

WLRD Science Seminar - May 25th 2004

Metals Removal in the Membrane Bioreactor Wastewater Treatment Process

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Presentation Outline

- **“Motivation” for metals analysis in membrane bioreactor (MBR)**
- **Pilot MBR process configuration**
- **Pilot MBR metals data evaluation**
- **Summary**
- **Further work**

Motivation for MBR Pilot Metals Analysis

Effluent Quality

Evaluation of Reuse Options

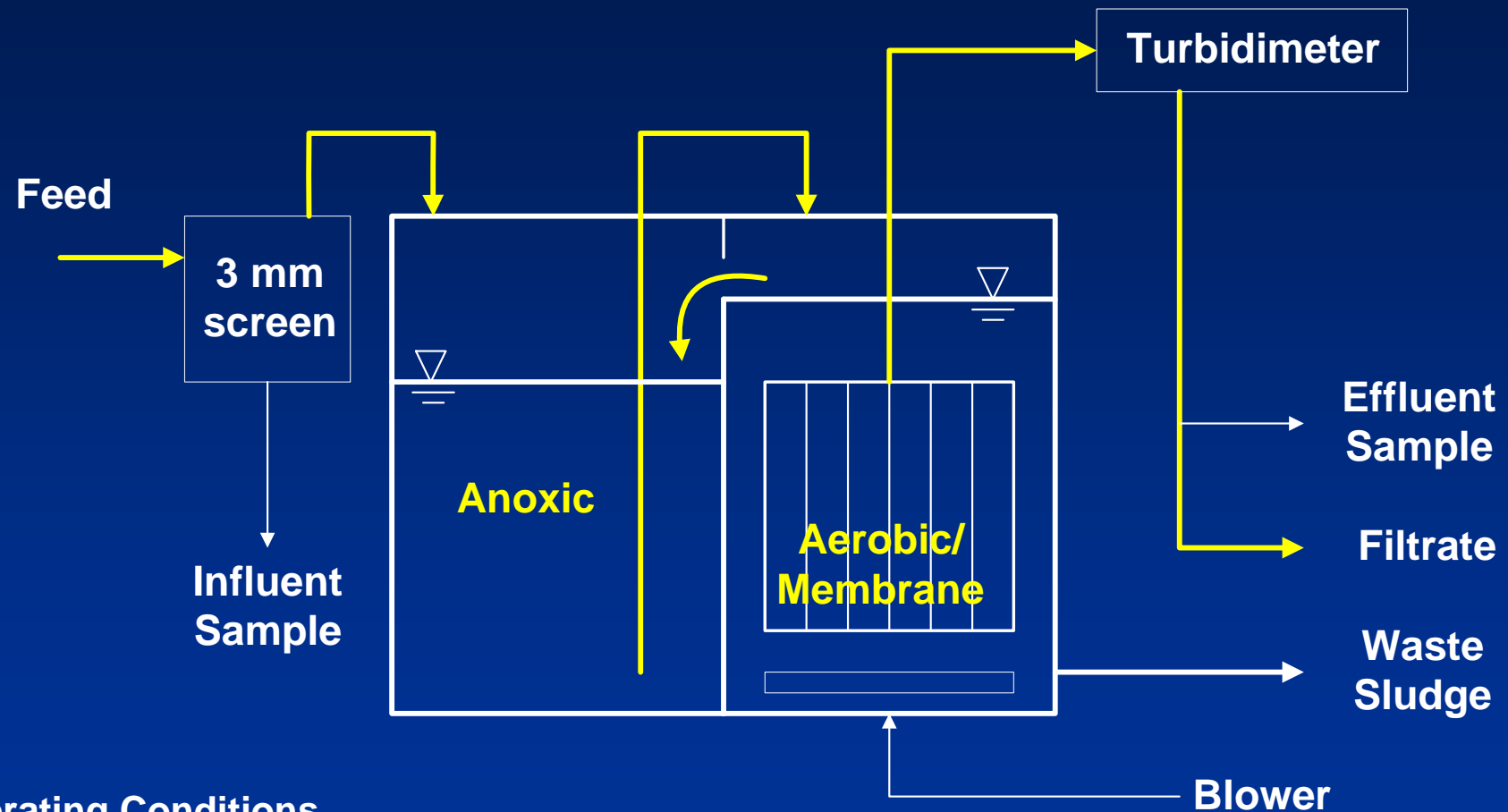
Removal Efficiency

*Evaluation of MBR Process
Impact on Biosolids Quality*

Effluent Quality / Removal Efficiency / Fate

*Evaluation of MBR Process
Comparison to CAS Process
Impact on Biosolids Quality
Impact of MBR SRT on Metal Removal*

Enviroquip MBR Pilot Plant



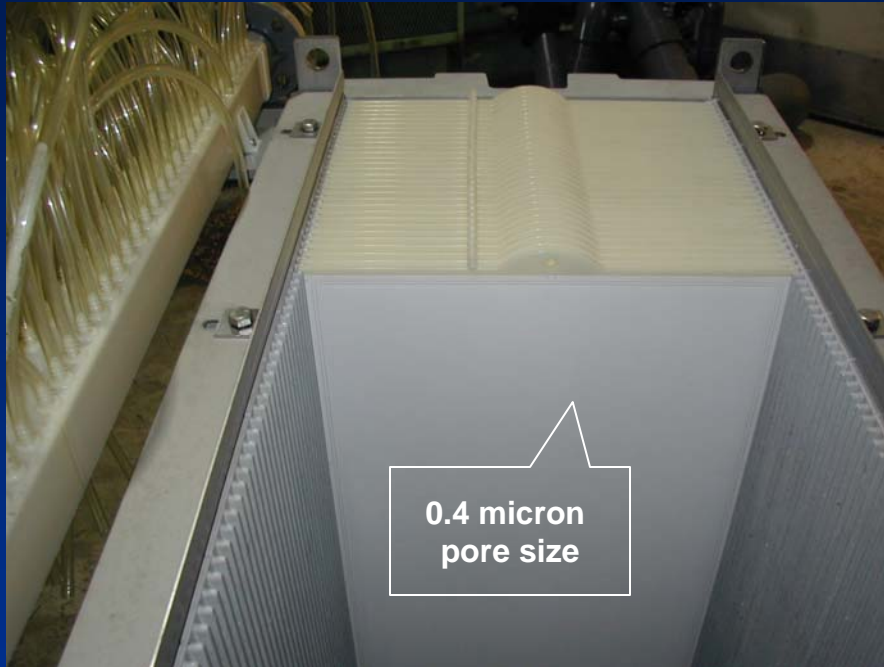
Operating Conditions

HRT = 6 hrs

SRT = 18 - 50 days

MLSS = 8,000 - 15,000 mg/L

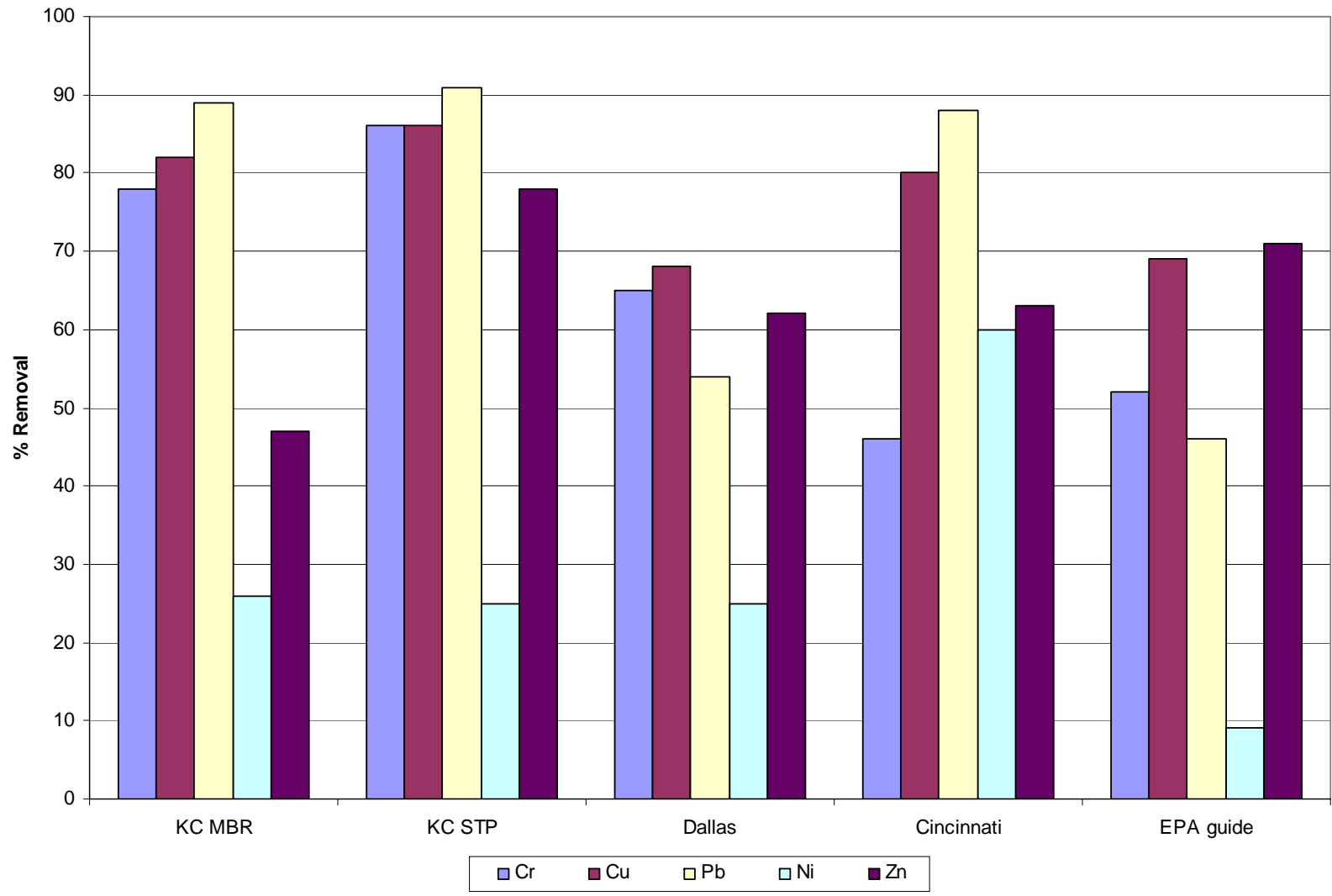
Membrane Plates



Test Methodology

- **Pilot Sample Locations**
 - influent
 - effluent
 - mixed liquor
- **Sample Frequency**
 - monthly
- **Sample Type**
 - grab
- **Metals Analysis**
 - Environmental Laboratory Routines
(06-02-004, 06-03-004, and 06-01-004)
- **Sample Planning Assumptions**
 - influent metal variability during sample period
 - grab sampling versus 24-hr composite

Pilot MBR Metal Removal Efficiency



Data Source: Petrasek et al, 1983

Pilot MBR Influent Metal Concentrations

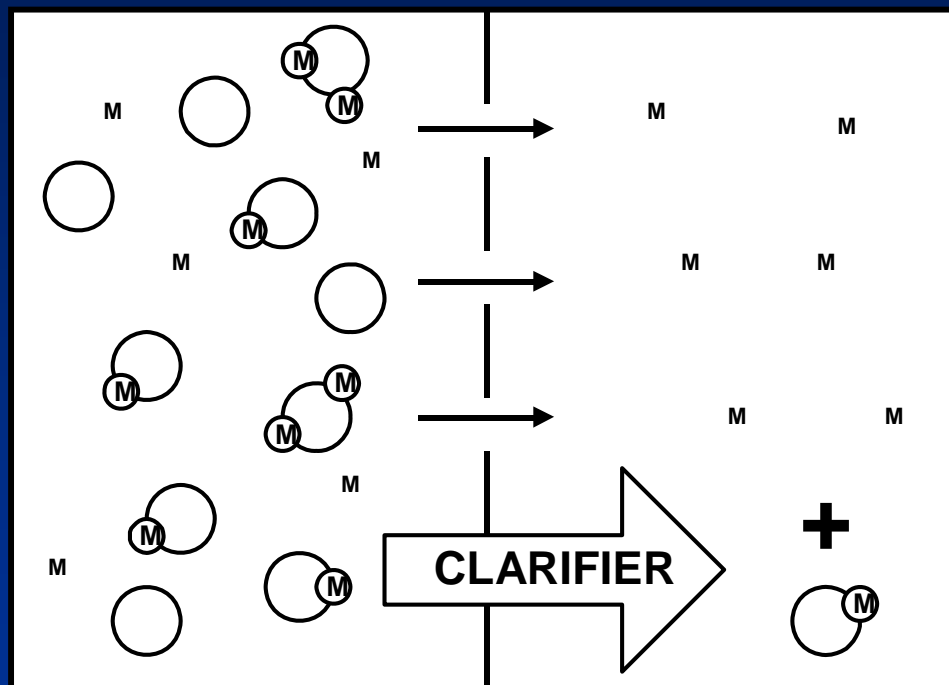
Metal	Influent Metal Concentrations (mg/L)			
	KC MBR	Dallas	Cincinnati	239-Plant survey
Cr	0.004	0.205	0.630	0.145
Cu	0.050	0.224	0.800	0.151
Pb	0.008	0.052	0.880	0.103
Ni	0.005	0.062	0.450	0.140
Zn	0.100	0.366	1.240	0.354

Data Source: Petrusek et al, 1983

Pilot MBR “Estimated” Biosolid Metal Concentrations

Biosolids Concentrations (mg/kg)					
Metal	WP 2003 (12 samples)		MBR pilot est. (4 samples)		40CFR503 limit
	mean	max	mean	max	
As	7	8	14	18	41
Cd	4	9	3	4	39
Cr	37	43	43	46	1,200
Cu	495	560	578	737	1,500
Pb	106	132	122	128	300
Mo	13	22	11	14	tbd
Ni	29	35	39	43	420
Se	6	8	13	17	36
Zn	840	960	715	759	2,800
Hg	2	4	2	4	17

Pilot MBR versus CAS



MBR Pilot Metal Removal (%) - Dec 30 sample			
	MBR	MBR + TSS	Difference
Cr	86	77	9
Cu	93	84	9
Pb	97	85	13
Ni	56	50	6
Zn	64	57	7

Impact of Concentration Factor (CF)

$$CF = f(\text{SRT, HRT, MLSS})$$

Summary

- **Metal Removal Efficiency**
 - MBR consistent with literature data
 - MBR exceeds EPA guide with the exception of Zn
- **Biosolid Metal Concentrations**
 - minimal risk of exceeding current 40 CFR 503 biosolid regulation
- **Membrane Bioreactor versus Conventional Activated Sludge**
 - MBR as suspended solids filter has impact on final effluent metal concentrations

Future Work

Hollow-Fiber Membrane Bioreactor Biological Phosphorus Removal Pilot
South Treatment Plant
July 2004 - March 2005

Flat-Plate Membrane Bioreactor Peak Hydraulic Loading Pilot
West Point Treatment Plant
June 2004 - March 2005

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Questions

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