
Raw water	Excessive growth <i>Trichoderma</i> sp. + 1 Mucorales	Excessive growth <i>Trichoderma</i> sp.	Excessive growth <i>Trichoderma</i> sp.
Filtered water	1 <i>Cladosporium</i> sp.	1 <i>Trichoderma</i> sp.	No growth
Treated water	No growth	No growth	No growth
Furulund	No growth	No growth	No growth
Havnabakken	No growth	1 <i>Cladosporium</i> sp.	No growth

# Total no of bacteria (celler/cm<sup>2</sup>)

	<b>FISH (prober and DAPI)</b>
Raw water	$7.5 \times 10^6 - 1.7 \times 10^7$
Filtered water	$2.4 \times 10^5 - 2.7 \times 10^5$
Treated water	$1.5 \times 10^4 - 4.1 \times 10^4$
Furulund	$9.0 \times 10^4 - 1.4 \times 10^5$
Havnabakken	$2.7 \times 10^4 - 4.1 \times 10^4$

# Opportunistic pathogenic bacteria and indicators

	Cells/cm <sup>2</sup> biofilm					
	Presumptive <i>Pseudomonas</i>	Presumptive <i>Legionella</i>	Confirmed <i>Legionella</i>	Presumptive <i>Aeromonas</i>	Coliforms	<i>E. coli</i>
<b>Raw water</b>	30	114	-	6	21	0.1
<b>Filtered water</b>	<1	43	15	<1	<0.1	<0.1
<b>Treated water</b>	<1	<1	<1	<1	<0.1	<0.1
<b>Furulund</b>	<1	28	18	<1	<0.1	<0.1
<b>Havnabakken</b>	<1	47	27	<1	<0.1	<0.1

# Why focus on biofilm formation

