TUBITAK MARMARA RESEARCH CENTER
Environment Institute

APPRAISAL OF TECHNICAL OPTIONS for GREY WATER TREATMENT PROCESSES

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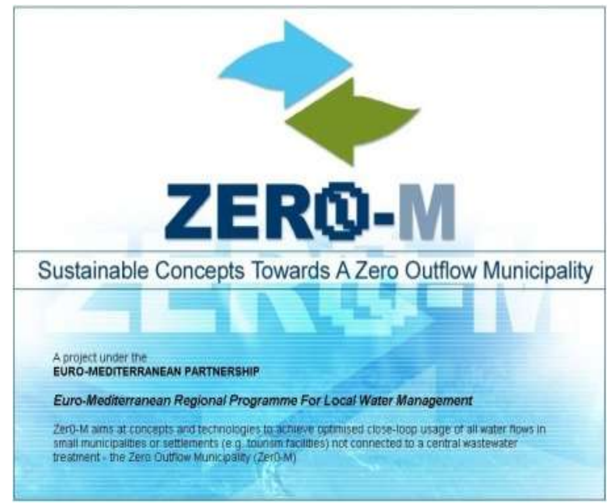
WASTEWATER IN SMALL COMMUNITIES
TOWARDS THE WATER FRAMEWORK DIRECTIVE (WFD)
AND THE MILLENNIUM DEVELOPMENT GOALS (MDG)

Seville
25-28 April 2011

INTRODUCTION

- GW from laundry, dishwashing, bathing
- Low OM, nutrients, pathogens
- Reuse to mitigate water stress, due to climate change
- Achieve SWM in Mediterranean region
- Reused for non-drinkable purposes



Objectives

- Provide information on appraisal of GW treatment options for

    effluent quality, efficiency, reliability, operation, economy,

    compliance reuse standards

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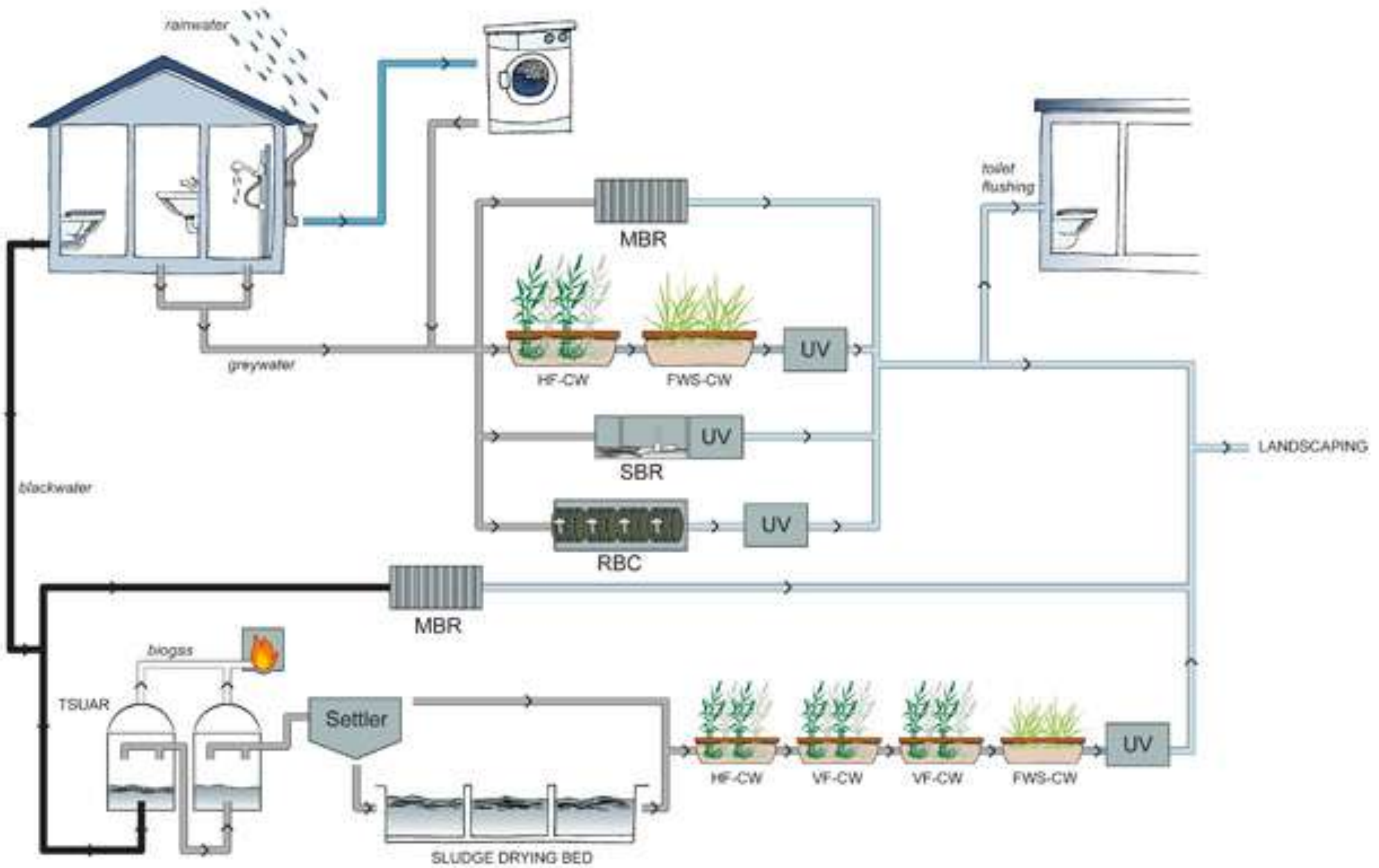
MRC



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MEDA Water

GW inlet characteristics

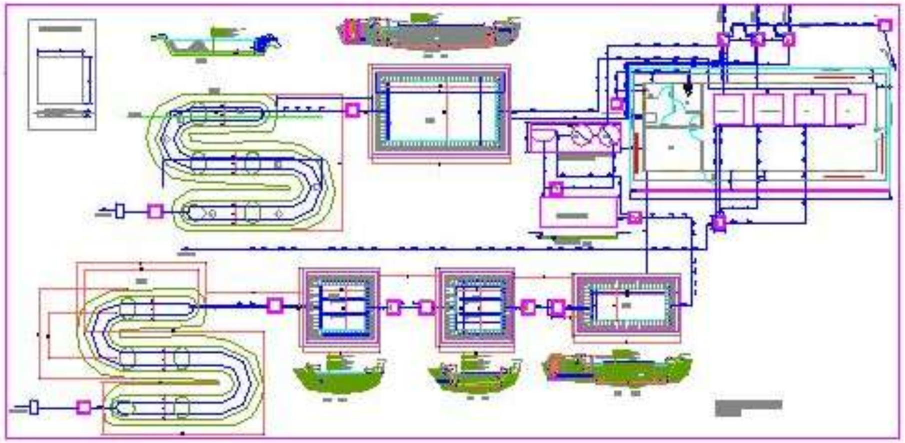
- 2 buildings (28 apartmens)
- 18-26 people (21 avg)
- 18 month period results
- Flow

Q= 197 l/c-d (60%BW 40% GW)

parameter	Influent avg. (std. dev.)
pH	7.2 (0.3)
COD_T, mgL^{-1}	295 (79)
COD_{sol}, mgL^{-1}	191(54)
BOD_5, mgL^{-1}	110 (55)
T Coliform /100mL,	$>10^6$
Turbidity, NTU	90 (50)
TSS, mgL^{-1}	63 (30)
TKN, mgL^{-1}	7.4 (3.7)
NH_4^+-N, mgL^{-1}	1.6 (1.4)
TP, mgL^{-1}	7.3 (3.1)
Alkalinity, $CaCO_3$, mgL^{-1}	192 (29)

Treatment Unit	Operational parameters
RBC	Q= 150 and 400 l/d D=46cm discs (36) radial and concentric passages A=16 m2 R=2-3 rpm OL R= 3.5 and 8.6 gCOD m2/d HLR = 0.03 m^3/m^2d connected settling chamber

Treatment Unit	Operational parameters
CW systems	Q= 1000 l/d area HF – CW = 28 m^2 FWS – CW = 35 m^2 HLR for HF = 36 $l/m^2.d$ Feeding by submerged pump



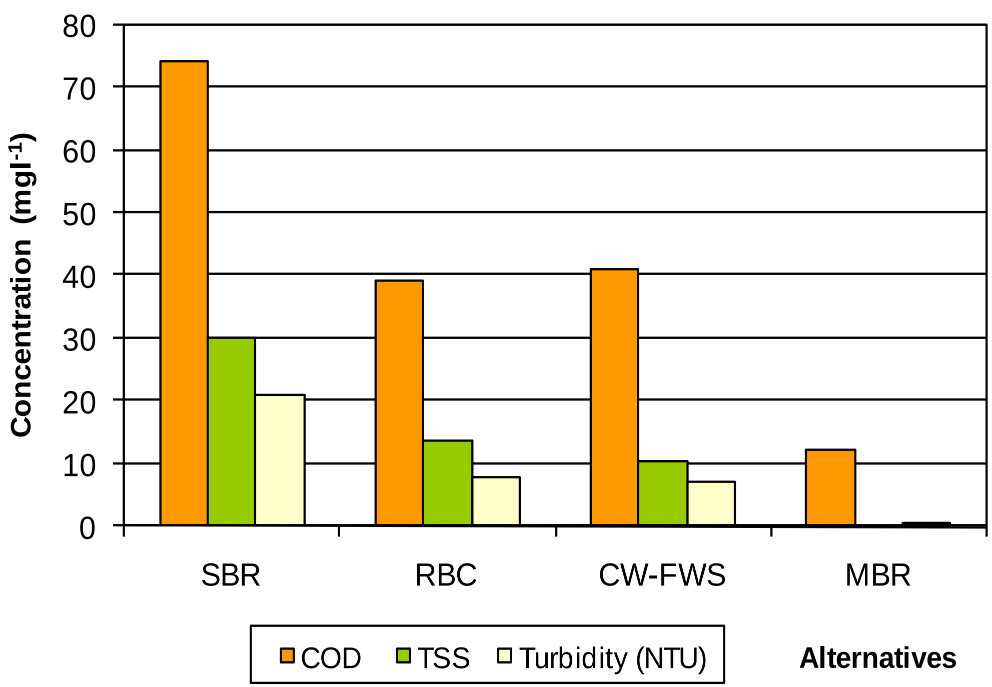
Treatment Unit	Operational parameters
MBR	Q= 800 l/d V= 600 L working vol. BUSSE GmbH Company a micro-filtration plate and frame module (KUBOTA) T. filtration area = 5 m^2 HRT=18h OL=0.3 kgCOD/m^3-d Feeding by submerged pump

Treatment Unit	Operational parameters
SBR	Q= 400 l/d V= 600 L total working vol. by PONTOS GmbH., 2 serial chambers for biological reactions (400L) 3rd tank for storage including UV disinfection. Hybrid SBR had suspended and attached biomass HRT=0.5+0.5 d OLR = 0.15 kg BOD_5/m^3 Feeding by submerged pump

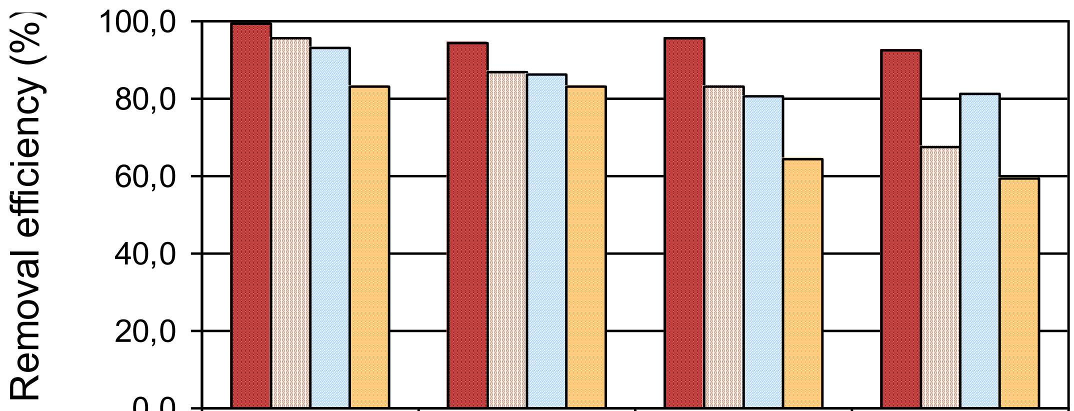
	pH	BOD mgl^{-1}	TSS mgl^{-1}	Fecal C. Number/ 100 ml	E.Coli Number/ 100ml
EPA Suggested Guidelines for water reuse, 2004 [8]					
Urban reuse; All types of landscape irrigation, vehicle washing, toilet flushing, and other uses with similar access or exposure to the water	6-9	≤ 10	≤ 5	ND	-
Agricultural reuse; Food crops not commercially processed	6-9	≤ 10	≤ 5	ND	-
Agricultural reuse; Food crops commercially processed	6-9	≤ 30	≤ 30	<200	-
EU Guidelines (76/160/EEC)[9]					
Bathing waters	6-9	-	-	100 (G); 2,000 (M)	-
WHO (guideline value for grey water use in)[10]					
Restricted irrigation	-	-	-	-	$<10^5$
Unrestricted irrigation of crops eaten raw	-	-	-	-	$<10^3$
Lawn irrigation	-	-	-	200 (G), 1000 (M)	-
Turkey, Water Pollution Control Regulation (WPCR), [12]*					
Irrigation	6.5-8.5	≤100	≤45	≤100	-

(G) guideline, (M) mandatory

Treated GW characteristics



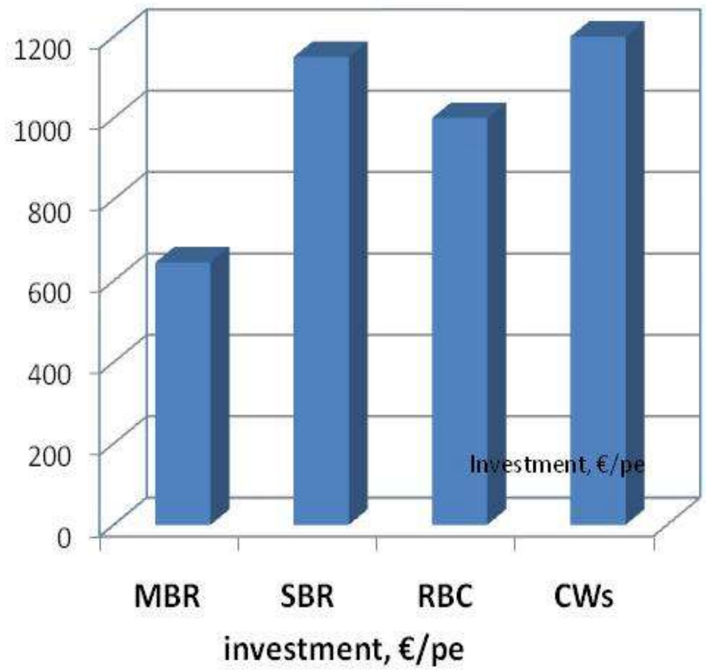
Comparison of GW treatment systems

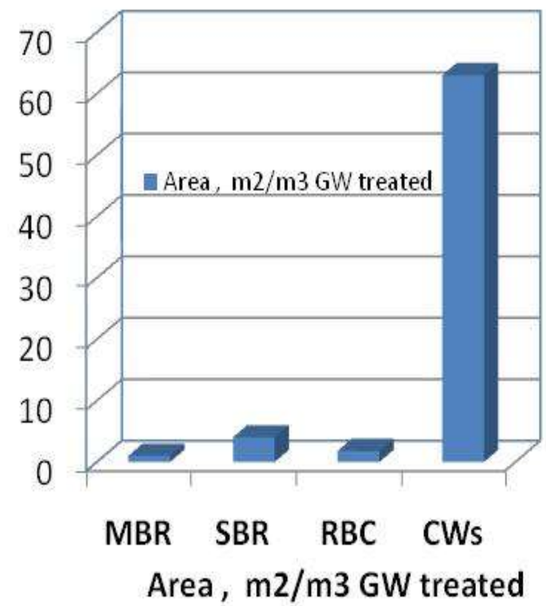


	Turbiditiy	COD	TSS	NH4-N
MBR	99,2	94,7	95,7	92,4
RBC	95,4	87,2	83,0	67,5
HF+FWS	93,1	86,5	80,8	81,3
SBR	83,1	82,9	64,2	59,6

Parameters

Comparison of GW treatment systems





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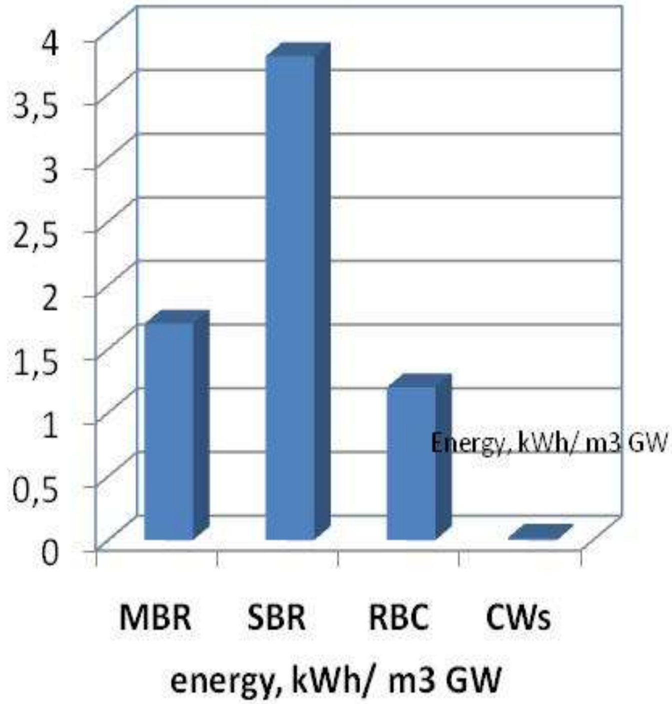

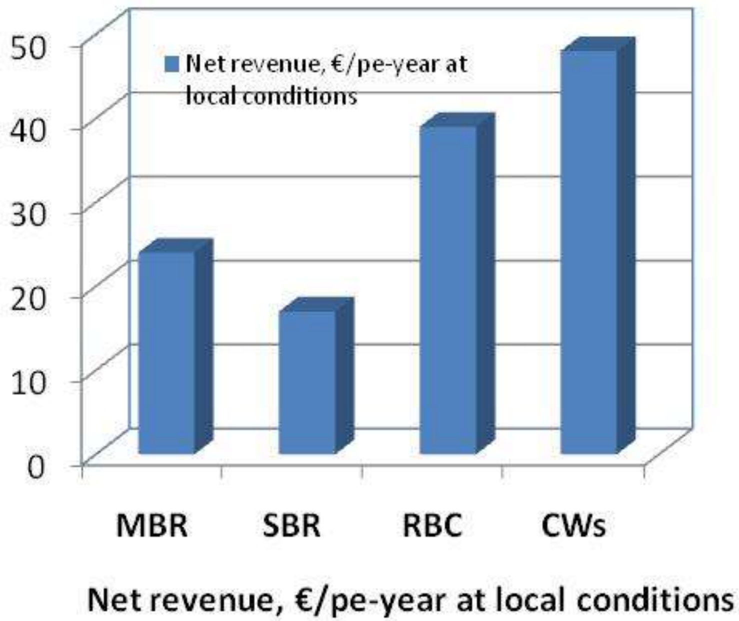

*evaporation was not accounted for CWs

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Assessment of GW treatment technologies applied in this study

Parameters / GW technology	MBR	SBR	RBC	CWs
Operator technical level	high	high	low	low
Sludge , L/ m^3GW-d	5	4-5	1-3	-
Disinfection requirement	no	no (inc. UV)	yes	no
Effluent for reuse,	unrestricted reuse	irrigation, with filtration	irrigation with filtration+UV	irrigation

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Results

• All cases high removal efficiencies

• Best removal performance was obtained with the MBR

•Effluent quality satisfied EPA suggested guidelines urban reuse criteria including toilet flushing

• For all alternatives at least criteria for agricultural reuse for food crops commercially processed (EPA Guidelines) fulfilled mostly.

• Criteria violated sometimes for TSS and turbidity due to detached particles RBC and some detoriations in effluent for SBR → filtration (gravity or pressure recommended)

• For RBC UV disinfection advisable

• For net revenue, calculated based on local electricity and water prices, (5% levelling factor and 5% interest)

• CWs systems are proved to be favorable.

Conclusions

• It was experienced that the most qualified staff required technology for operation is MBR.

• RBC and CWs are quite advantageous for the point of operational ease

• Each system designed and operated possesses own advantages,

• Local conditions in terms of economic, social, environmental and hygienic concerns play the virtual role for appraisal

THANKS