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Performance comparison of three compact systems in grey-water treatment

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Introduction

Greywater

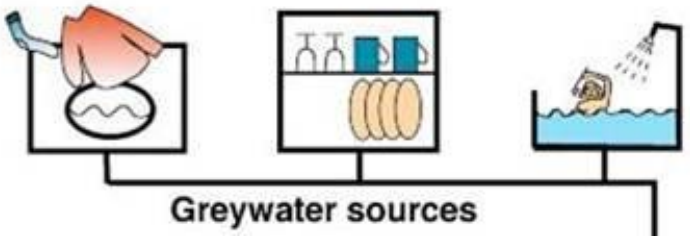
- ✓ Greywater is defined as household wastewater with minimal input of human excreta
- ✓ It includes used water from baths, showers, hand basins, washing machines, dishwashers, laundries and kitchen sinks

→ Greywater is all domestic wastewater except toilet waste

→ In some cases kitchen wastewater is also excluded

Introduction

Greywater



Contribution to domestic wastewater :

- 60–75% of water volume
- 29–62% of organic matter
- 9–14% of Nitrogen
- 20–32% of Phosphorus

Introduction

Drivers for separate greywater treatment

- Greywater is easier to treat than conventional (mixed) wastewater, because it contains almost no pathogens and little ammonia nitrogen

Drivers for treated greywater reuse

* Reduces potable water demand
* Aquifer recharge
* Improved sustainability of water resource management

Introduction

Treated greywater reuse options

- Agriculture and aquaculture
- Irrigation: landscape, golf courses
- Municipal uses

  - Fire protection, street cleaning, car washing, cooling, boiler feed and road construction operation
- Non-potable domestic uses

  - Toilet flushing, air conditioning, laundry, floor cleaning
- Use for recreation

  - Ponds, lakes, streams and fountains
- Discharge to surface water, percolation to groundwater

Introduction

Greywater Treatment depends on : reuse option

-**Outdoor** (Irrigation)

- ✓ Simple system such as :
  - ❖ Sand filter
  - ❖ Settlement
  - ❖ flotation

-**Indoor** (Toilet flushing)

- ✓ A more complex system is required such as :
  - ❖ Membrane bioreactors (MBR)
  - ❖ Rotating biological contactors (RBC)
  - ❖ Sequencing batch reactors (SBR)
  - ❖ Other

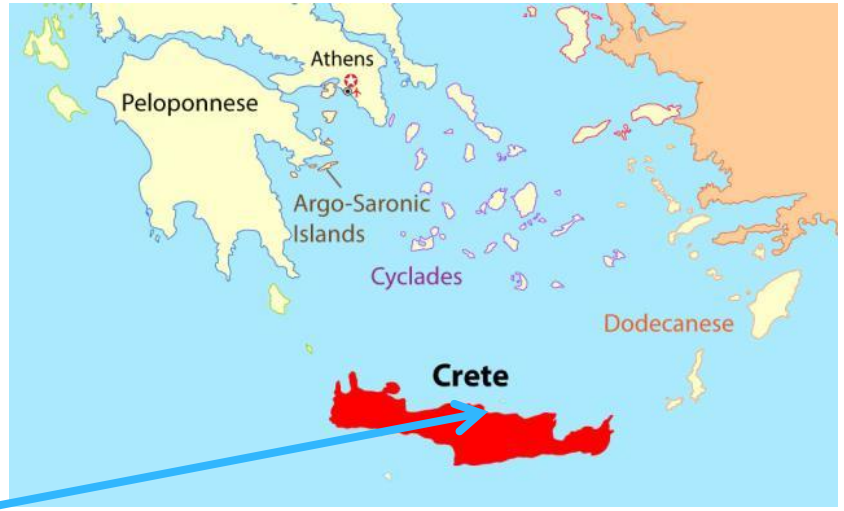
Objective

* During this study the efficiency of three compact treatment systems to treat grey water was examined.

  * **Advantex AX-20**, Orenco systems Inc, USA
  * **Biokinetic BK 2000**, Norwego, USA
  * **Biorock S**, Biorock, Luxemburg

Experimental set-up

The experiment took place in the open-air laboratory of TEI Crete in Heraklion, Greece (N 35º, 19”; E 25º, 10”)



Compact systems

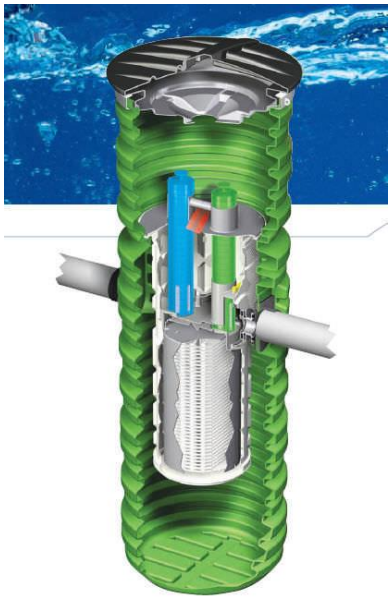
AdvanTex® AX-20, Orenco Systems Inc, USA

- ✓ A packed bed filter using a textile material as the treatment media.

Compact systems

Biokinetic, Norwego, USA

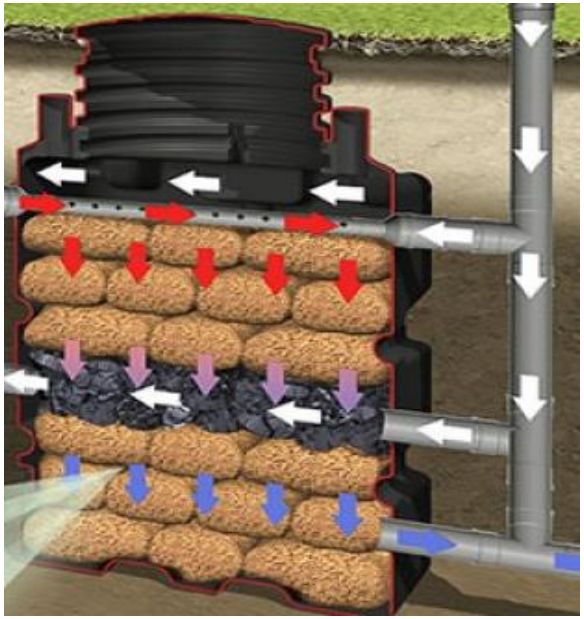
- ✓ Filter bed



Compact systems

BioRock S, BioRock ®, Luxemburg

- ✓ Filter bed



Operation

Artificial grey water

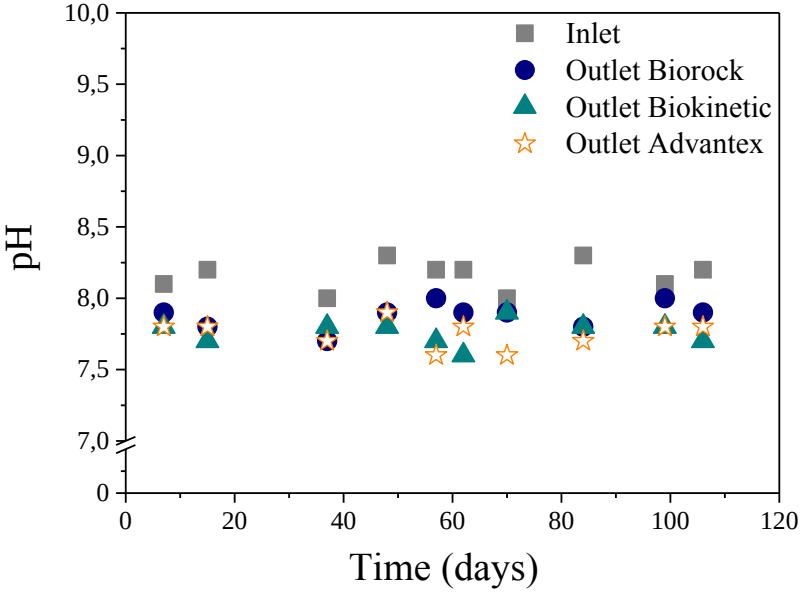
Parameter	Amount
Tertiary treated wastewater	1000 L
Laundry powder	80 g
Soaps	100 g

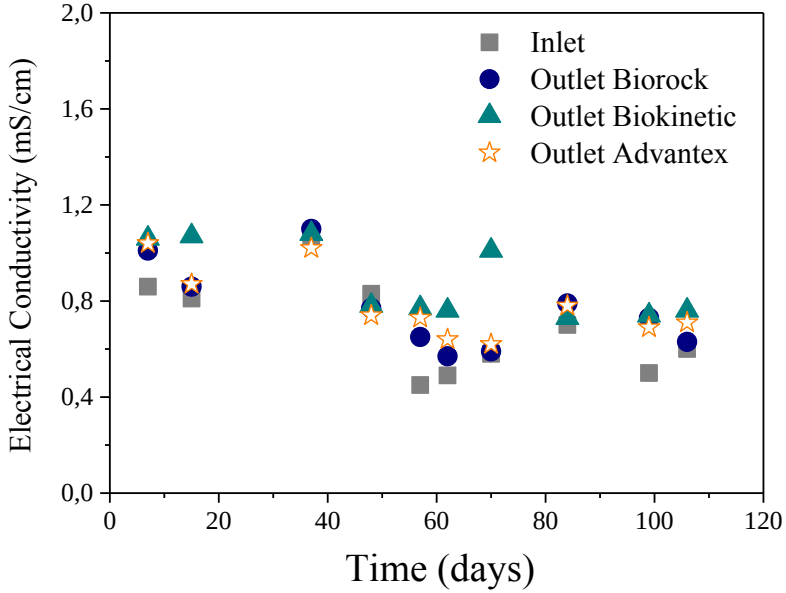
Monitoring

- Influent and effluent were sampled regularly and analyzed for:

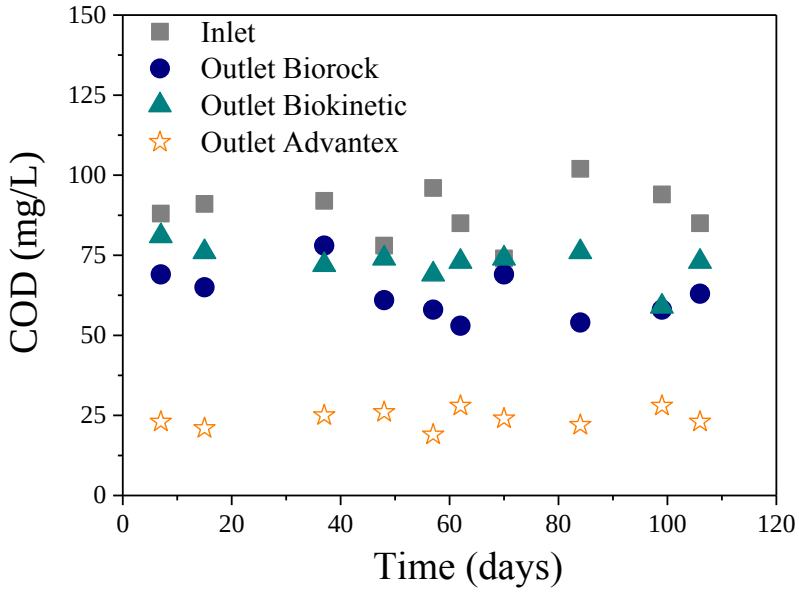
- ❖ pH (pH-meter 3110, WTW)
- ❖ Electrical Conductivity (EC-meter 525, Crison)
- ❖ Chemical oxygen demand (test kits,Hach-Lange)
- ❖ Total Nitrogen (test kits,Hach-Lange)
- ❖ Total Phosphorus(test kits,Hach-Lange)
- ❖ Anionic Surfactants (test kits,Hach-Lange)
- ❖ Total Coliforms (IDEXX Quanti-Tray®)

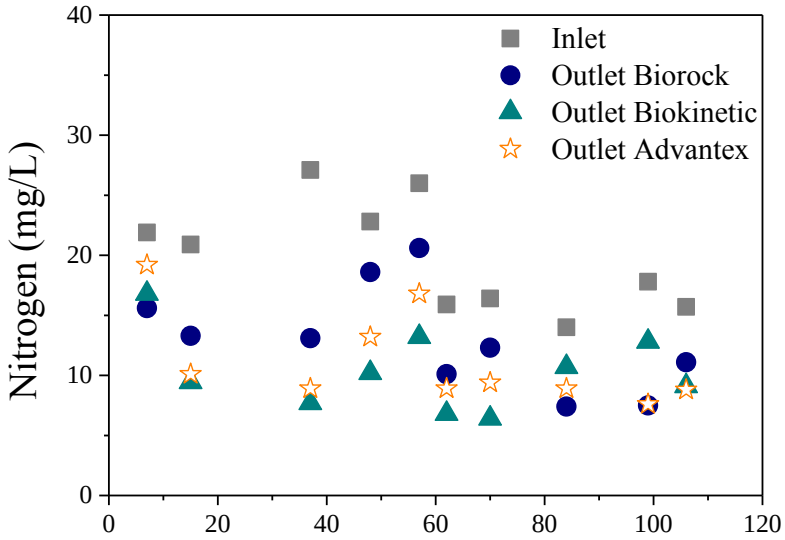
Results


pH
Time (days)
Inlet
Outlet Biorock
Outlet Biokinetic
Outlet Advantex
10,0
9,5
9,0
8,5
8,0
7,5
7,0
0
0
20
40
60
80
100
120

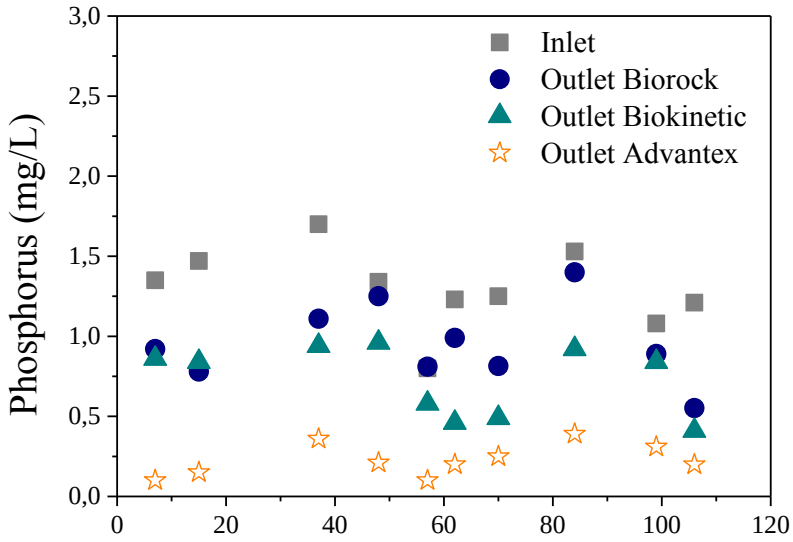

Electrical Conductivity (mS/cm)
Time (days)
Inlet
Outlet Biorock
Outlet Biokinetic
Outlet Advantex
2,0
1,6
1,2
0,8
0,4
0,0
0
20
40
60
80
100
120

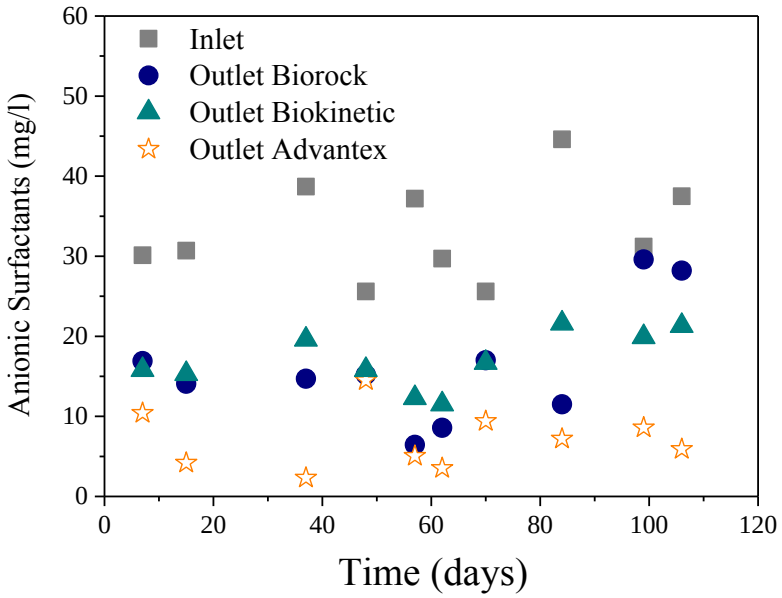
Results


COD (mg/L)
Time (days)
Inlet
Outlet Biorock
Outlet Biokinetic
Outlet Advantex
0
25
50
75
100
125
150
0
20
40
60
80
100
120


Nitrogen (mg/L)
Inlet
Outlet Biorock
Outlet Biokinetic
Outlet Advantex
0
10
20
30
40
0
20
40
60
80
100
120

Results


Phosphorus (mg/L)
3,0
2,5
2,0
1,5
1,0
0,5
0,0
0
20
40
60
80
100
120
Inlet
Outlet Biorock
Outlet Biokinetic
Outlet Advantex


Anionic Surfactants (mg/l)
60
50
40
30
20
10
0
0
20
40
60
80
100
120
Time (days)
Inlet
Outlet Biorock
Outlet Biokinetic
Outlet Advantex

Results

Parameter	Influent	Effluent Biorock	Effluent Biokinetic	Effluent Advantex
pH	8.2 ± 0.1	7.9 ± 0.1	7.8 ± 0.1	7.8 ± 0.1
EC (mS/cm)	0.69 ± 0.20	0.77 ± 0.18	0.88 ± 0.16	0.78 ± 0.15
COD (mg/l)	88 ± 12	63 ± 10	73 ± 13	24 ± 6
TN (mg/l)	19.9 ± 4.6	13.0 ± 4.3	11.2 ± 4.0	10.3 ± 3.2
TP (mg/l)	1.3 ± 0.3	1.0 ± 0.3	0.7 ± 0.2	0.2 ± 0.1
Surfactants (mg/l)	33 ± 6	16 ± 7	17 ± 4	7 ± 4
Total Coliforms (MPN/100ml)	4.8×10^4	3.4×10^3	3.2×10^3	1.9×10^2

Conclusion

* A slightly decrease of pH value and a slightly increase of EC values were observed in effluents for all examined systems
  * This should be under consideration in case of outdoor reuse (for irrigation)
* COD concentration in effluents was lower for Advantex system (~25mg/l)

Conclusion

* Low removal of nitrogen was observed for all examined systems
* Anionic surfactants decreased in all effluents especially using Advantex system
* Pathogen risk was not eliminated, indicated that a chlorination process or a UV system should be added

Thank you for your attention

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