



# INTERREC Kick-off (20.06.2006)

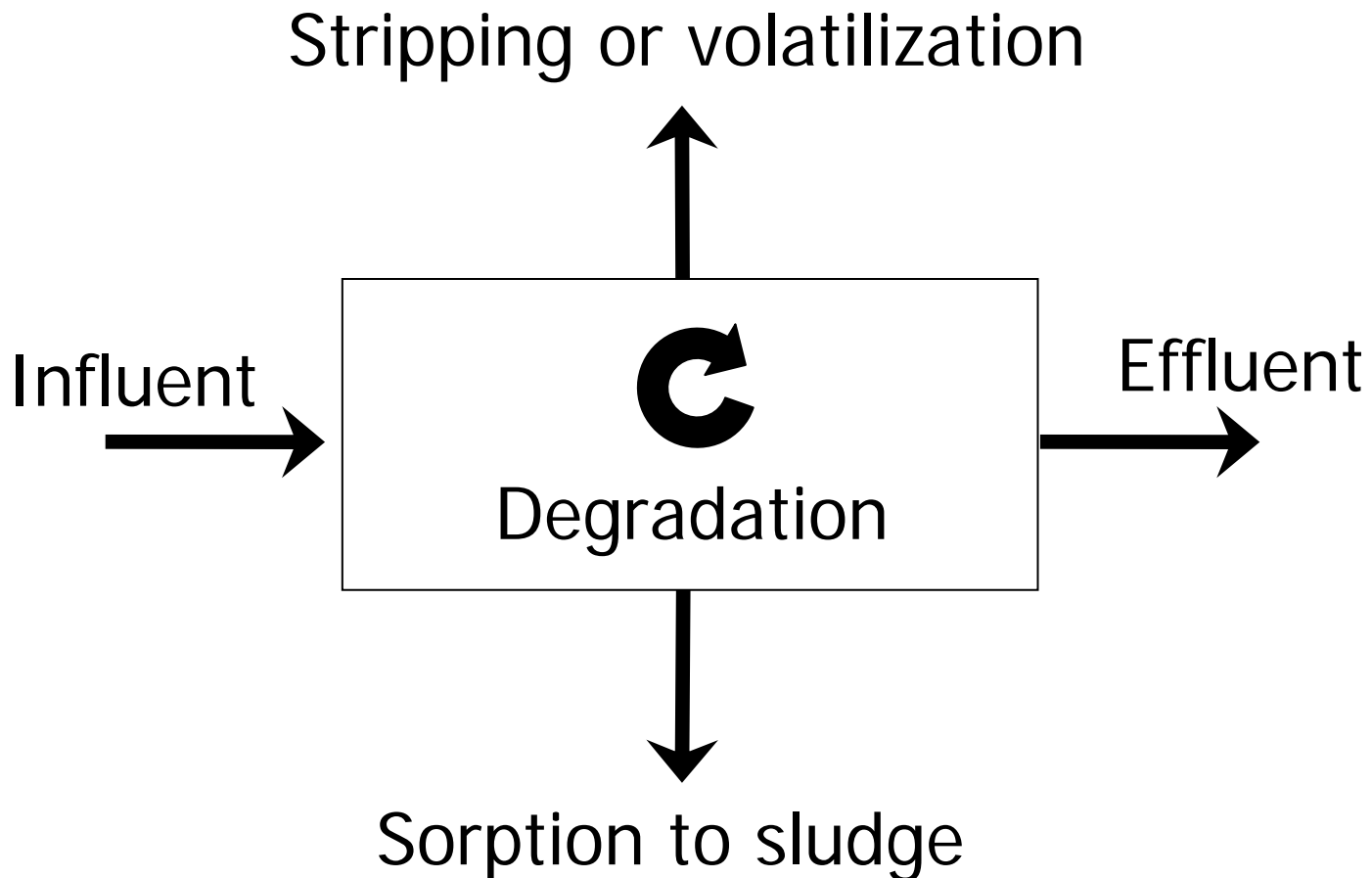
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# Fate of XOCs in WWTPs

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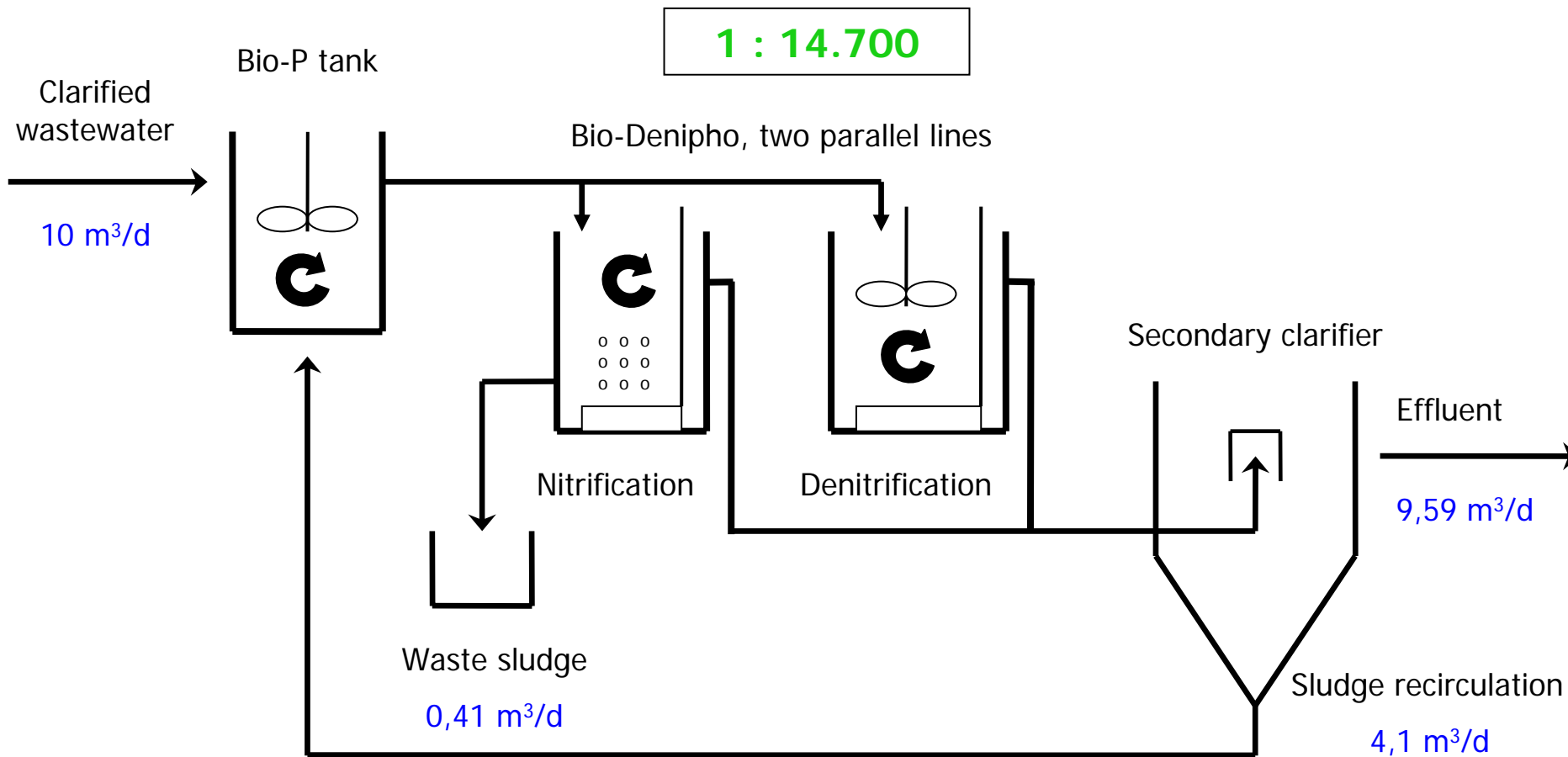


# Project purposes

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- To investigate, optimize, and model the biodegradation of XOCs in WWTPs
- To integrate the models in existing WWTP models

# Process diagram





# Pilot plant data

Flow		10 m <sup>3</sup> /d
Solid retention time (SRT)		20 days
Hydraulic retention time (HRT)		1,5 days
Volume	Bio-P tank	1,7 m <sup>3</sup>
	Bio-N tank 1	5,1 m <sup>3</sup>
	Bio-N tank 2	5,1 m <sup>3</sup>
	Secondary clarifier	3,7 m <sup>3</sup>
	Total	15,6 m <sup>3</sup>



# Analytical quality assurance

- External quality assurance (Eurofins as reference lab)
- Standard addition, variability, and reproducibility
- **DL:** NP/BPA 0,2/0,6 µg/l     **QL:** NP/BPA 0,6/1,7 µg/l

	Nonylphenol	Bisphenol A
Tap water	+	+
Influent	+	+
Effluent	+	+
Sludge	(+)	+



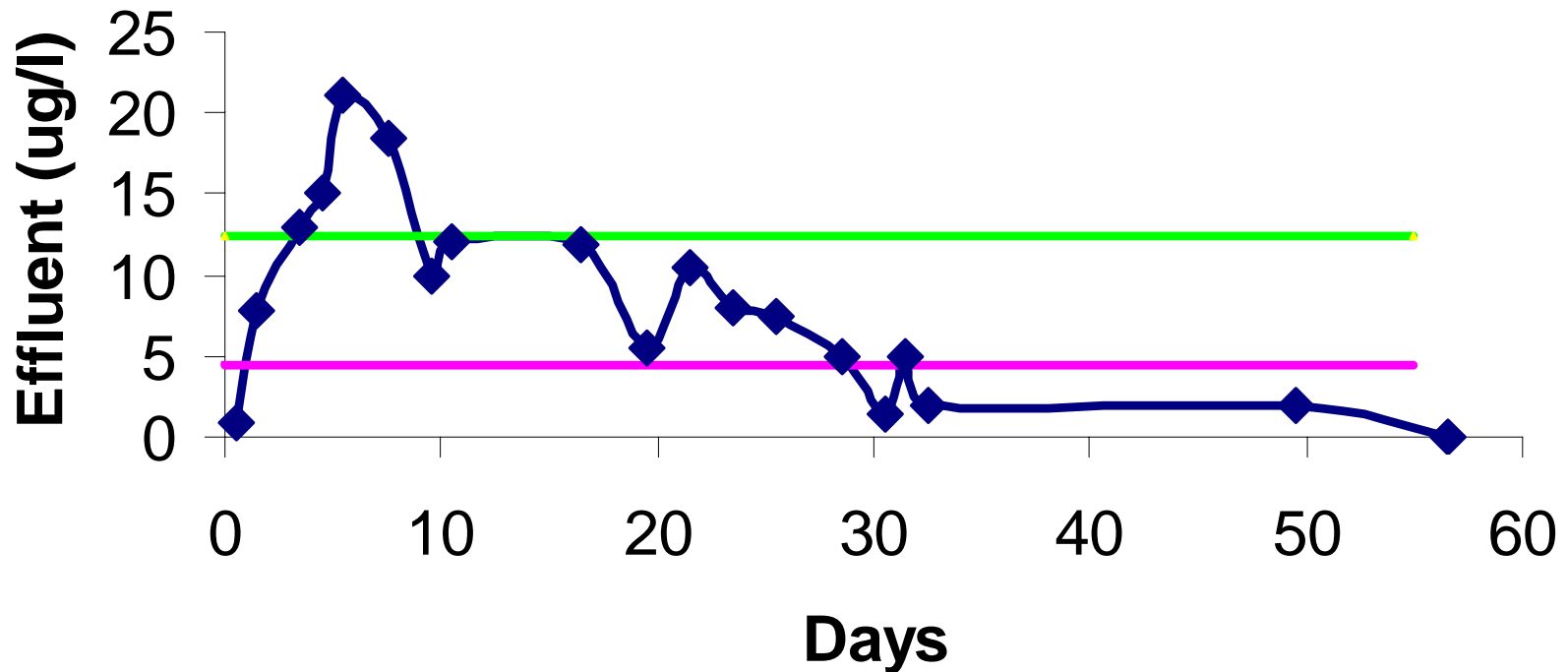
# Experiments: Summer 2005

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- 14.06-22.08: Step experiment  
Addition of 1 mg NP and BPA per litre to Bio-P influent
- Auto-sampler: Every 25 min.
- Grab-samples: 7.30, 11.00, and 14.30

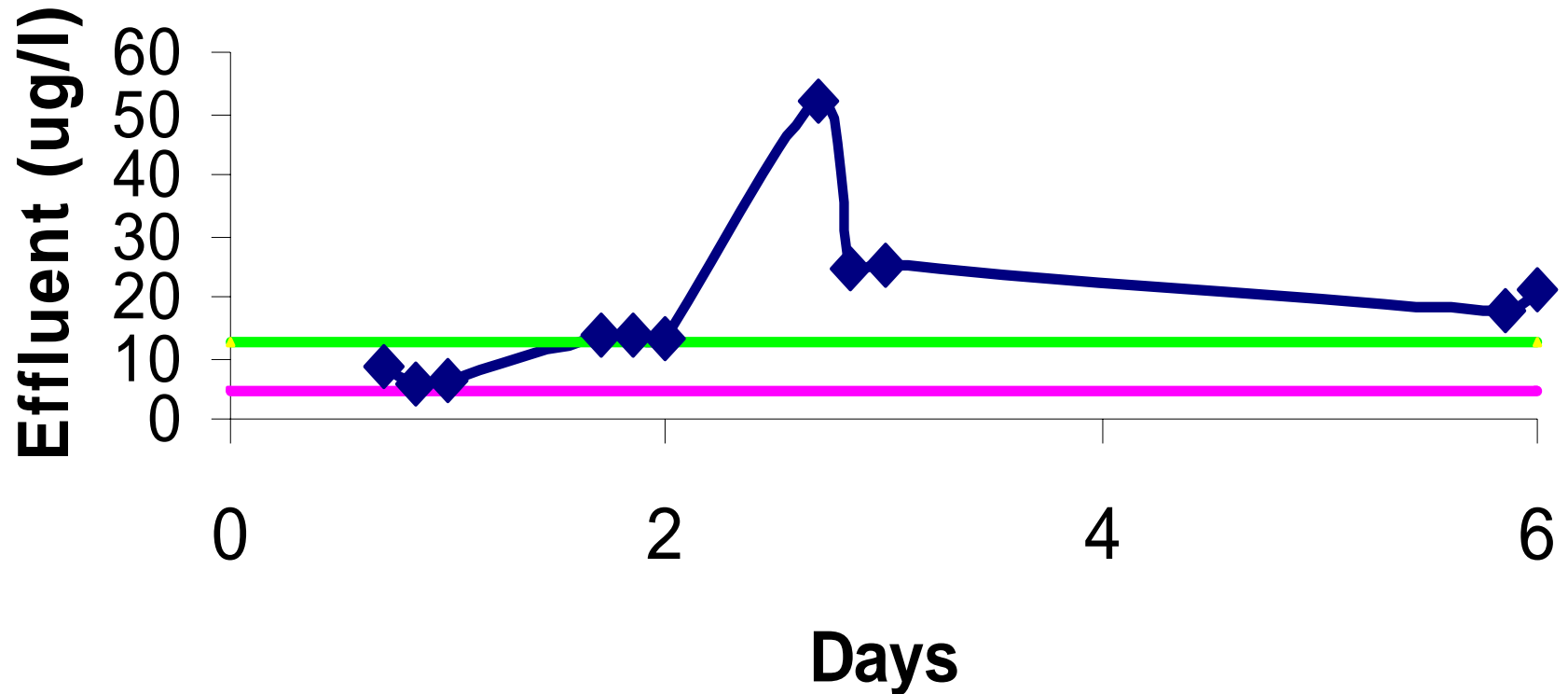
# Results: NP, auto-sampler

## Addition of 1 mg NP per litre



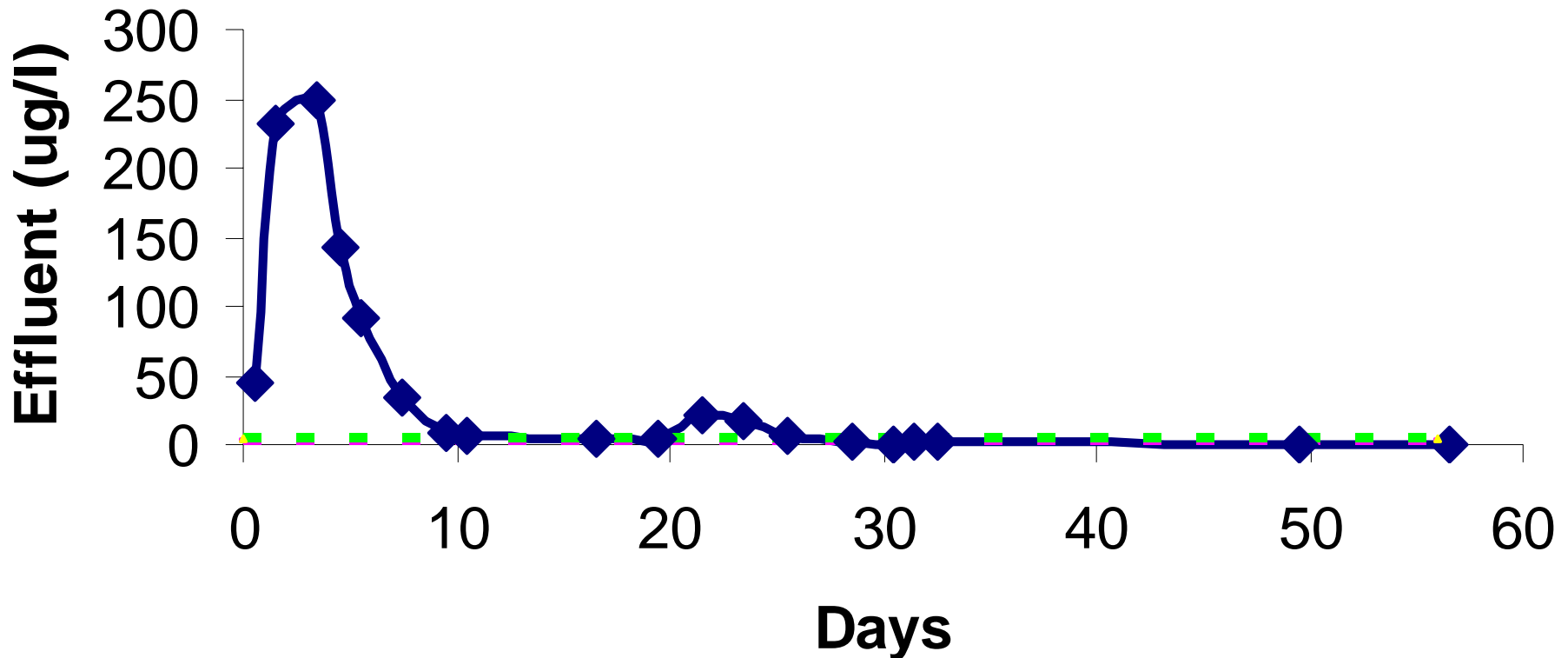
# Results: NP, grab samples

## Addition of 1 mg NP per litre



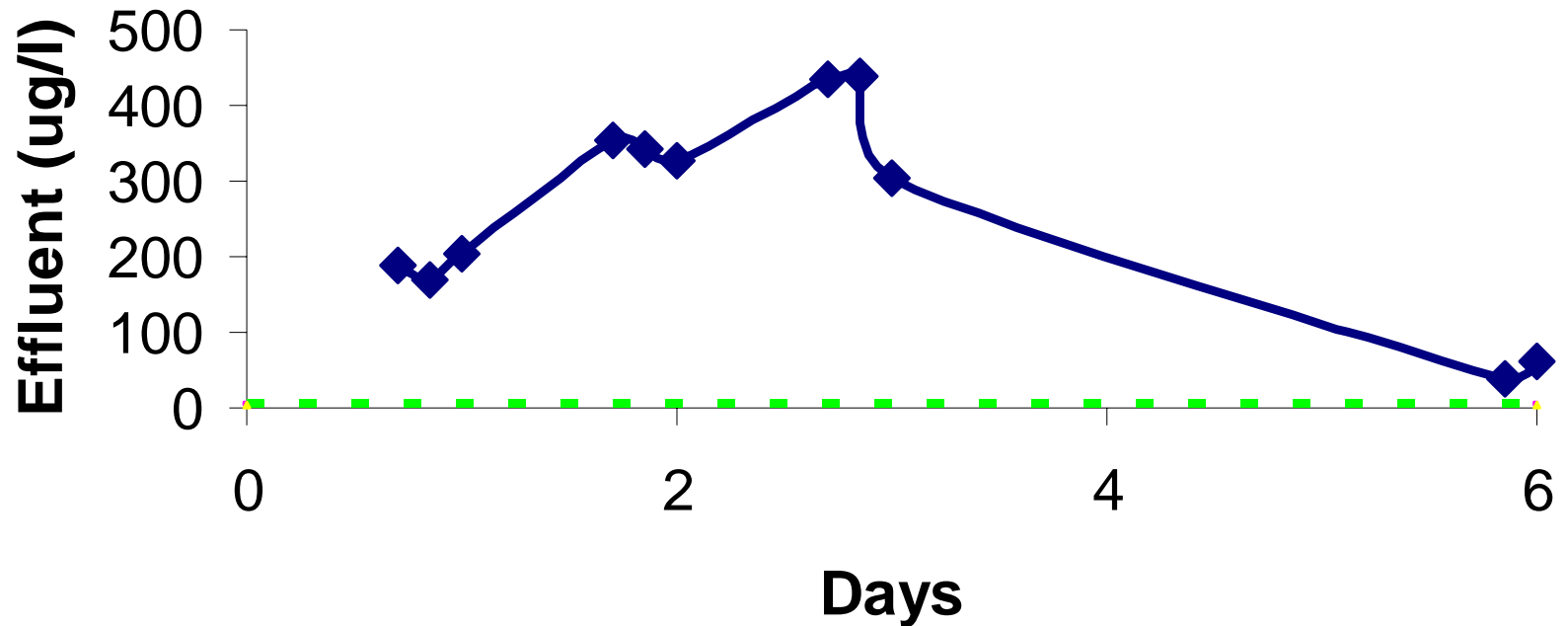
# Results: BPA, auto-sampler

## Addition of 1 mg BPA per litre



# Results: BPA, grab samples

## Addition of 1 mg BPA per litre





# Conclusions: Summer 2005

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- The break-through curve peaked after 2-3 days and were quickest observed and most significant for BPA
- BPA and NP in the effluent reached the background mean effluent concentration after respectively 10 and 20 days
- The decrease in concentrations illustrates biodegradation



# Christmas experiment 27.12.06

- Addition: 1,25 mg HRT: 1,3 day Q = 12 m<sup>3</sup>/d

µg/l	Influent	After add.*	Bio-P eff.
NP (SD)	<b>6,6</b> (1,9)	<b>942</b>	<b>436</b> (97)
BPA (SD)	<b>15,9</b> (5,2)	<b>922</b>	<b>477,5</b> (21,4)

µg/l	Bio-N nit.	Effluent	Recirc.
NP (SD)	<b>141</b> (45)	<b>5,6</b> (1,7)	<b>187,5</b> (93)
BPA (SD)	<b>94,5</b> (8,5)	<b>1,3</b> (0,2)	<b>118</b> (39)



## 27.12: Fate of NP in 24 hours

- Assumption: Surplus sludge contains  $< 141 \mu\text{g/l}$

mg/d	Influent	Addition	Total	
Input	79	15.000	15.079	<b>Degradated</b>
	Effluent	Sludge	Total	<b>&gt; 14.943</b>
Output	67	$< 69$	$< 136$	<b>&gt; 99,1 %</b>
	0,45 %	$< 0,45 \%$	$< 0,9 \%$	



## 27.12: Fate of BPA in 24 hours

- Assumption: Surplus sludge contains  $< 94,5 \mu\text{g/l}$

	Influent	Addition	Total	
Input	191	15.000	15.191	<b>Degradated</b>
	Effluent	Sludge	Total	<b><math>&gt; 15.128</math></b>
Output	16,5	$< 46,5$	$< 63$	<b><math>&gt; 99,6 \%</math></b>
	0,1 %	$< 0,3 \%$	$< 0,4 \%$	



## 27.12: Distribution of BPA

- BPA concentration in the water phase remains constant – the opposite seems to be the case in the solid phase – biodegradation ?

	Water ( $\mu\text{g/l}$ )	Water (%)	Solid ( $\mu\text{g/kg DW}$ )	Solid (%)	Total ( $\mu\text{g/l}$ )
Bio-P	226	47	51.800	54	477,5
Bio-N (1-5)	51	53,5	8.300	44	94,5
Bio-N (6-10)	47,5	54,5	7.600	43,5	87
Bio-N (11-14)	47,5	60,5	5.800	37	78



# Further experiments

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- Batch experiments with unadapted biomass (12 h)
- Break-through experiments with unadapted biomass
- Batch experiments with adapted biomass (12 h)
- Decreased solid retention time (SRT = 13,5 days)
- Batch experiments with adapted biomass (12 h)
- Changes in order and duration of redox periods
- Drugs in co-operation with DFU