PROSAB – Basic Sanitation Research
Network 5: 2003 → 2008

Brazilian technology for water conservation in urban areas

Ricardo Franci Gonçalves

Dept. of Environmental Engineer. - UFES

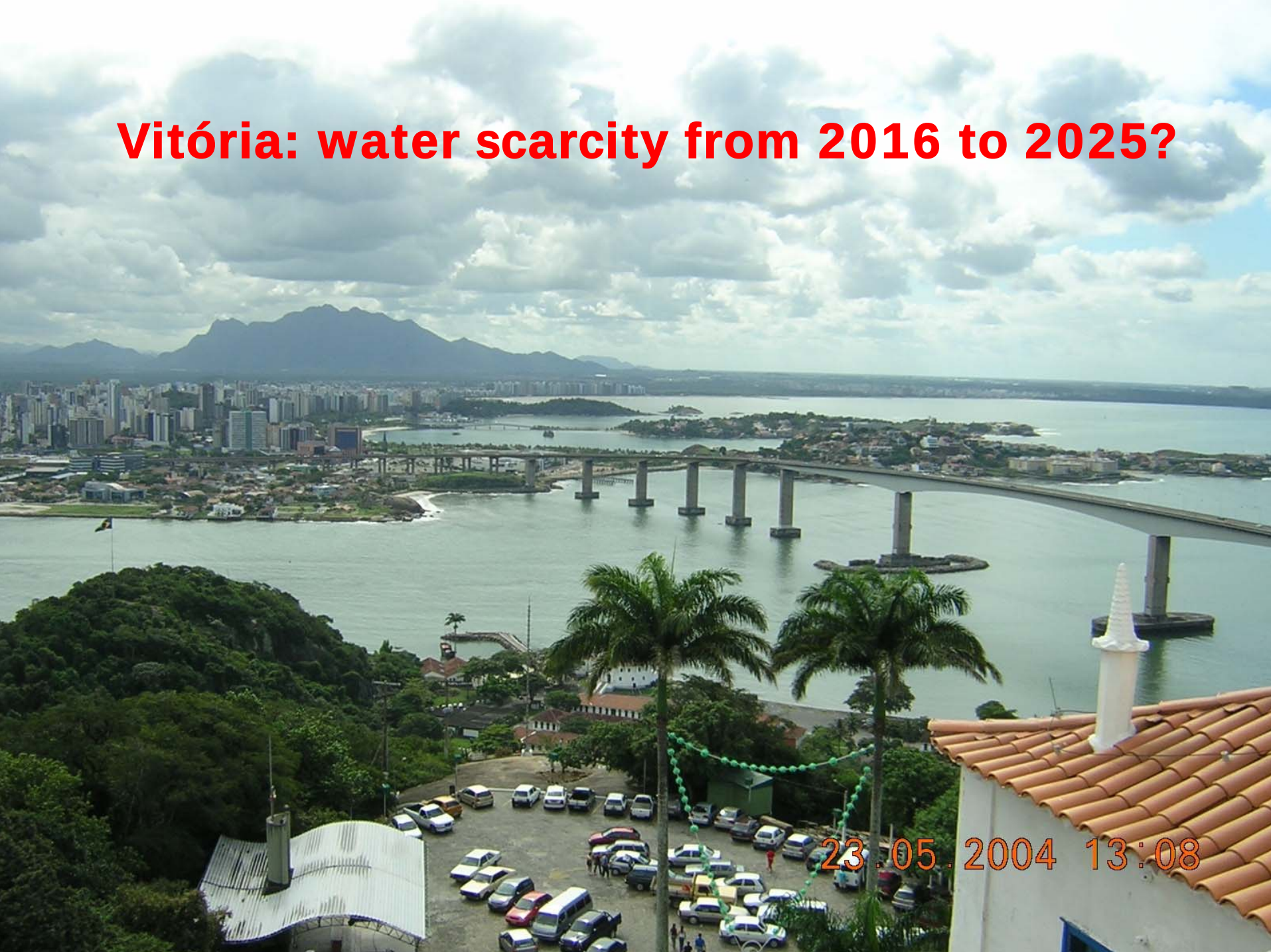
PROSAB
PROGRAMA DE PESQUISA EM SANEAMENTO BÁSICO

FINEP
Financiadora de Estudos e Projetos

Federal Univ. of Espírito Santo
Federal Univ. of Santa Catarina
UNICAMP
IPT - SP

Federal Univ. of Bahia
Federal Univ. of Mato G. do Sul
Federal Univ. of Paraíba
Federal Univ. of Itajubá

Vitória: water scarcity from 2016 to 2025?



Metropolitan region of São Paulo: 63 m^3/s

Metropolitan region of São Paulo 2010

69,8 ≤ Demand ≤ 78,6 m3/s

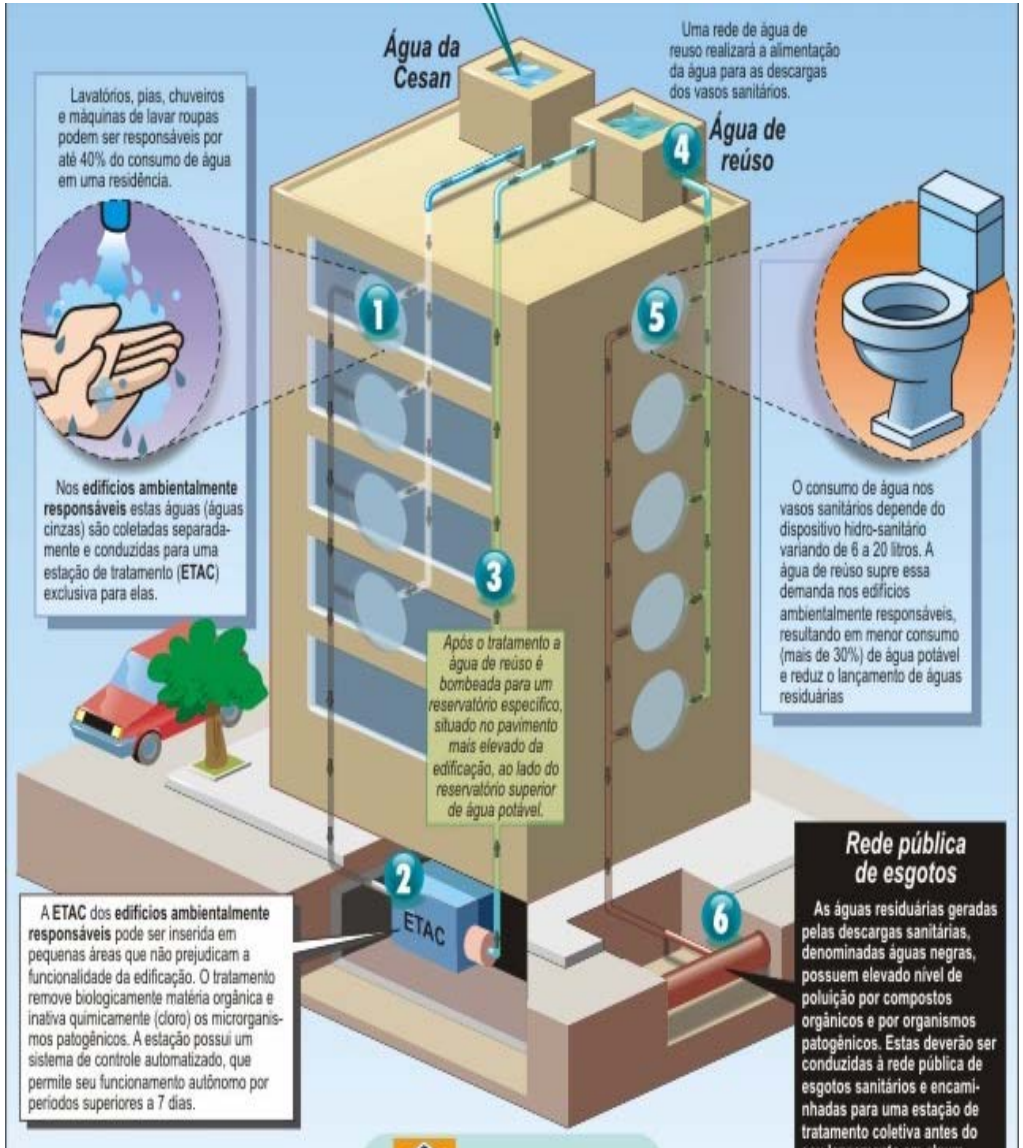
Supply = 73 m3/s

If the demand ↓ → + 4%

Without any action → - 8%

Source: Águas do Brasil – Mônica Porto – Banco Mundial

Green building



- ✓ Individual water meters
- ✓ Water saving devices
- ✓ Control of water losses
- ✓ Rainwater catchment
- ✓ Greywater reuse

The present situation in Brazil

Generalized interest at the urban areas

Technology development → treatment and reuse

Few experiences → large scale

Legislation

Human resources

Brazilian standards → Alternative water sources legislation

	Rainwater	Greywater	Wastewater
Retention	Lei Nº 13.276/2002 -São Paulo/SP	-	-
Use or reuse (residential)	Lei Nº 10.785/2003 -Curitiba/PR Lei Nº 13.276/2002 -São Paulo/SP Lei Nº 6.345/2003 - Maringá/PR	Lei Nº 10.785/2003 -Curitiba/PR Lei Nº 6.345/2003 - Maringá/PR	NBR 13.969/1997
Urban reuse	-	-	Lei Nº 6.076/2003 -Maringá/PR Lei Nº 13.309/2002 -São Paulo/SP NBR 13.969/1997

BRAZIL: Proposed standards for the toilet flushing

Parâmetros	Manual de "Consevação e reúso de água em edificações " Classe 1 (FIESP, 2005)				NBR 13.969/97 item 5.6.4 Classe 3
pH	6,0 - 9,0	6 a 9		6 a 9	-
Cor (UH)	≤ 10				-
Turbidez (NTU)	≤ 2	1 a 2	5	5	< 10
Óleos e Graxas (mg/L)	≤ 1				-
DBO (mg/L)	≤ 10	20	30	10	-
Coliformes Fecal (NMP/100mL)	Não detectáveis	100	200	10	< 500
Compostos Orgânicos Voláteis	Ausentes				-
Nitrato (mg/L)	≤ 10				-
Nitrogênio Amoniacal (mg/L)	≤ 20				-
Nitrito (mg/L)	≤ 1				-
Fósforo Total (mg/L)	≤ 0,1				-
SST (mg/L)	≤ 5	30	30		-
SDT (mg/L)	≤ 500				-
		Germany	Canada	Japan	

The Basic Sanitation Research Network 5

Research Network 5

2003 – 2006

"The development of technological alternatives for the segregation, treatment and final disposal of human excreta, to reduce the water consumption and the conventional infra-structure, specially at the peripheric urban areas.

2006 – 2008

"Water and energy conservation in water supply systems and buidings, by lowering the demand, use of alternatives sources and other types of rational water use".

The Network Composition

Institution	Coordinator	Period
Federal Univ. of Espírito Santo	Ricardo Franci Gonçalves	2003 - 2008
Federal Univ. of Santa Catarina	Luiz Sérgio Philippi	2003 – 2008
UNICAMP	Edson A. Abdul Nour	2003 - 2006
IPT - SP	Wolney Castilhos Alves	2003 - 2008
Federal Univ. of Bahia	Asher Kiperstok	2006 - 2008
Federal Univ. of Mato Grosso do Sul	Peter B. Cheung	2006 – 2008
Federal Univ. of Paraíba	Heber Pimentel Gomes	2006 – 2008
Federal Univ. of Itajubá	Afonso Heriques M. Santos	2006 - 2008

Consultors:
Prof. Eduardo Pacheco Jordão (UFRJ), Sydney Seckler (USP),
Prof. Gilberto Januzzi (UNICAMP)


ECOSAN 2007
UFPB
UFBA
UNIFEI
UFMS
UFES
UNICAMP
UFSC

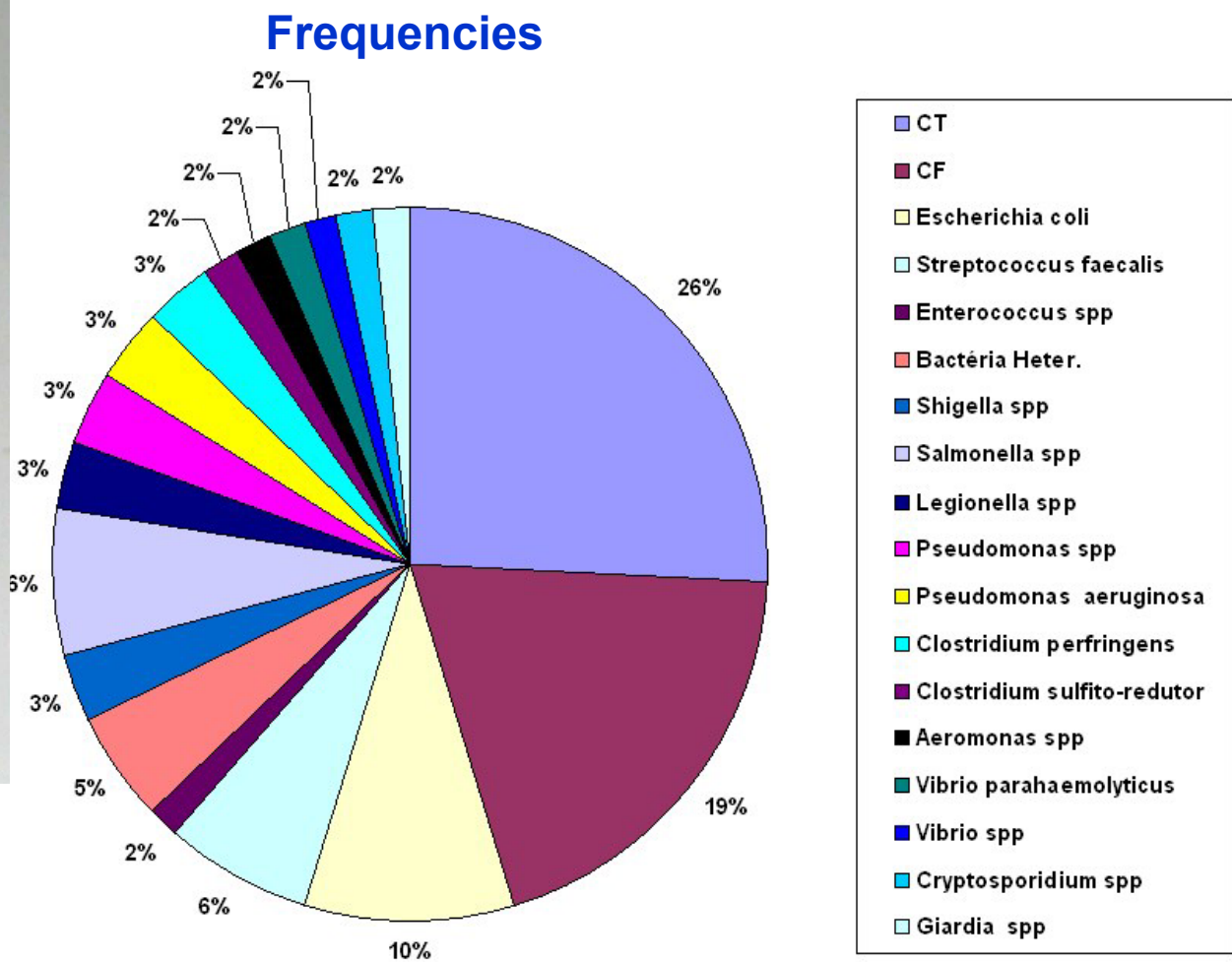
Rainwater

UFSC

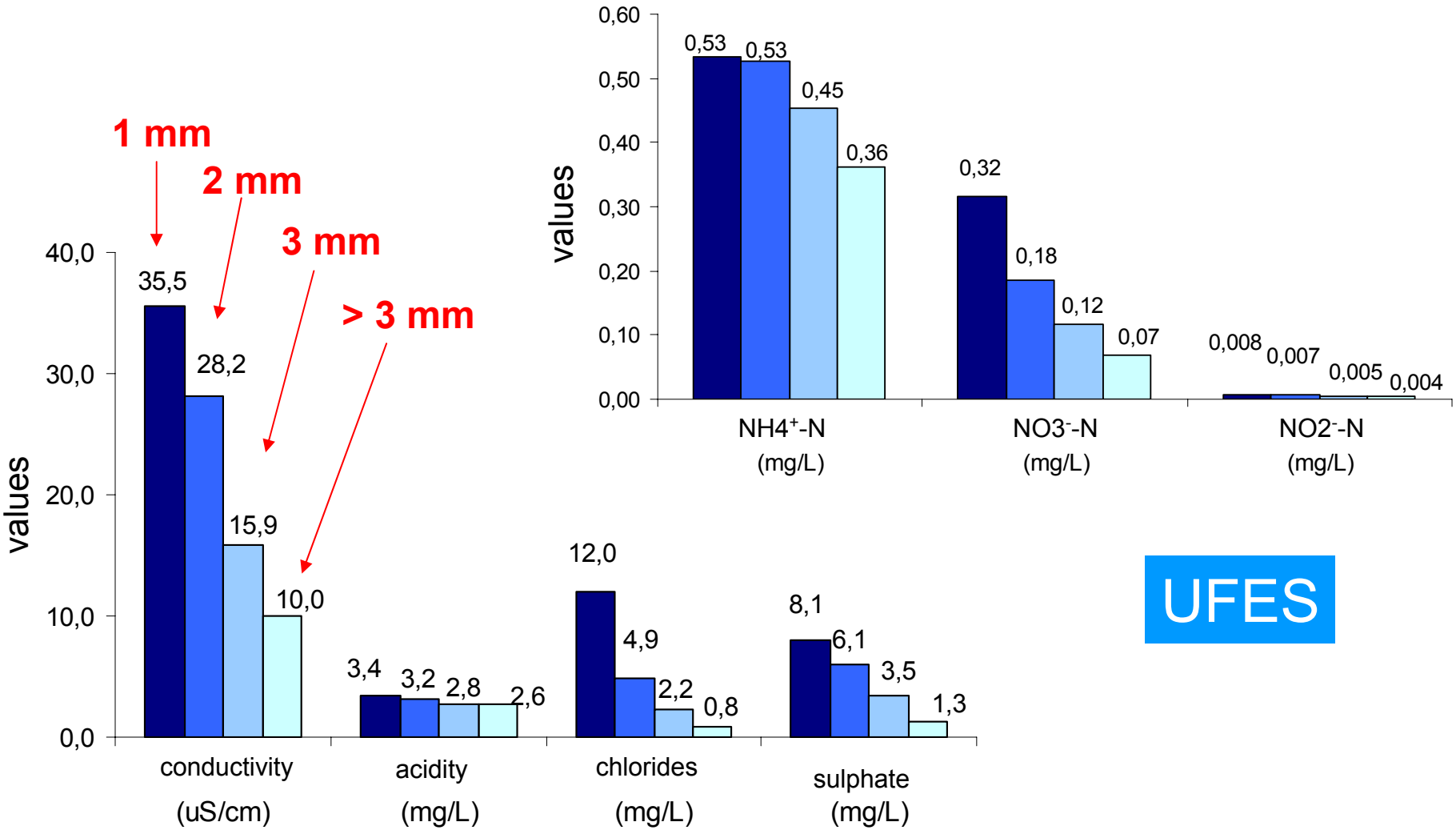
- Characterization
- Quantitative studies
- Water uses
- Treatment
- Equipments

Rainwater - IPT

First precipitation – São Paulo

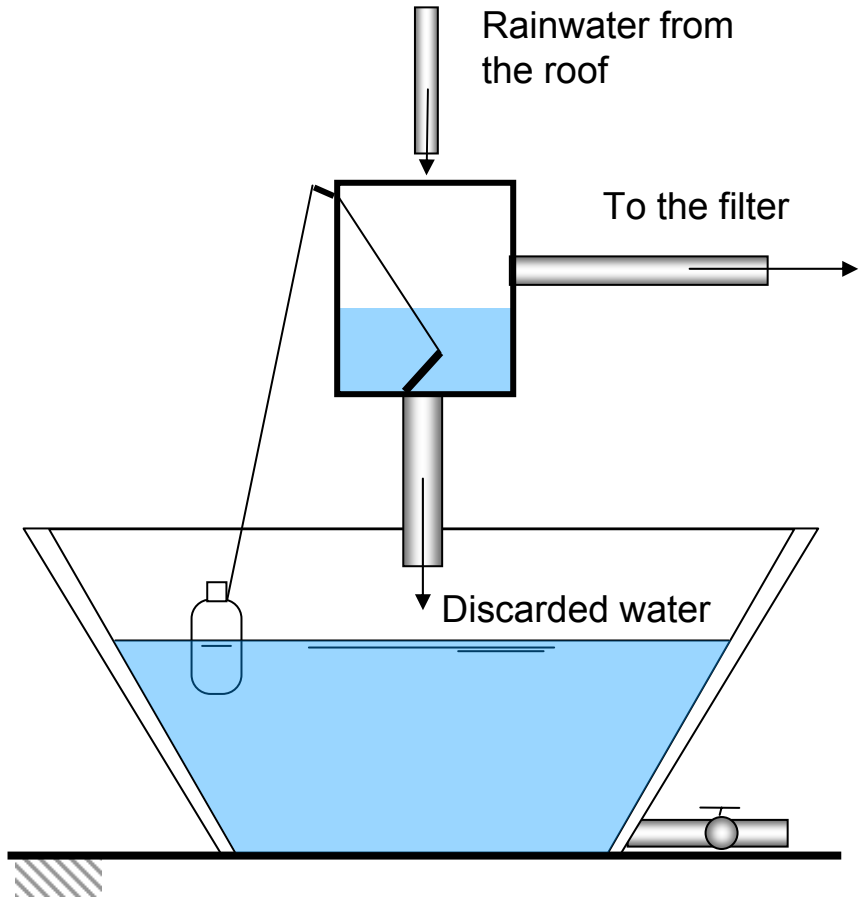


Atmosphere Cleaning Effect



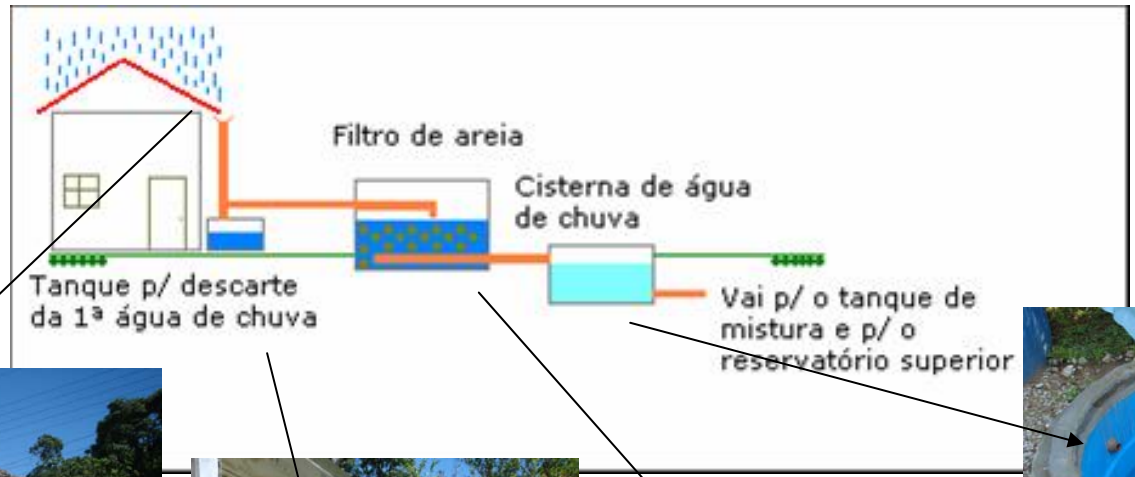
UFES

IPT



First precipitation device

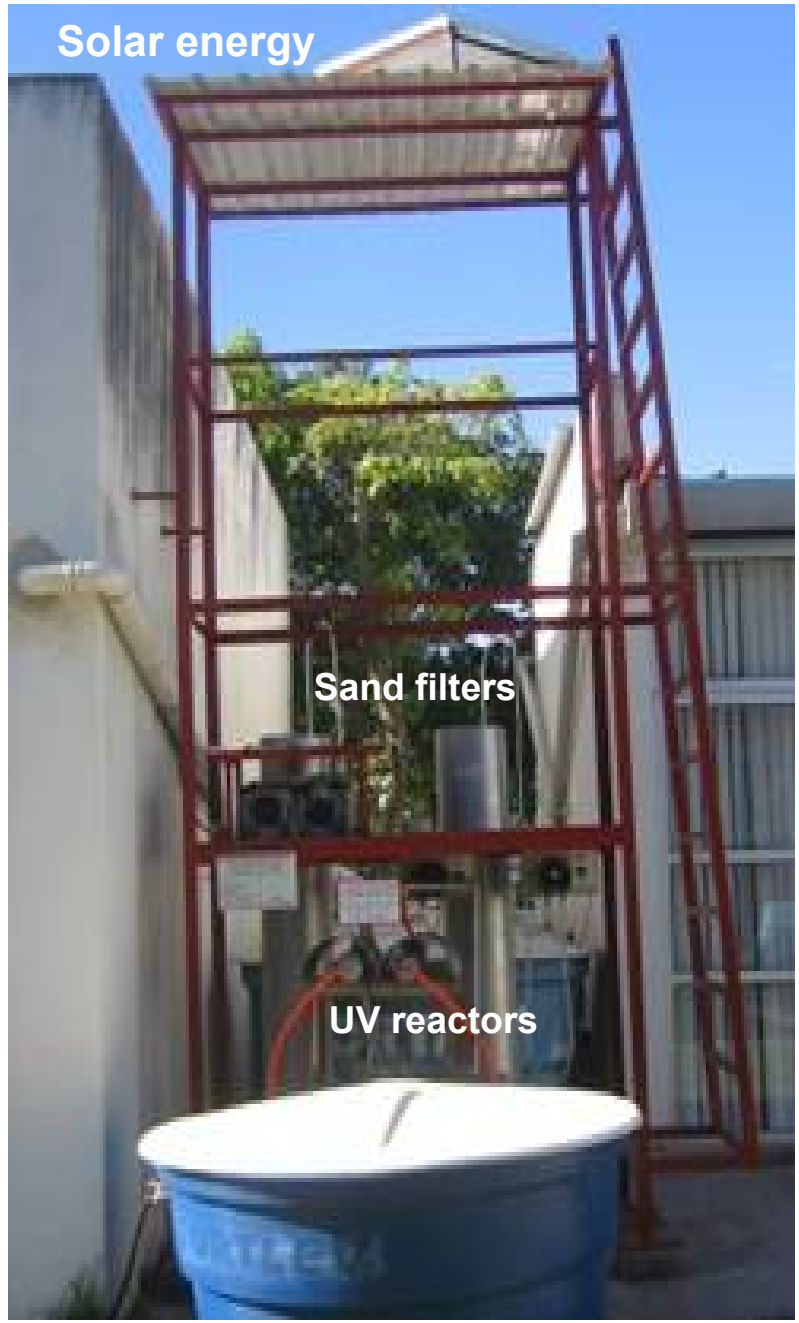
UFSC

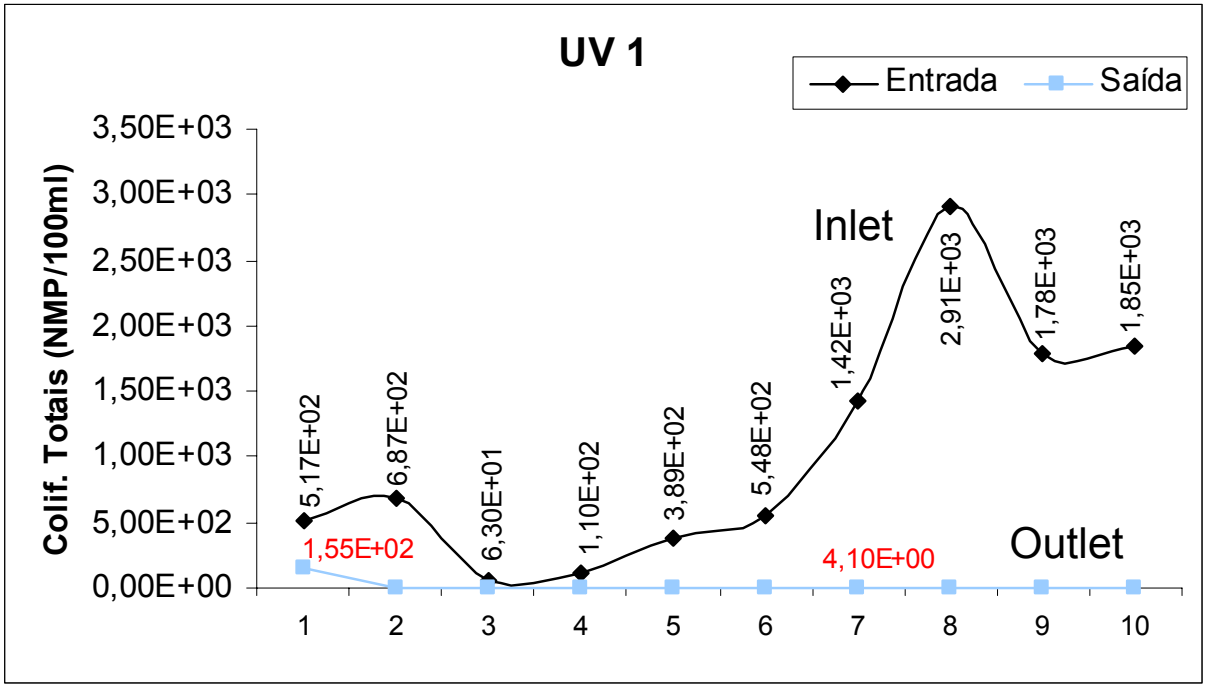

Filtro de areia
Cisterna de água de chuva
Tanque p/ descarte da 1ª água de chuva
Vai p/ o tanque de mistura e p/ o reservatório superior


P9

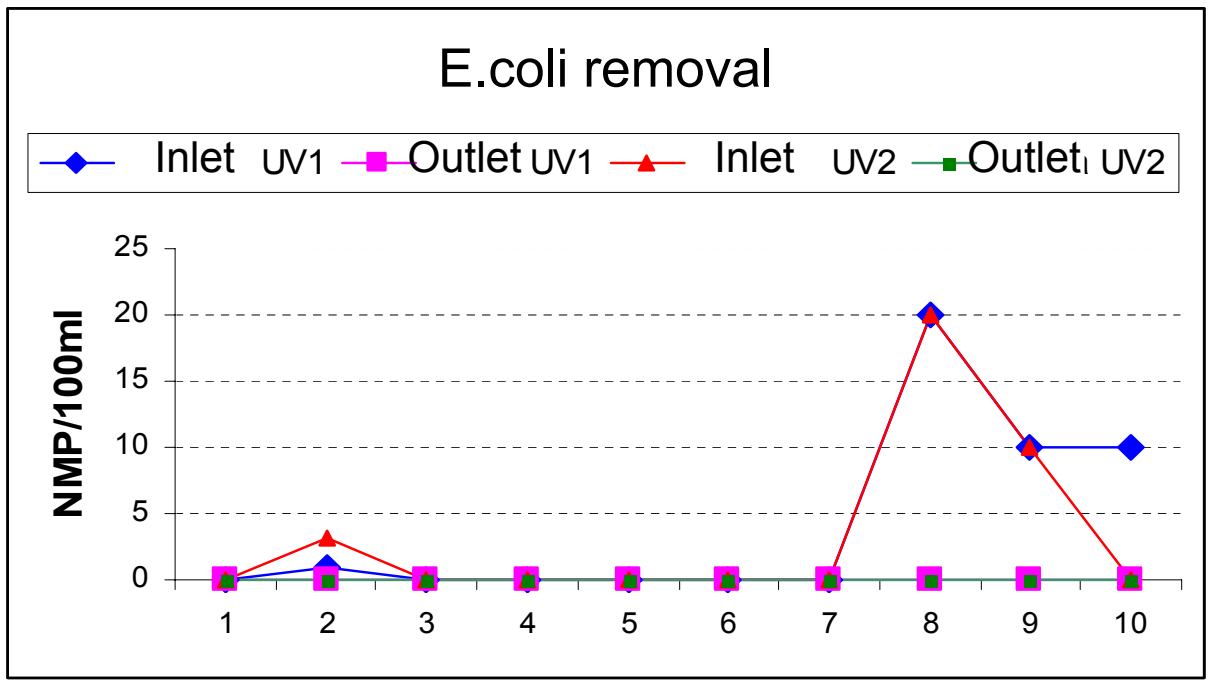

P9

UFES – Rainwater





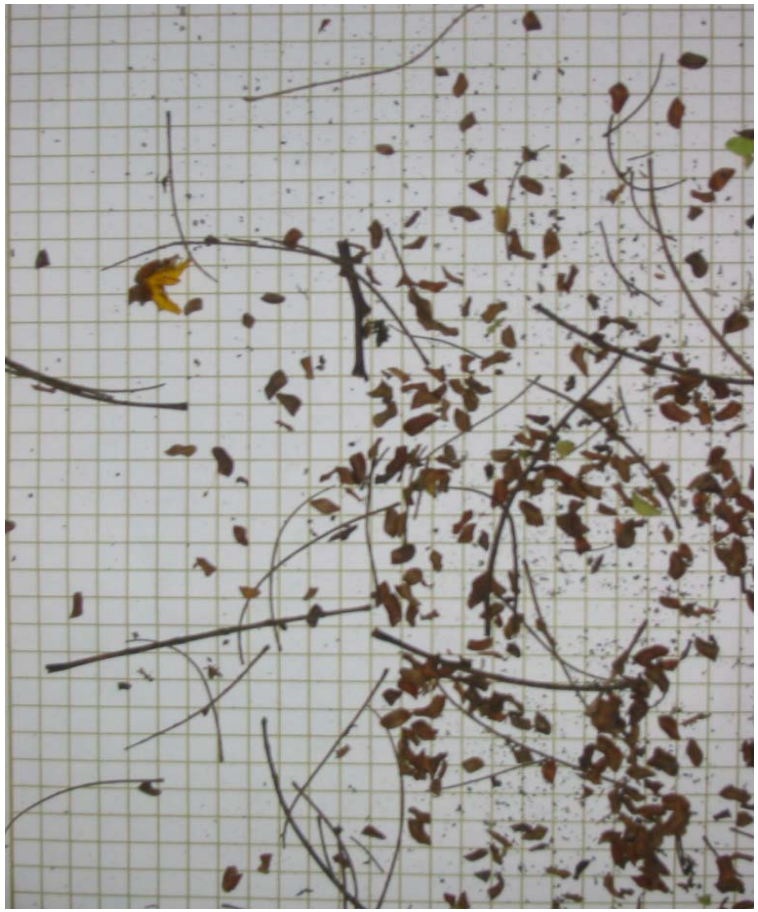
UFES – Rainwater treatment system



Rainwater - IPT

Rainwater - IPT

Methodology to evaluate the filters



Microsoft Excel - chuva8 (SRH)

Arquivo Editar Exibir Inserir Formatar Ferramentas Dados Janela Ajuda

Digite uma pergunta

65%

Arial 9

H6

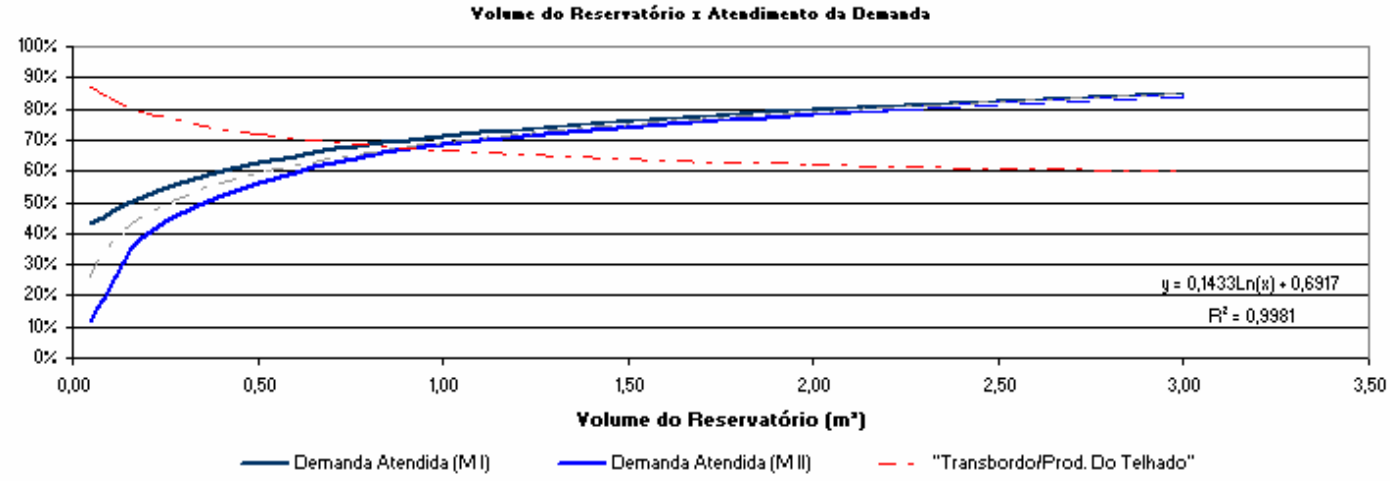
Demanda Total		
numero de pessoas	5,0	
Consumo *per capita*	80,0 litros/dia	
Consumo Total	400,0 litros/dia	0,4 m³

Demanda para água de chuva		
Consumo *per capita* a ser atendido com chuva	40,0 litros/dia	
Consumo a ser atendido com chuva	200,0 litros/dia	0,2 m³

Reservatórios		
Capacidade do Tanque Principal (superior)	0,25 m³	250,0 litros
Percentual da demanda anual atendida	43,3% a 54,4%	
Demanda anual atendida (média)	**48,8%**	
Volume anual da rede para suprir deficit	41,4 m³ a 33,3 m³	
Média	37,4 m³	
Deficit/ Demanda anual	56,7% a 45,6%	
Volume inicial de água no reservatorio	0,3 m³	250,0 litros

OFERTA	
Área de telhado	100,0 m²
Chuva Anual Total	1.803,2 mm
Coef de captaçao	0,85

INDICADORES	
Consumo anual Total:	146,0 m³
Demanda anual para chuva:	73,0 m³
Produçao anual do telhado:	153,3 m³
Relação Prod telhado/Demanda	210,0%
Transbordo anual (médio)	117,7 m³
Rel transbordo/prod telhado	77%
Volume total da rede:	**110,4 m³**
Volume substituído:	35,6 m³
Demanda total atendida:	24,4%
dias atendidos integralmente	39,7%
dias atendidos parcialmente	22,3%
Retorno do investimento:	4,8 anos



UNIVERSIDADE FEDERAL DA BAHIA
ESCOLA POLITECNICA
DEPARTAMENTO DE ENGENHARIA AMBIE

TECLIM - Rede de Tecnologias Lim
e Minimização de Resíduos

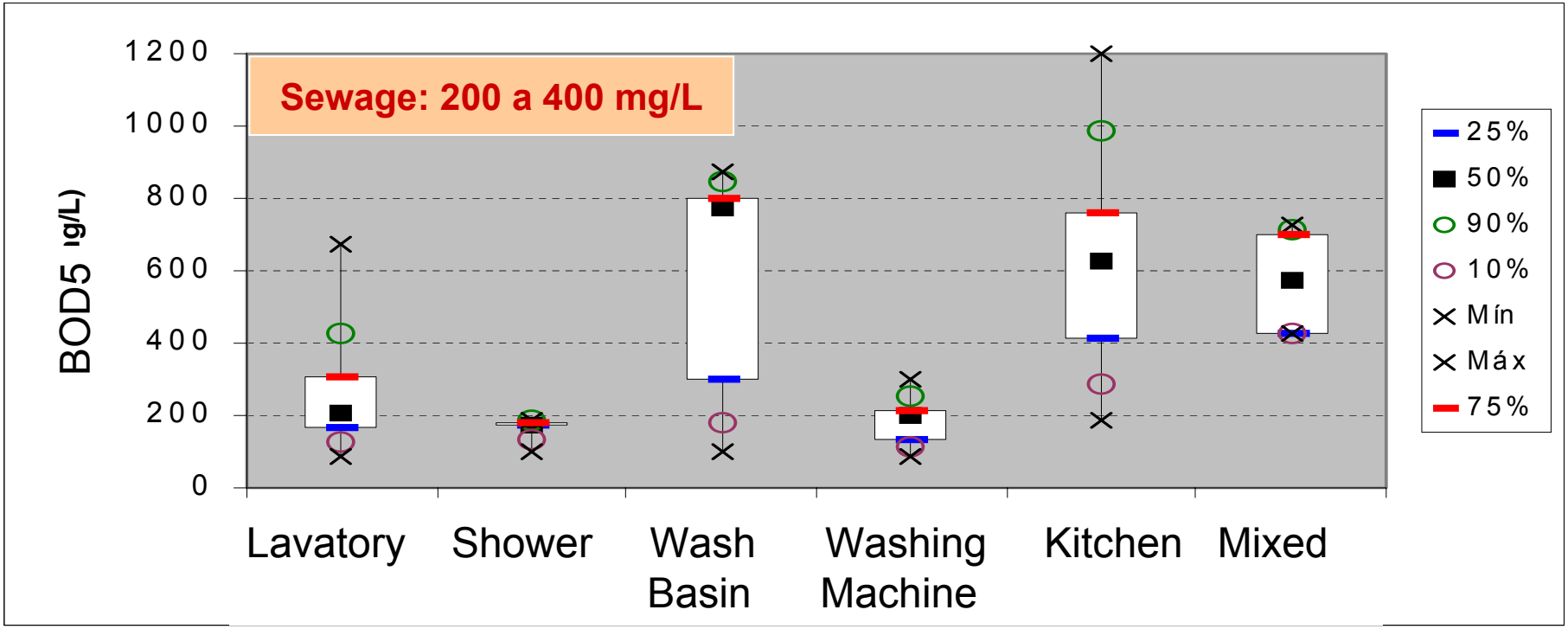
Entrada | GRAFICO | calculo (Métodos I) | Comparativo (Método I) | Calculo Metodo II | Compa

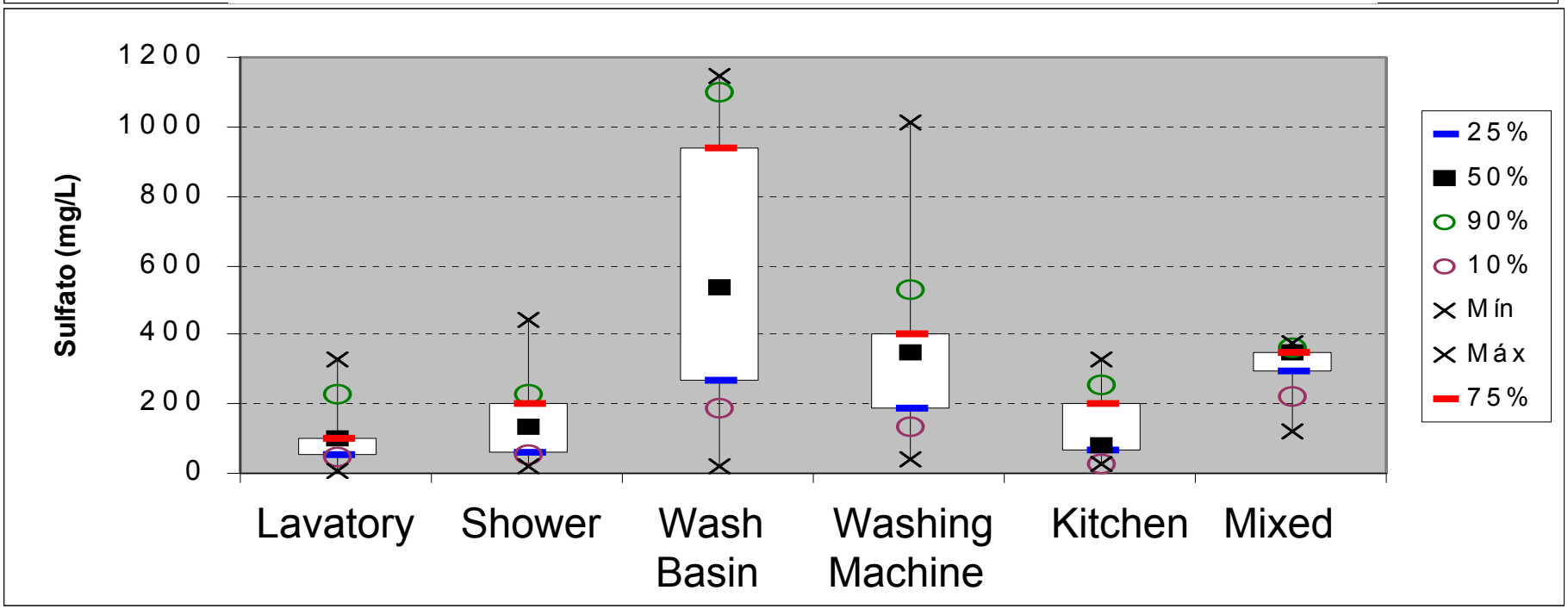
Greywater

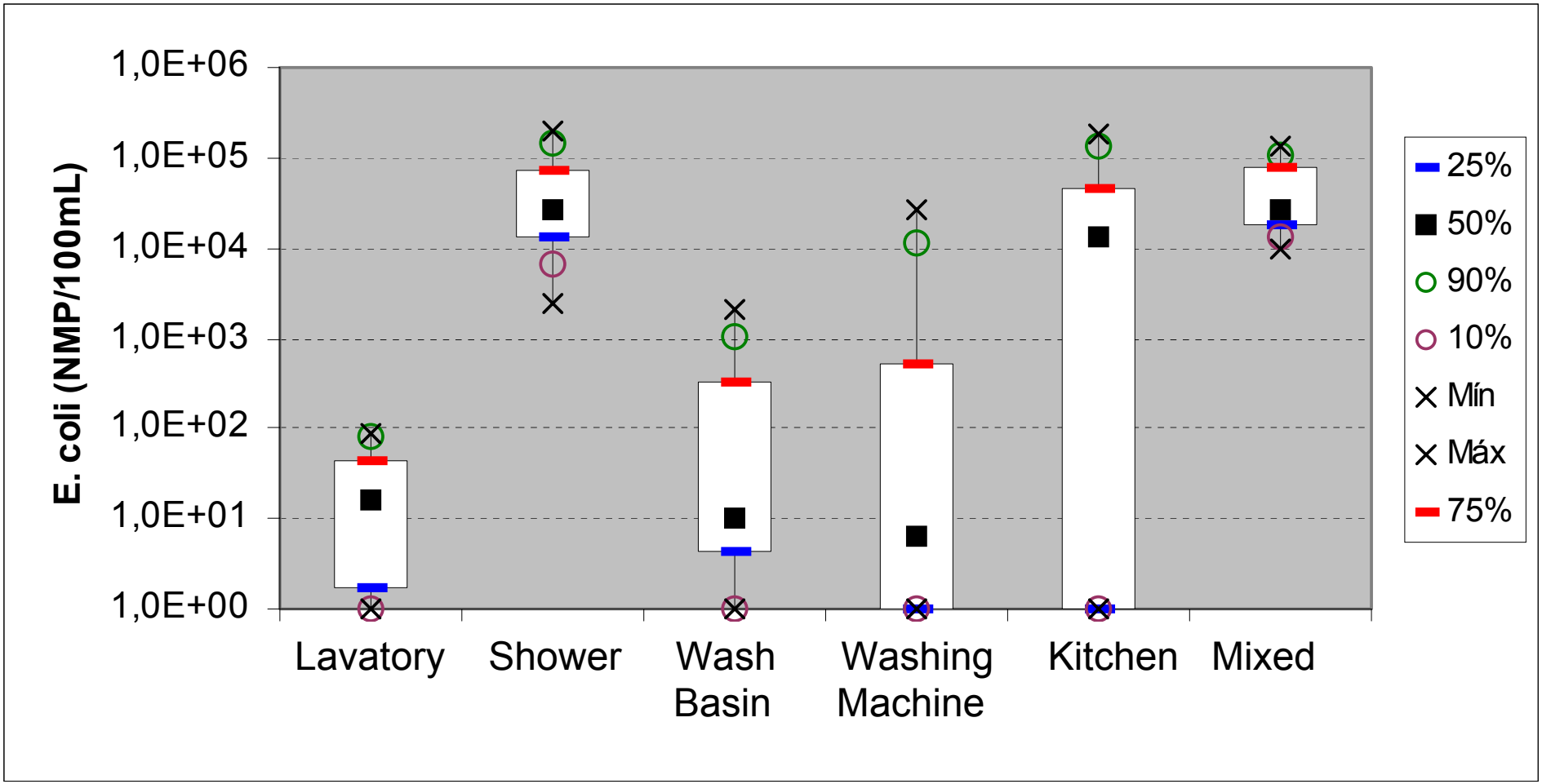
UFES

- Characterization
- Quantitative studies
- Reuse
- Equipments

Characterization


Sewage: 200 a 400 mg/L
BOD5 ıg/L)
1200
1000
800
600
400
200
0
Lavatory
Shower
Wash Basin
Washing Machine
Kitchen
Mixed
25%
50%
90%
10%
Mín
Máx
75%

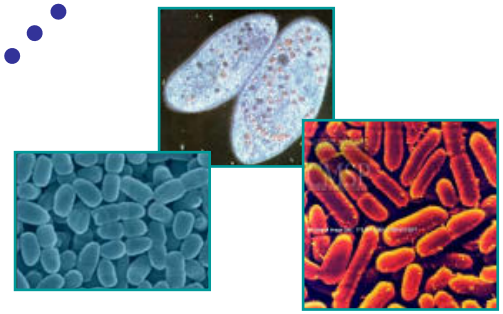

Sulfato (mg/L)
1200
1000
800
600
400
200
0
Lavatory
Shower
Wash Basin
Washing Machine
Kitchen
Mixed
25%
50%
90%
10%
Mín
Máx
75%



Sewage

10^6 – 10^8 mg/L

Greywater



Microrganismes

Organic matter

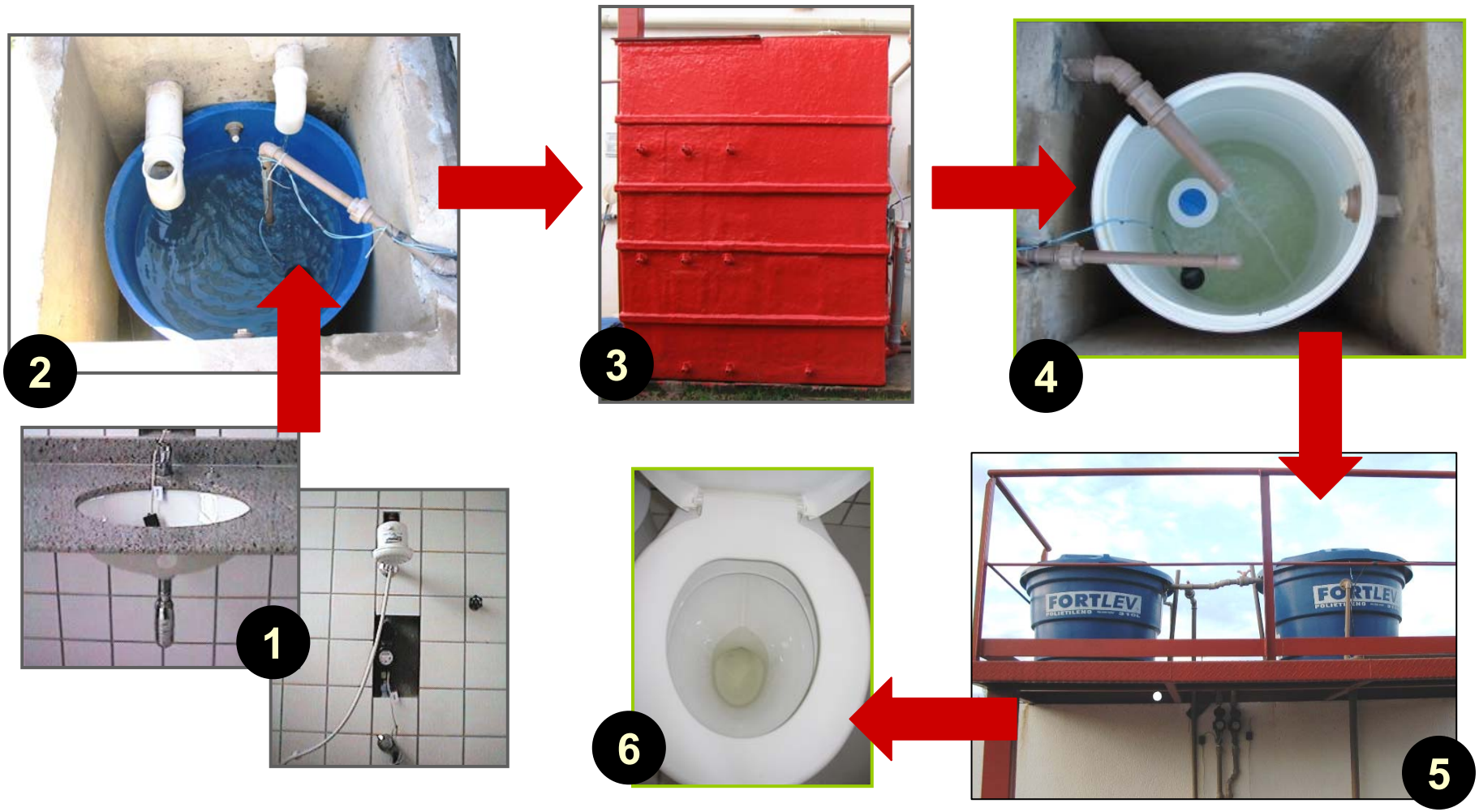
COMPOSITION

Chemicals

Inorganic material

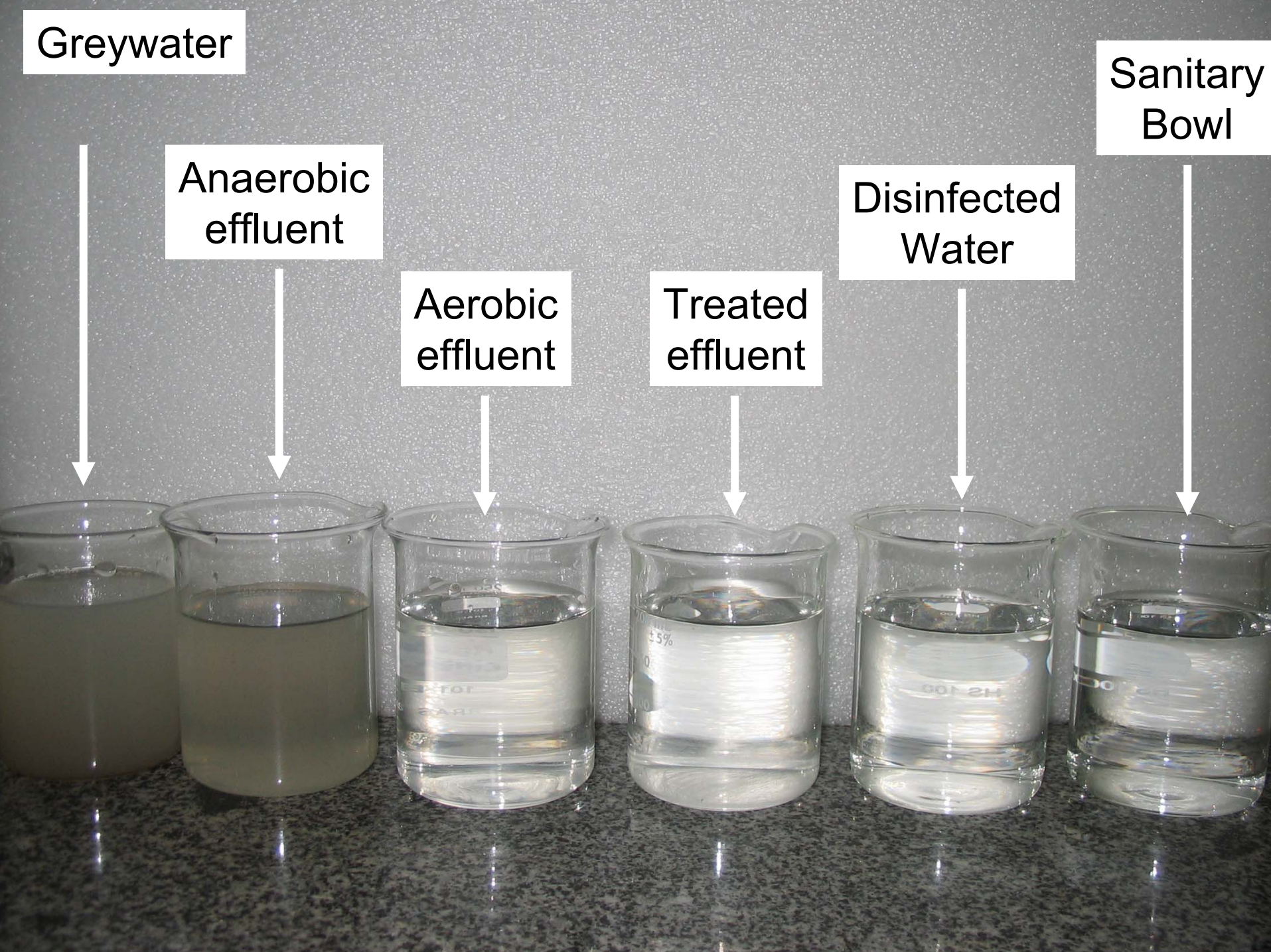
Treatment

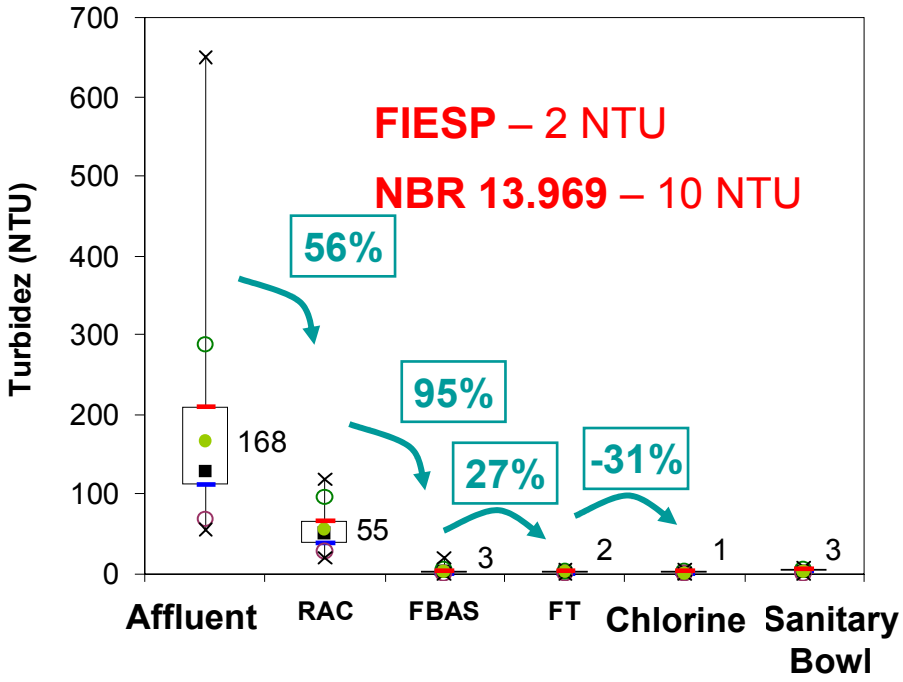
Reuse system - UFES

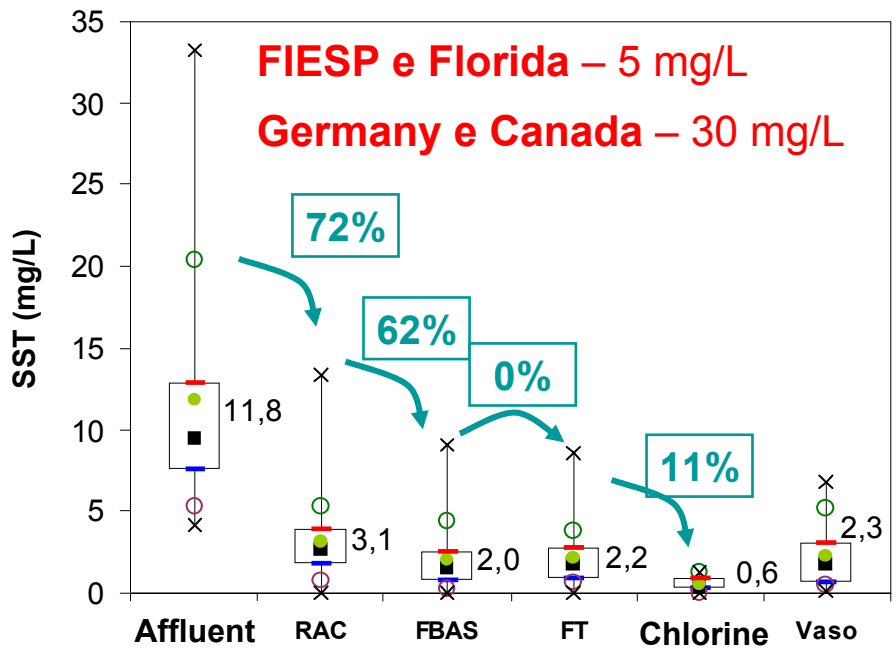


Compact greywater treatment plant

Disinfection


Greywater
Anaerobic effluent
Aerobic effluent
Treated effluent
Disinfected Water
Sanitary Bowl


FIESP – 2 NTU
NBR 13.969 – 10 NTU
56%
95%
27%
-31%
Turbidez (NTU)
700
600
500
400
300
200
100
0
168
55
3
2
1
3
Affluent
RAC
FBAS
FT
Chlorine
Sanitary Bowl


FIESP e Florida – 5 mg/L
Germany e Canada – 30 mg/L
72%
62%
0%
11%
SST (mg/L)
35
30
25
20
15
10
5
0
11,8
3,1
2,0
2,2
0,6
2,3
Affluent
RAC
FBAS
FT
Chlorine
Vaso

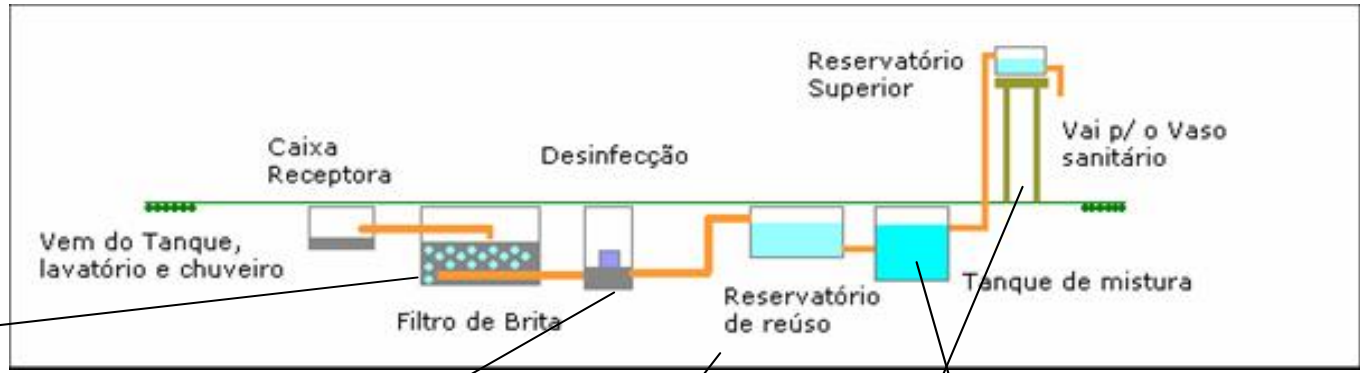
Summary of ETAC system performance

Parameter	Treatment			
	RAC	FBAS	FT	Chlorine
Color	+++	++++	+	+++
Turbidity	+++	++++	++	↓
TSS	++++	+++	↓	+
BOD_5	+++	++++	++	--
COD	++++	++++	++	+
E. coli	++	+++	+	++
Total Coliform	+++	++	+	++++

Legend:

++++ - very good efficiency 70 to 100% or 4 log units
+++ - moderate efficiency 40 to 69% or 3 log units
++ - Poor removal efficiency 10 to 39% or 2 log units
+ - very low efficiency or absent 0 to 10% or 1 log unit
↓ - worsening treatment efficiency as related to previous treatment

UFSC

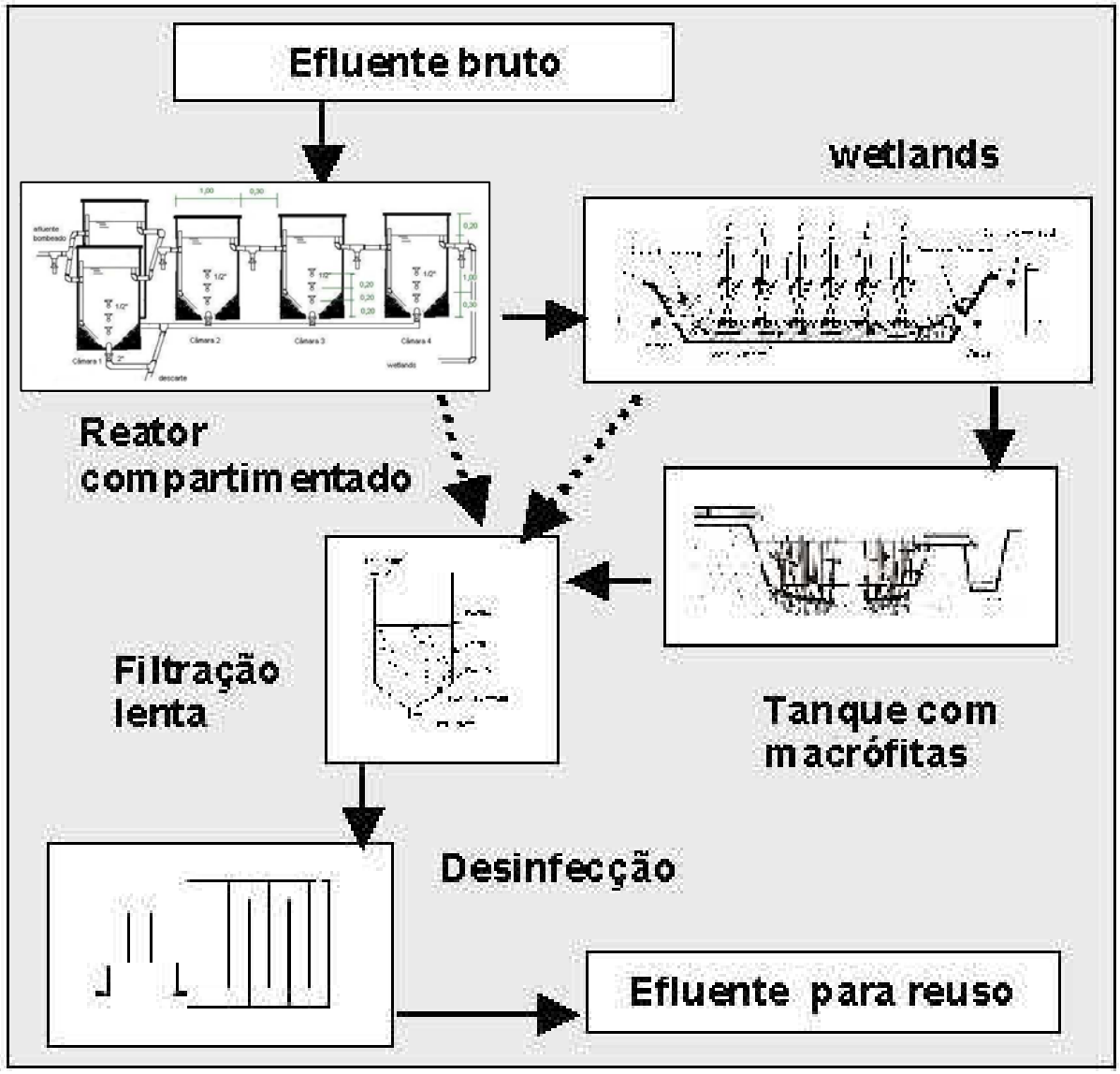

Reservatório
Superior
Vai p/ o Vaso
sanitário
Caixa
Receptora
Desinfecção
Vem do Tanque,
lavatório e chuveiro
Filtro de Brita
Reservatório
de reúso
Tanque de mistura

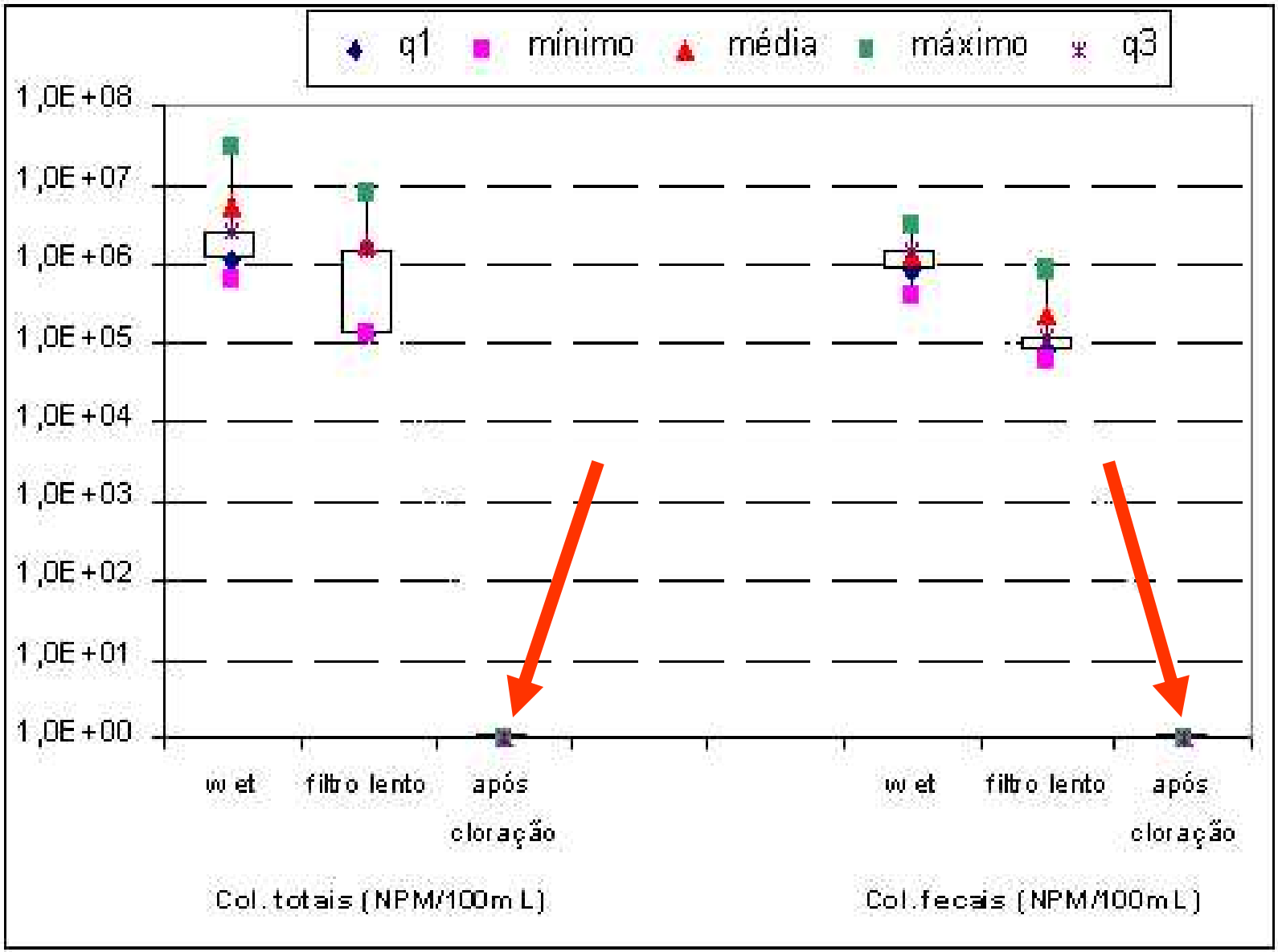
Black water

UNICAMP

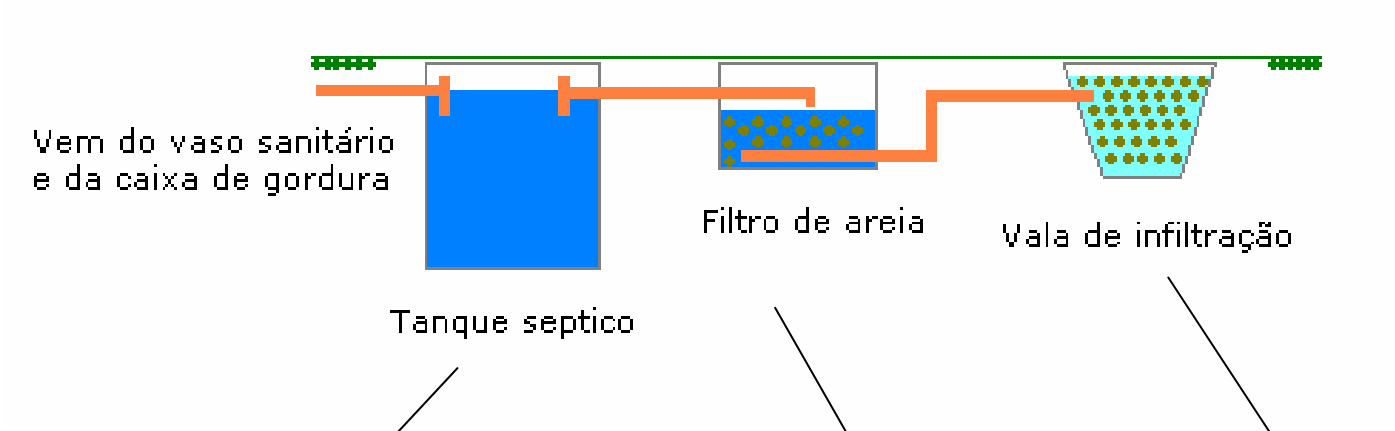
- Characterization
- Quantitative studies
- Treatment
- Equipments

UNICAMP


Efluente bruto
wetlands
Reator compartimentado
Filtração lenta
Tanque com macrófitas
Desinfecção
Efluente para reuso


q1
mínimo
média
máximo
q3
1,0E+08
1,0E+07
1,0E+06
1,0E+05
1,0E+04
1,0E+03
1,0E+02
1,0E+01
1,0E+00
wet
filtro lento
após cloração
wet
filtro lento
após cloração
Col. totais (NPM/100mL)
Col. fecais (NPM/100mL)

UFSC


Vem do vaso sanitário
e da caixa de gordura
Filtro de areia
Vala de infiltração
Tanque septico

UFES

IPT

GUARULHOS

Septic tank
100 inhabit.

Individual systems SANTO ANDRÉ

Urine

- Characterization
- Quantitative studies
- Treatment
  - reservatio
  - evaporation
- Nutrient recycling

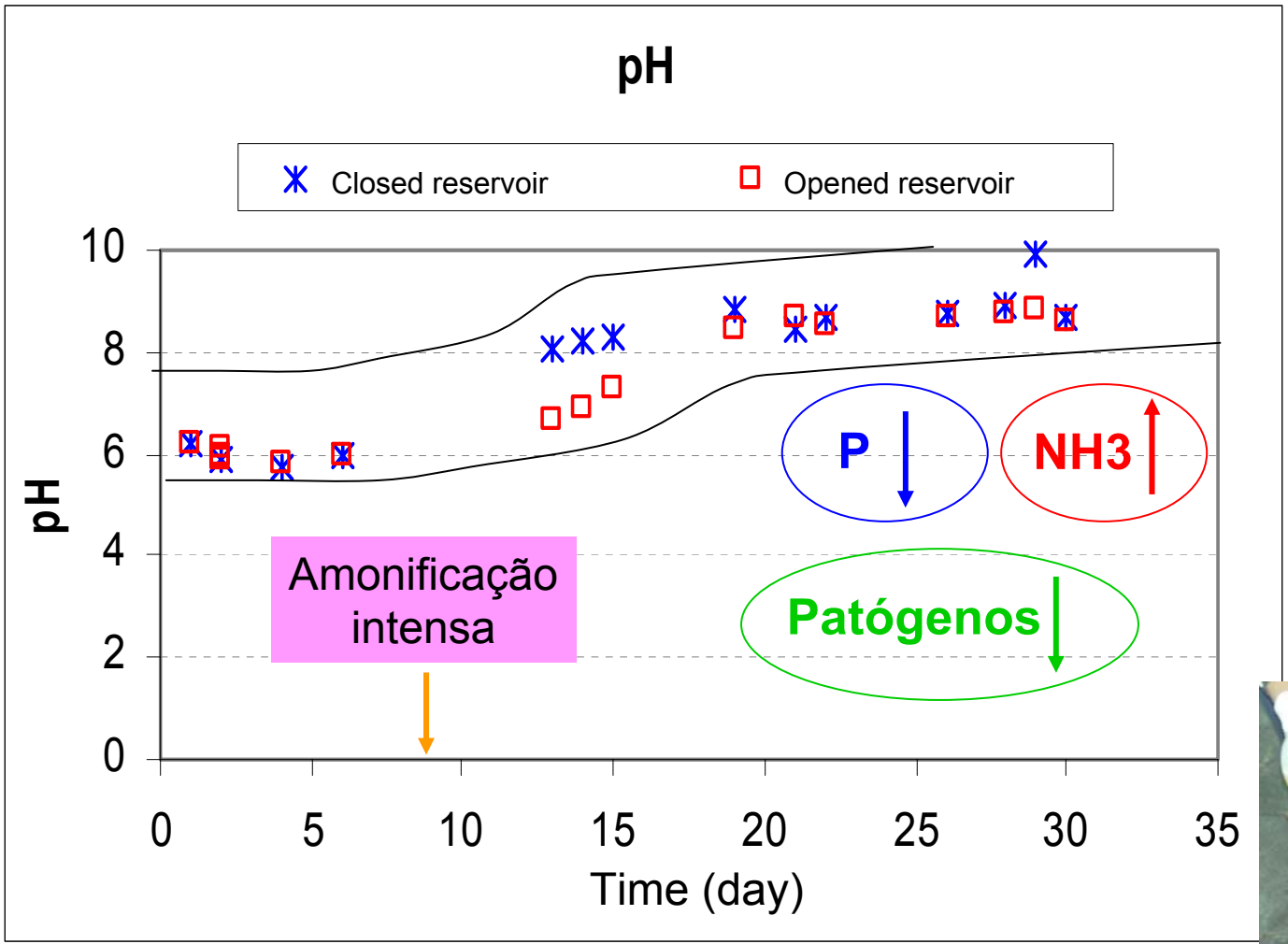
Urine Characterization

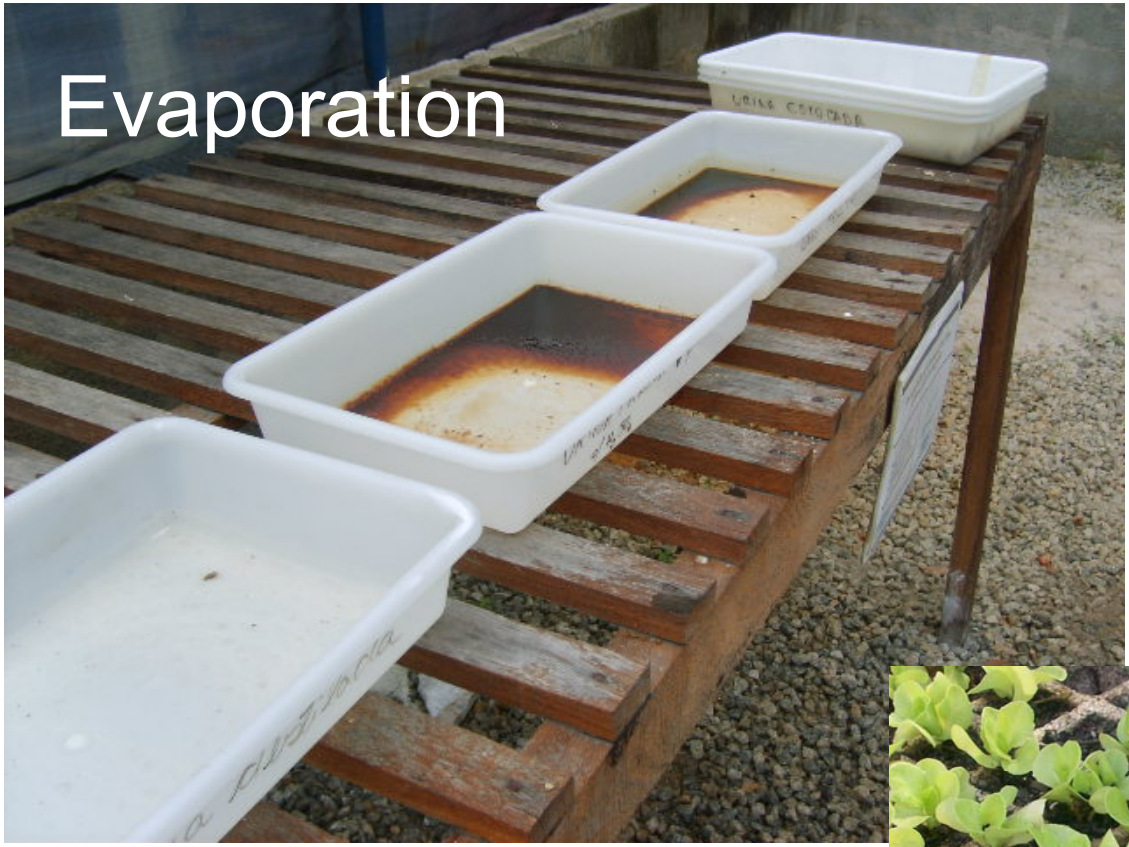
Sample	Daily production					
	Total (L/day)	Average (L/person.day)	Std. Dev.	Máx.	Mín.	Coef. Var
Male (n = 8)	11,796	1,475	0,427	2,063	0,820	29%
Female (n = 10)	12,485	1,249	0,664	2,223	0,356	53%
Misto (n = 18)	24,281	1,349	0,568	2,223	0,356	42%

Compairison: urine x sewage

	Urine (g/pd)			Sewage (g/p.d)		
	UFES	FITTSCHEN & HAHN (1998)	SNV apud FITTSCHEN & HAHN (1998)	VON SPERLING (1996)	ATV (1991) apud FITTSCHEN & HAHN (1998)	SNV (1995) apud FITTSCHEN & HAHN (1998)
N_{total}	11,5	10,8	11,0	8,0	11,0	13,5
P_{tot}	0,55	0,93	1	2,5	2,5	2,1
DBO	2,24	6,06	-	50	60	48
DQO	9,34	12,97	-	100	120	-

Urine → storage



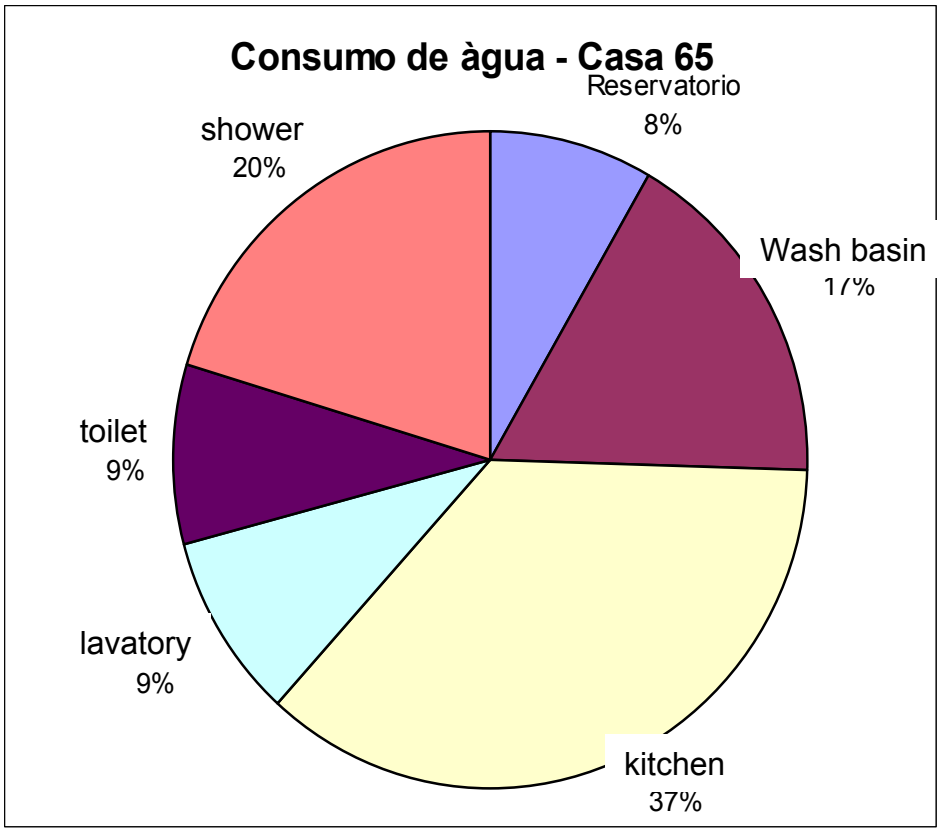

Evaporation

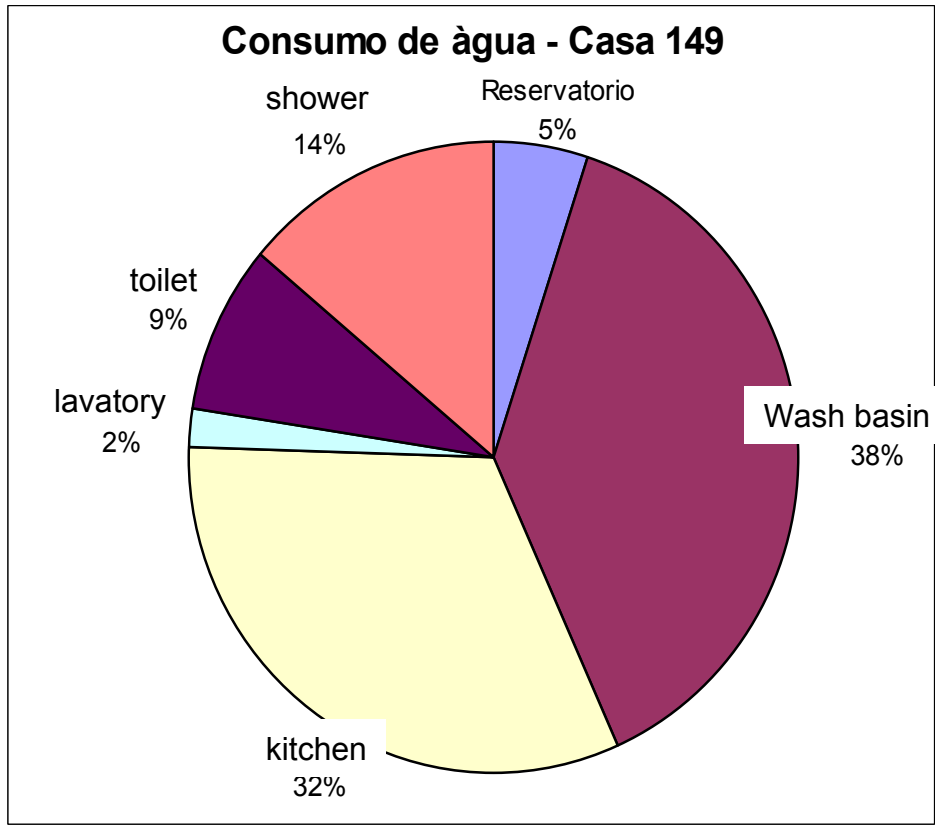

23/05/2007
Agriculture

Water consumption

- Characterization
- Quantitative studies
- Control of water losses
- Equipments

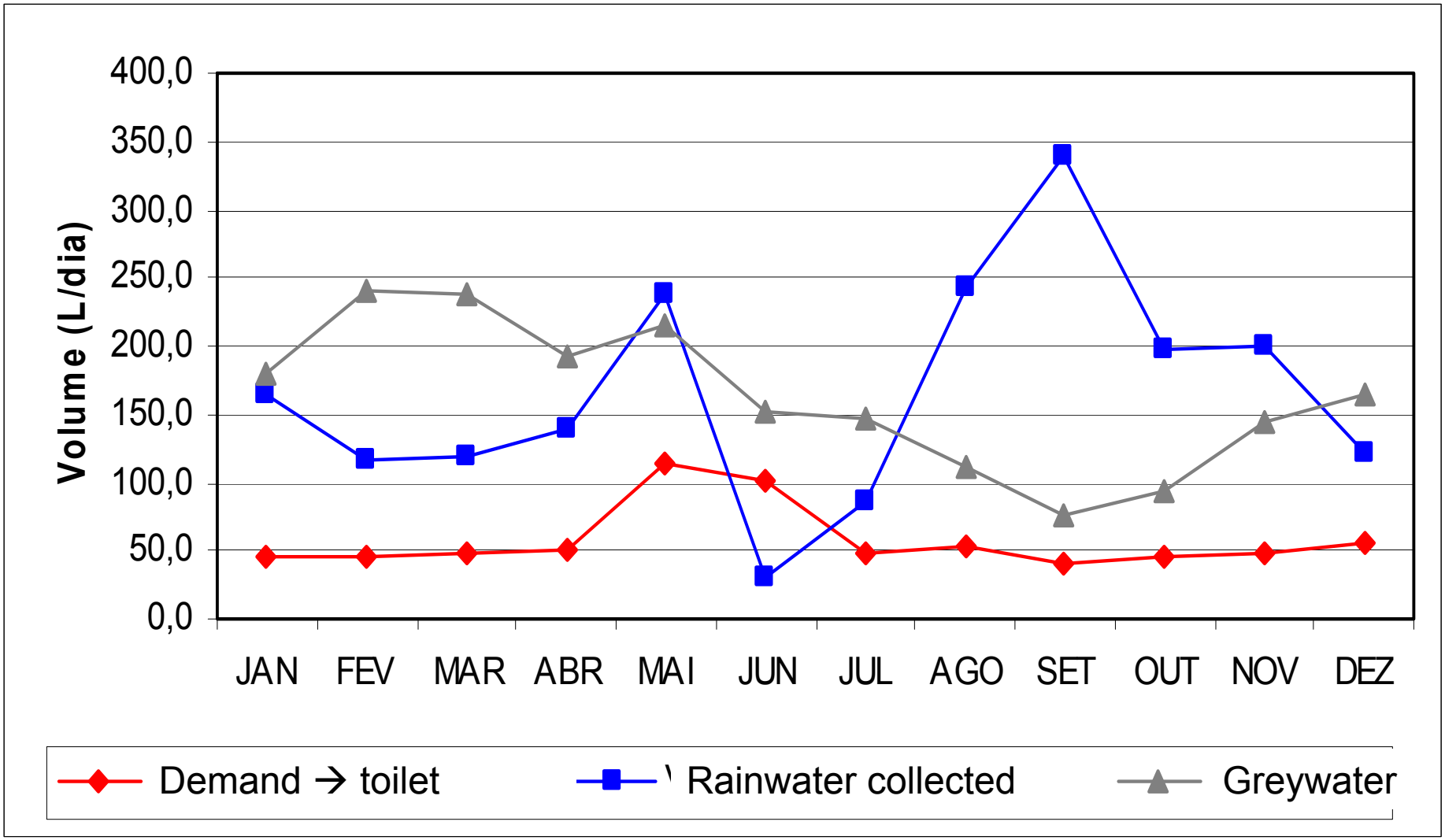
Water consumption





UFBA

Household: Demand x Production



Without greywater reuse

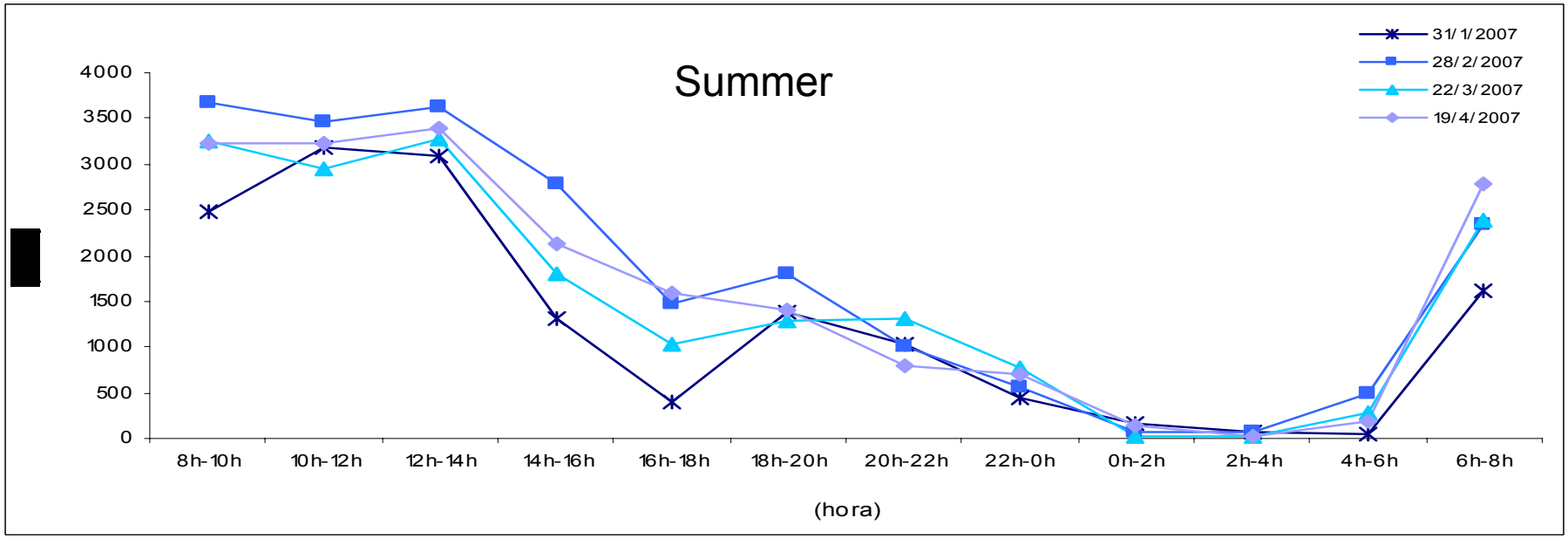
With greywater reuse

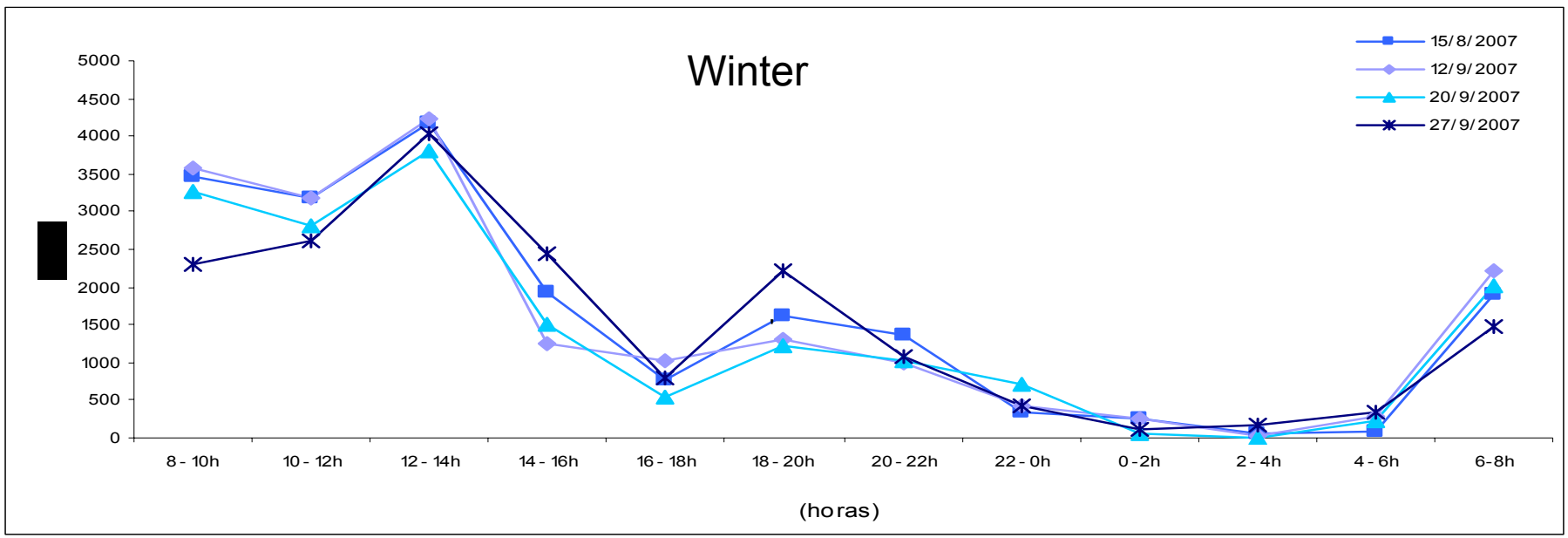
Hidrômetro geral

Hidrômetros individuais

Hidrômetros com saída de sinal

Cold Water Consumption → 24 h

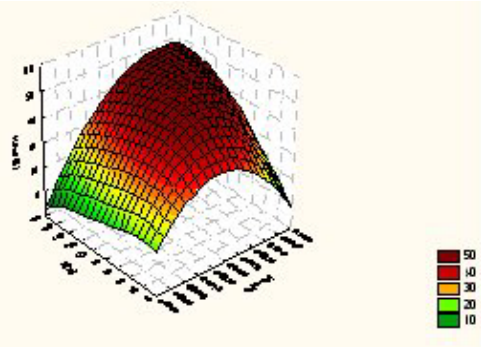




FEDERAL UNIVERSITY OF ITAJUBÁ (UNIFEI)

FEDERAL UNIVERSITY OF PARAÍBA (UFPB)

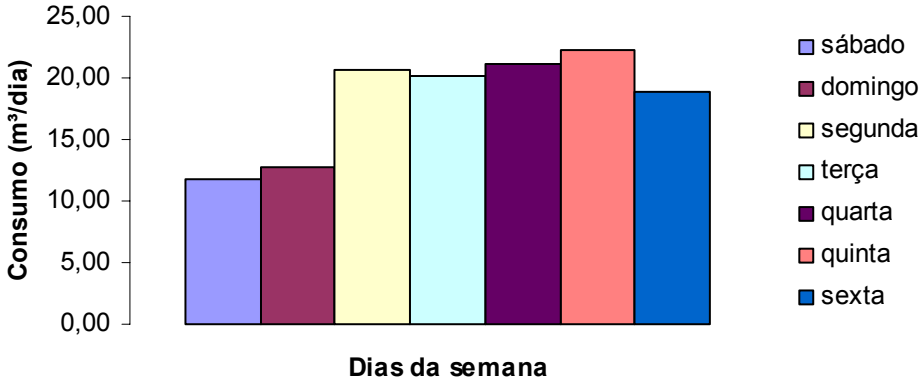
FEDERAL UNIVERSITY OF MATO GROSSO (UFMS)



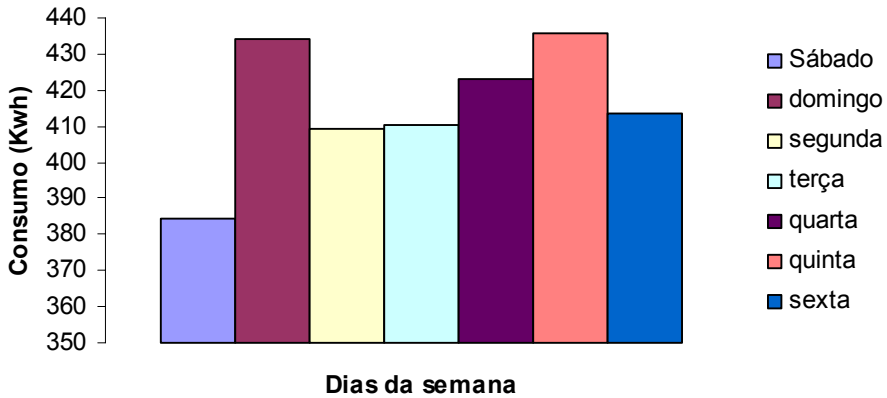
Energy consumption

UFES

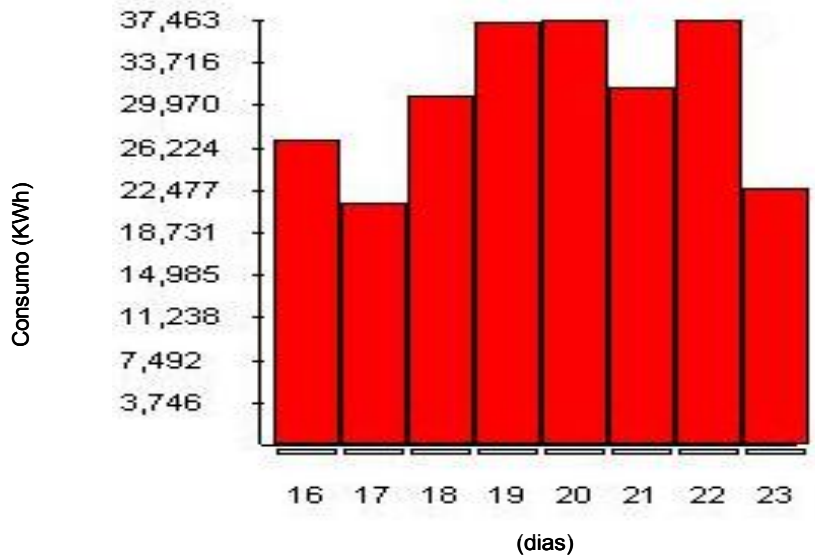
- Characterization
- Quantitative studies
- Optimization studies
- Equipments



Total consumption of water



Total consumption of energy



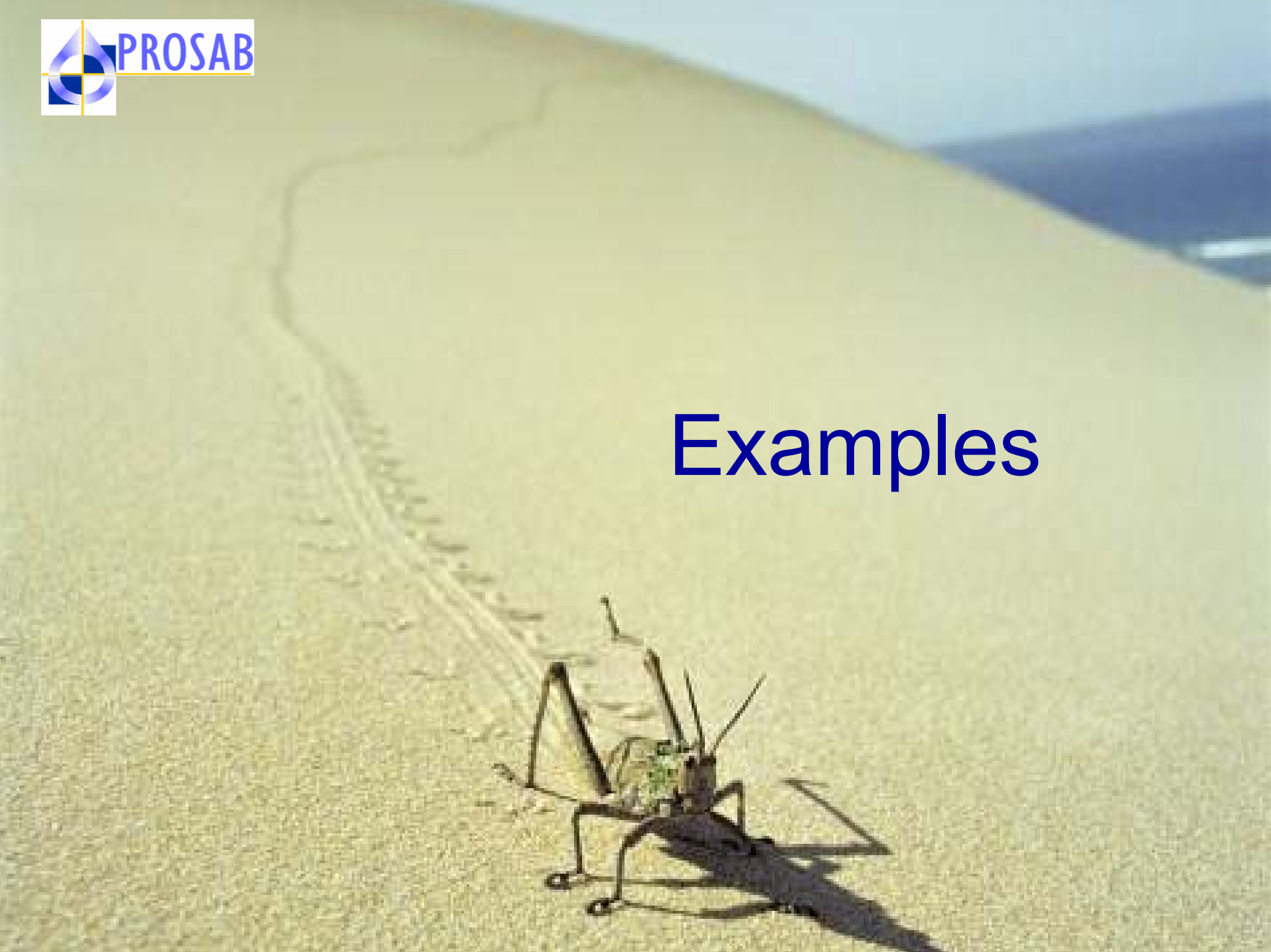
Energy consumption by the pumps

Daily consumption:
18m³ of water
30kwh of energy

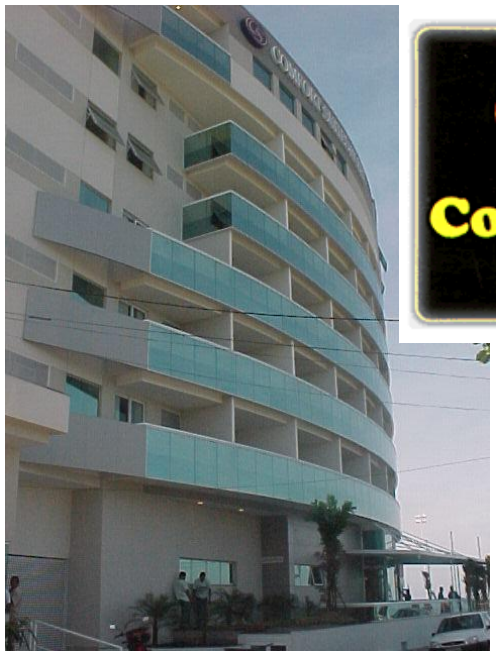
1,65 kwh/m³

7 % total consumption

Examples



Hotel Comfort Suítes / Macaé



- ✓ Greywater reuse
- ✓ 126 apartments
- ✓ Capacity: 252 peoples

CONSTRUTORA
PAES ERLACHER

Ed. Royal Blue / Vitória (ES)

- ✓ Greywater reuse
- ✓ Capacity: 260 inhab.

- ✓ Water consumption = 31.200 l/d
- ✓ Water saving: 30%
- ✓ R$ 120.000,00 (~ US$ 60.000)
- ✓ Payback < = 5 anos

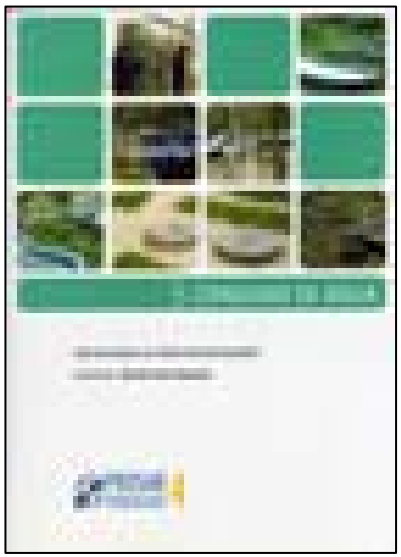
1º Residencial com Estação Hidro-Ecológica no ES

LORENGE
CONSTRUTORA E INCORPORADORA
Há 24 Anos Construindo
Imóveis Para Quem Valoriza a Qualidade

ROYAL BLUE


P8

Book → PROSAB Network 5



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Coordenador:
Prof. Ricardo Franci Gonçalves
Universidade Federal do Espírito Santo.

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Ricardo Franci Gonçalves

franci@npd.ufes.br

fone: (+ 5527)3335 2857
9222 9993