Assessment of some constructed wetland systems for treating wastewater and reuse it for irrigation purposes.

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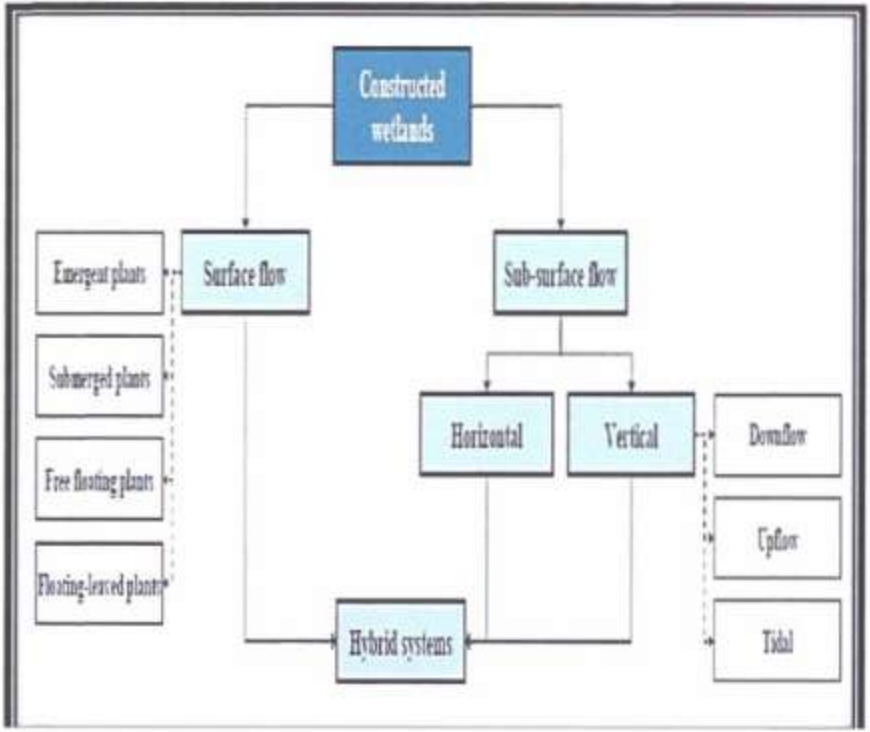
OUTLINE

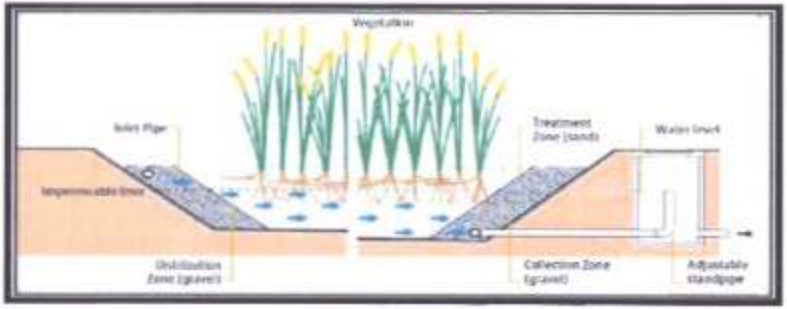
- **Background information:**
  - Definition
  - type of systems.
- **Ability of using these system in Iraq.**
  - Problem statement.
  - Research questions.
  - Research objectives .
- **Materials and methods**
  - Location
  - System design
  - infrastructure process
  - Operation and samples collection
- **The results.**
- **Conclusion.**

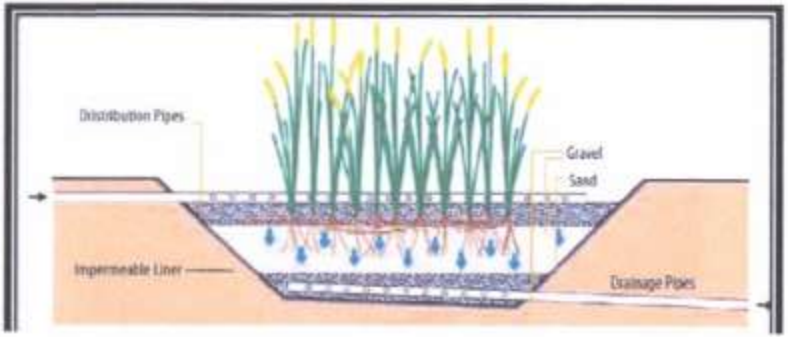
Introduction

- Constructed wetland treatment system, an engineering system was effectively used for treating wastewater from various pollutants, created from the cooperation of wetland plants, micro-organisms, substrate and other component.
- They are constructed to recreate, to the extent possible, the structure and function of natural wetlands, which is to act as filters or "nature's kidneys."
- They possess a rich microbial community in the sediment to effect the biochemical transformation of pollutants
- they are biologically productive, and most importantly, they are self-sustaining.
- These factors make constructed treatment wetlands a very attractive option for water treatment compared to conventional systems, especially when lifetime operating costs are compared.
- It has been widely implemented around the world for treating a variety of wastewater types due to their low construction costs, minimal energy consumption and easy operation (Vymazal, 2011a).

Types of constructed wetland systems







The ability of using constructed wetland systems in Iraq

➢Problem statement

- Iraqi population in 2017..is estimated 37milion.
- Produced around :
- Number of conventional wastewater treatment plants 11 main station and 27 sub station serve about 25% of Iraqi population if its perfectly worked!!!
- there is still around 75% of waste water without treatment.

Q: Where it goes ???????????

➢ Research questions :

- **Firstly, to what extent could the use of constructed wetland systems treat wastewater in Iraq?**
- **Secondly, is the treated water received from constructed wetland systems suitable for irrigation?**

➢ Research objectives :

- **First: Assessment of locally built constructed wetland systems as an effective way to treat wastewater.**
- **Second: Assessment of native species of aquatic plants that could be used in these systems.**
- **Third: Evaluation of the use of treated water produced by constructed wetland for irrigation.**

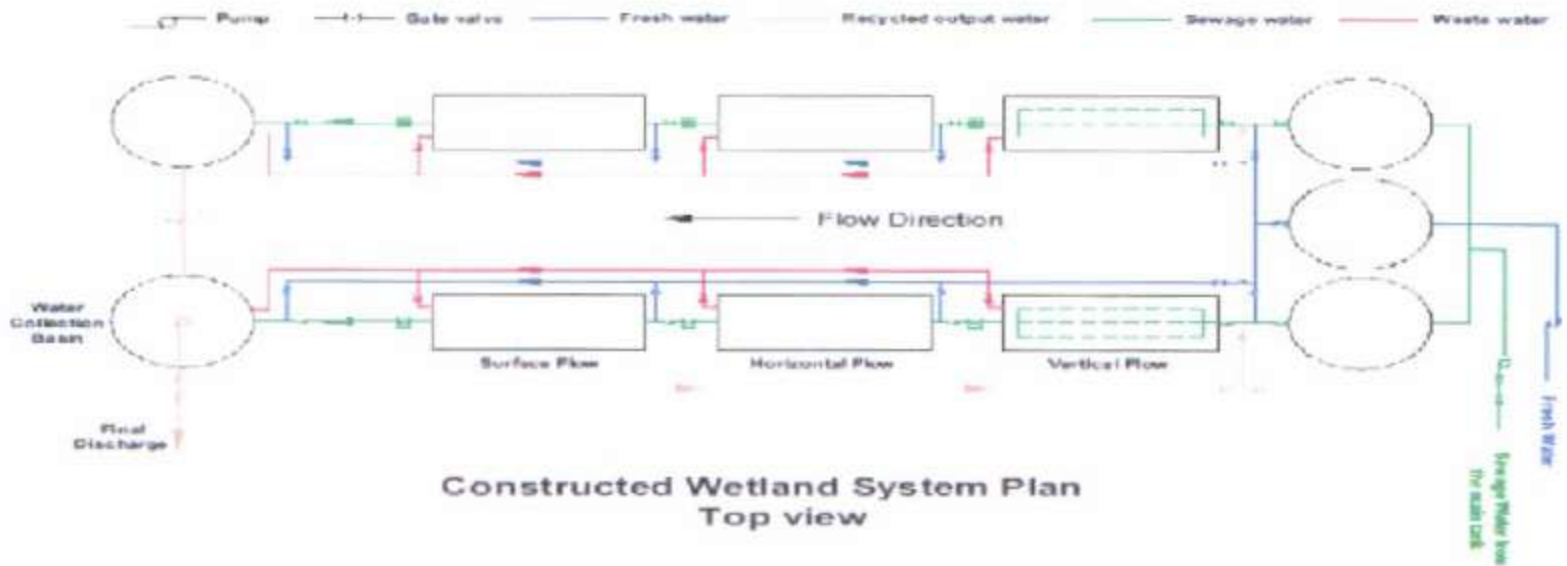
Materials and Methods

Constructed Wetland Station

Study Area

University of Basra

Design of Constructed Wetland Station

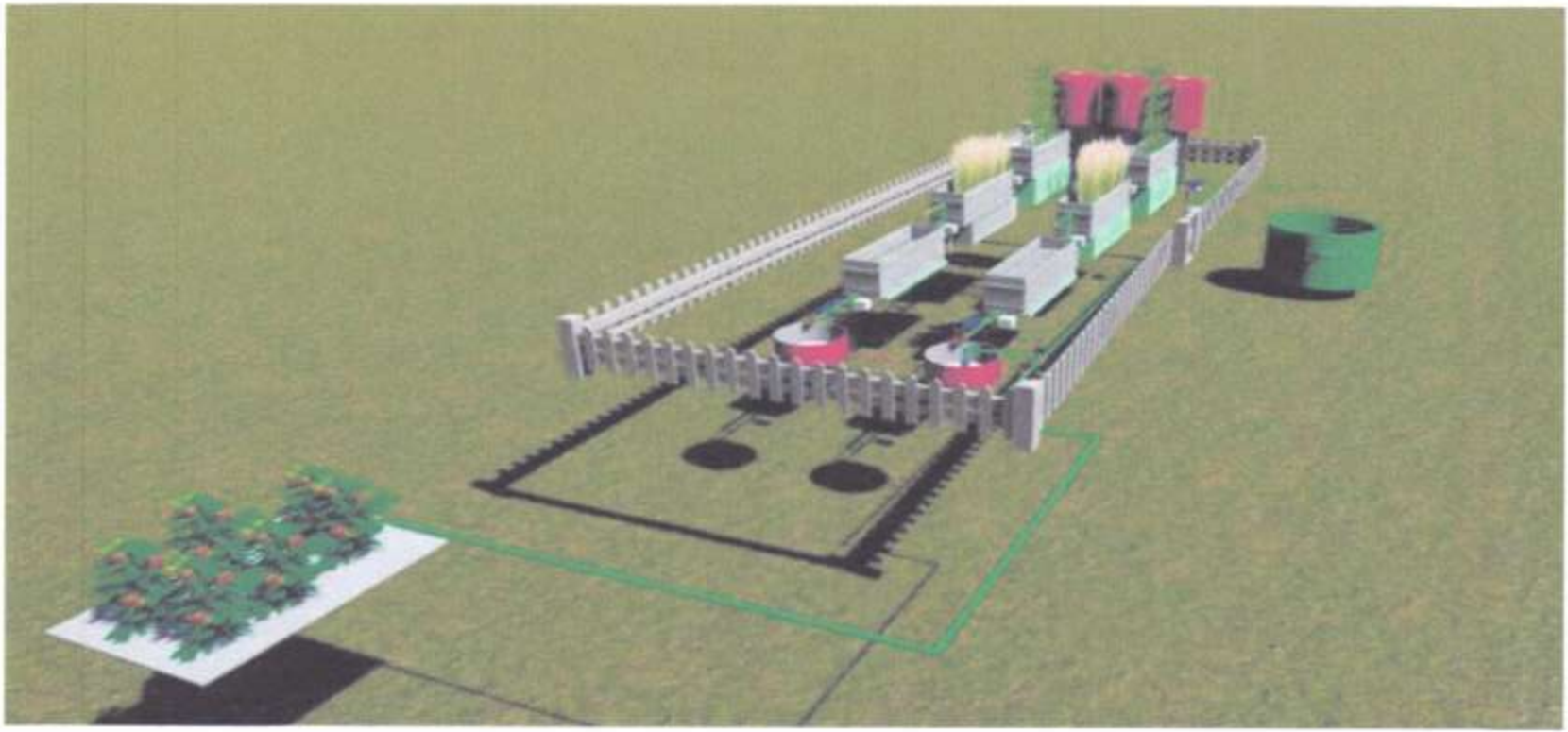


Constructed Wetland System Plan
Top view

Infrastructure process

The project area “up view”

Three dimensions view of The station



Before

After

• Operation methods

➢Stable operation:

✓When the systems separately Tested

➢ Movement operation:

✓When the systems operated as "Hybrid"

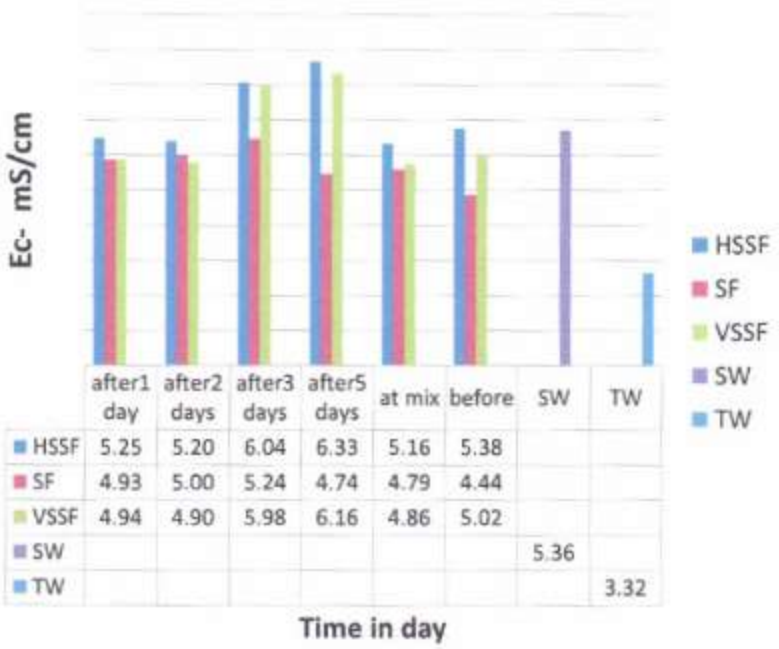
• Water quality parameters

- Ec
- T°
- pH
- Do
- BOD
- COD
- NH4-N
- TN
- TP
- PO4
- TURB.
- TSS
- F.C.B

The main Finding

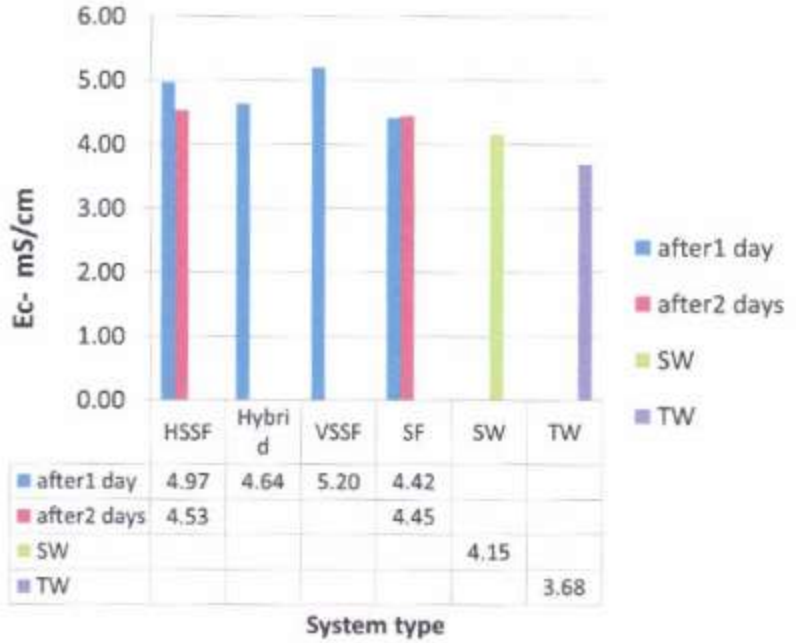
EC with type of system

Stable



	after1 day	after2 days	after3 days	after5 days	at mix	before	SW	TW
HSSF	5.25	5.20	6.04	6.33	5.16	5.38		
SF	4.93	5.00	5.24	4.74	4.79	4.44		
VSSF	4.94	4.90	5.98	6.16	4.86	5.02		
SW							5.36	
TW								3.32

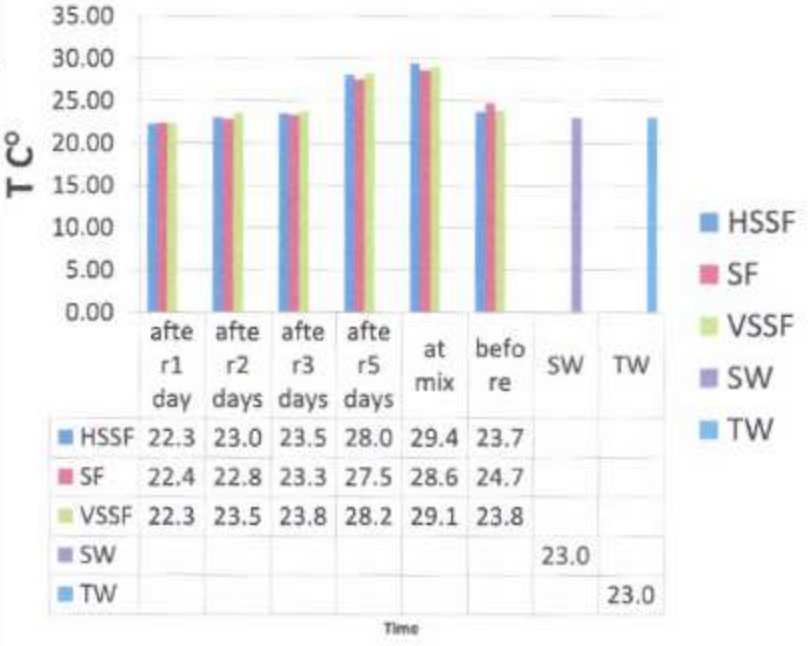
Movement



	HSSF	Hybrid	VSSF	SF	SW	TW
after1 day	4.97	4.64	5.20	4.42		
after2 days	4.53			4.45		
SW					4.15	
TW						3.68

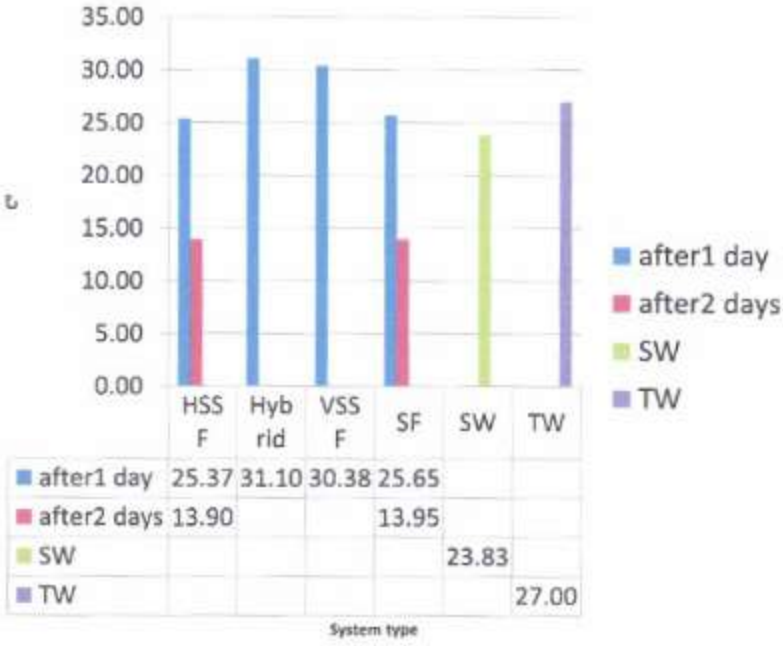
Temperature with the type of system

Stable



	after1 day	after2 days	after3 days	after5 days	at mix	before	SW	TW
HSSF	22.3	23.0	23.5	28.0	29.4	23.7		
SF	22.4	22.8	23.3	27.5	28.6	24.7		
VSSF	22.3	23.5	23.8	28.2	29.1	23.8		
SW							23.0	
TW								23.0

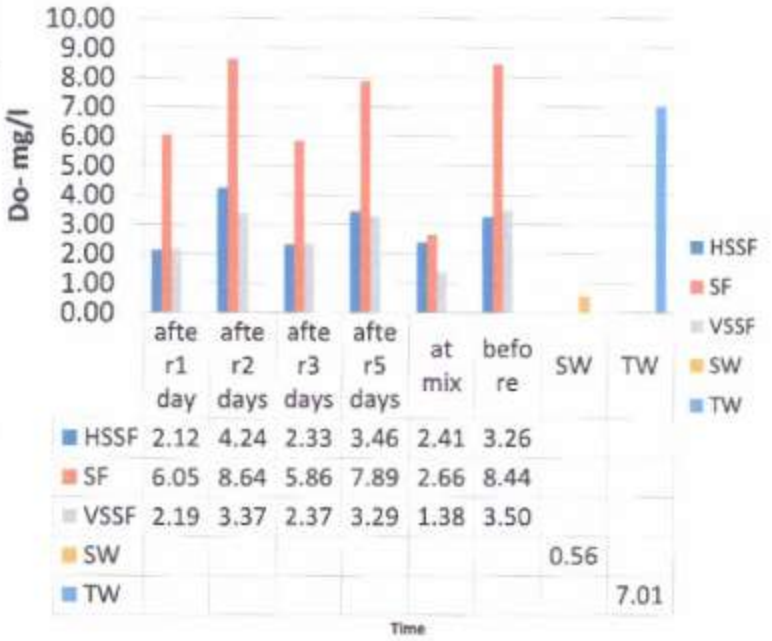
Movement



	HSSF	Hybrid	VSSF	SF	SW	TW
after1 day	25.37	31.10	30.38	25.65		
after2 days	13.90			13.95		
SW					23.83	
TW						27.00

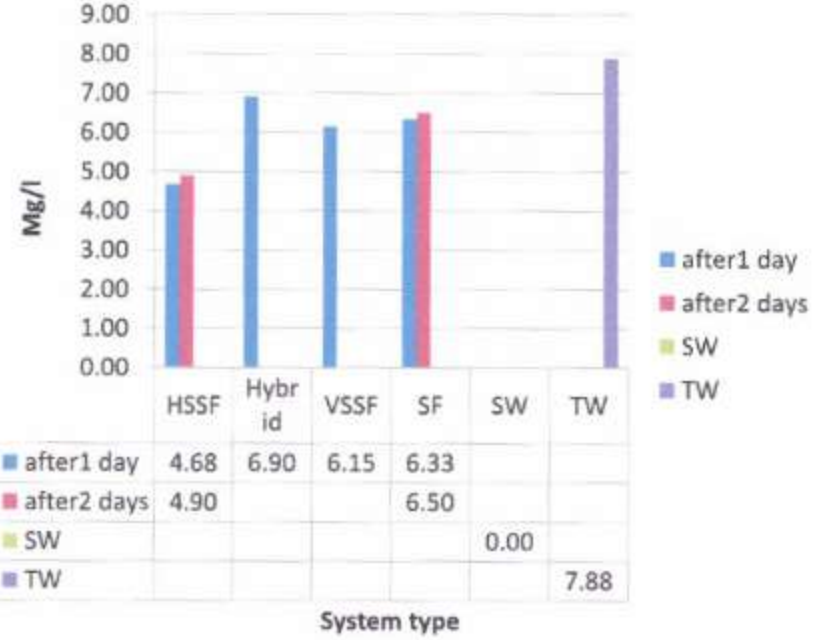
Dissolved Oxygen with the type of system

Stable



	after1 day	after2 days	at mix	before	SW	TW
HSSF	2.12	4.24	2.33	3.46	2.41	3.26
SF	6.05	8.64	5.86	7.89	2.66	8.44
VSSF	2.19	3.37	2.37	3.29	1.38	3.50
SW						0.56
TW						7.01

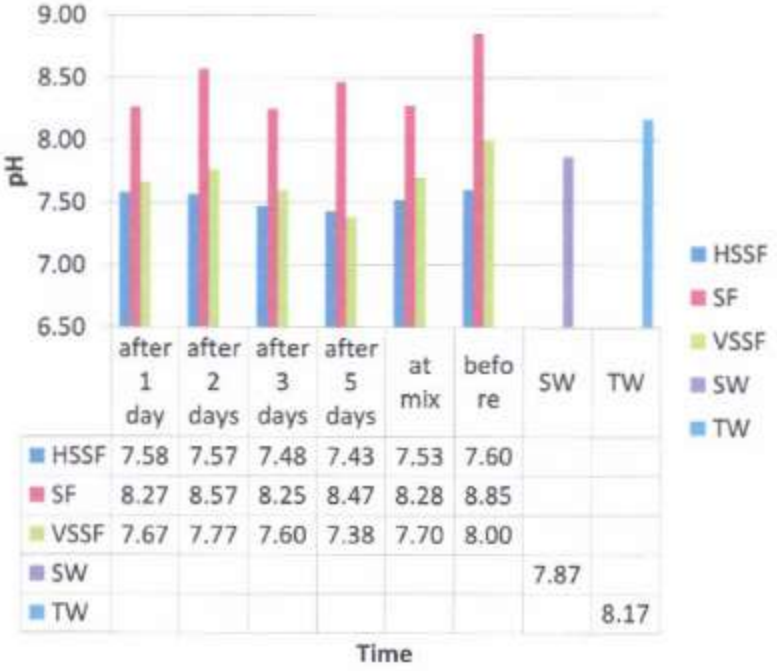
movement



	HSSF	Hybrid	VSSF	SF	SW	TW
after1 day	4.68	6.90	6.15	6.33		
after2 days	4.90			6.50		
SW					0.00	
TW						7.88

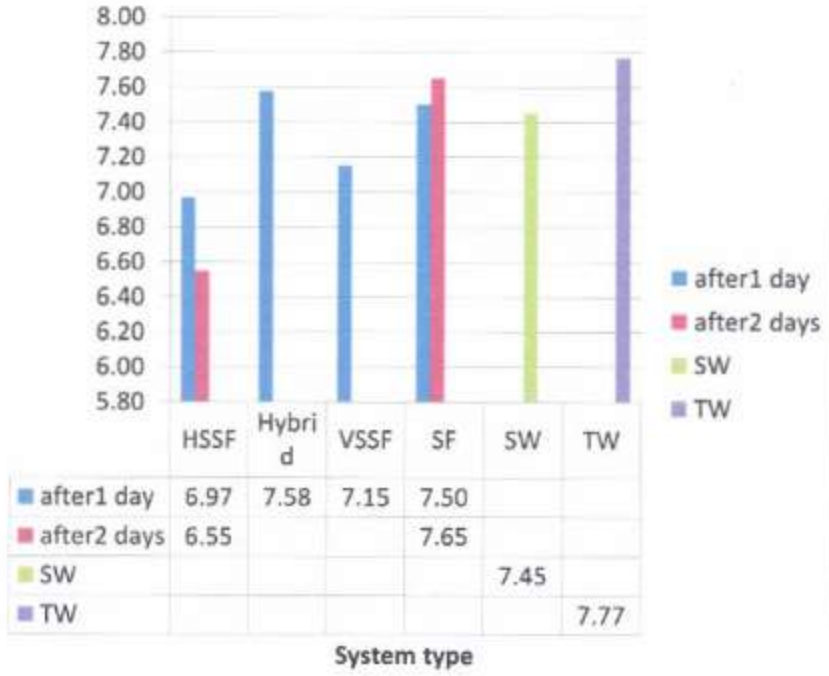
pH with type of system

Stable



	after 1 day	after 2 days	after 3 days	after 5 days	at mix	befo re	SW	TW
HSSF	7.58	7.57	7.48	7.43	7.53	7.60		
SF	8.27	8.57	8.25	8.47	8.28	8.85		
VSSF	7.67	7.77	7.60	7.38	7.70	8.00		
SW							7.87	
TW								8.17

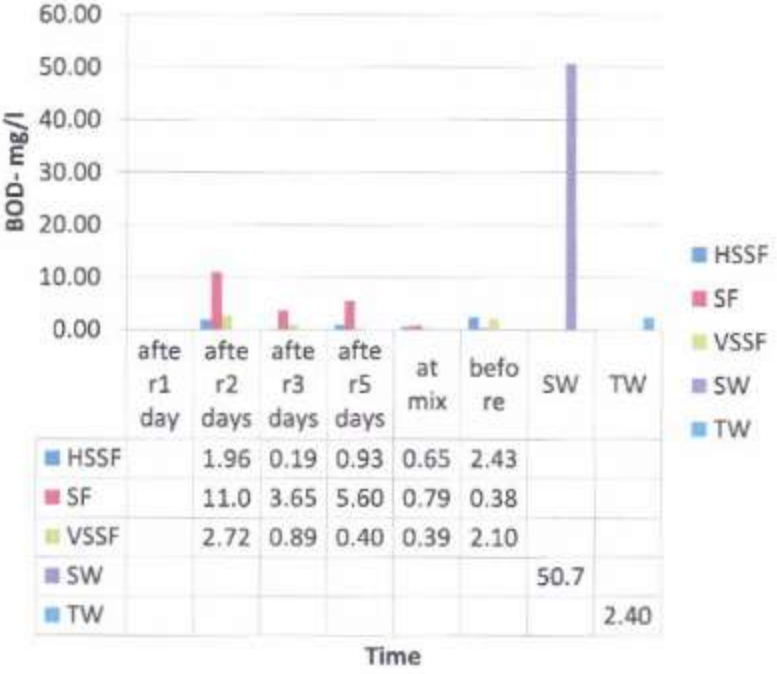
movement



	HSSF	Hybrid	VSSF	SF	SW	TW
after1 day	6.97	7.58	7.15	7.50		
after2 days	6.55			7.65		
SW					7.45	
TW						7.77

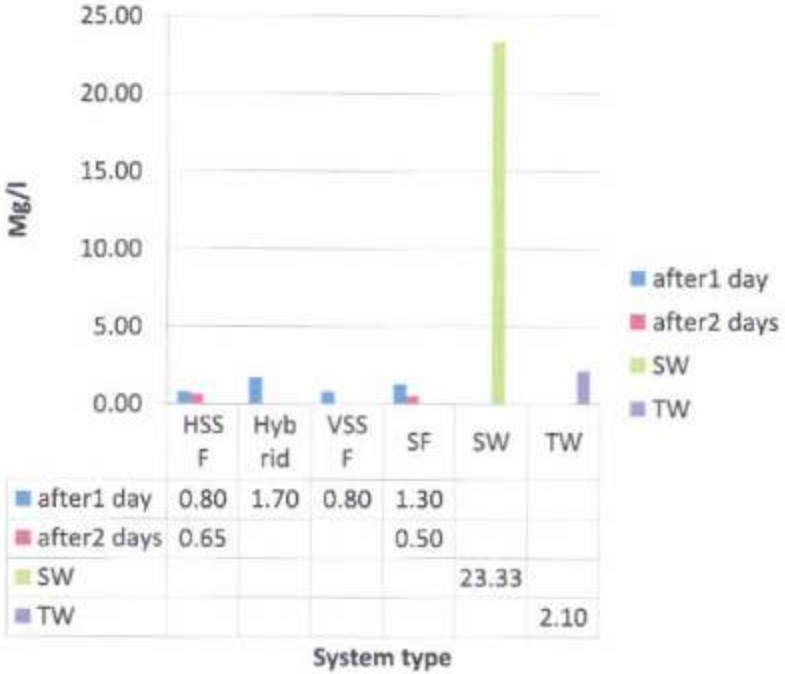
BOD-with type of system

Stable



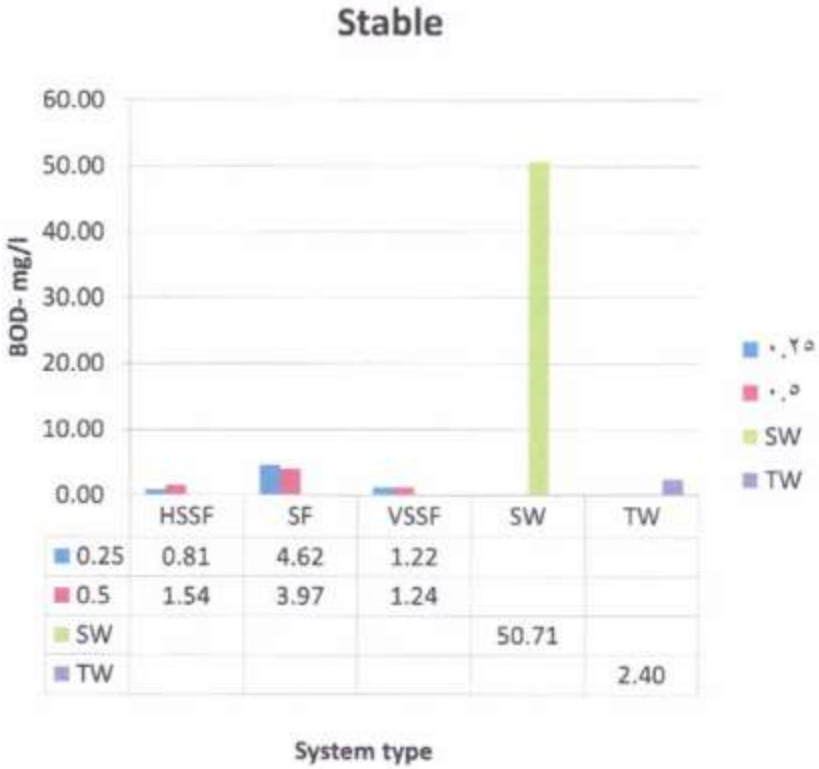
	after1 day	after2 days	after3 days	after5 days	at mix	before	SW	TW
HSSF		1.96	0.19	0.93	0.65	2.43		
SF		11.0	3.65	5.60	0.79	0.38		
VSSF		2.72	0.89	0.40	0.39	2.10		
SW							50.7	
TW								2.40

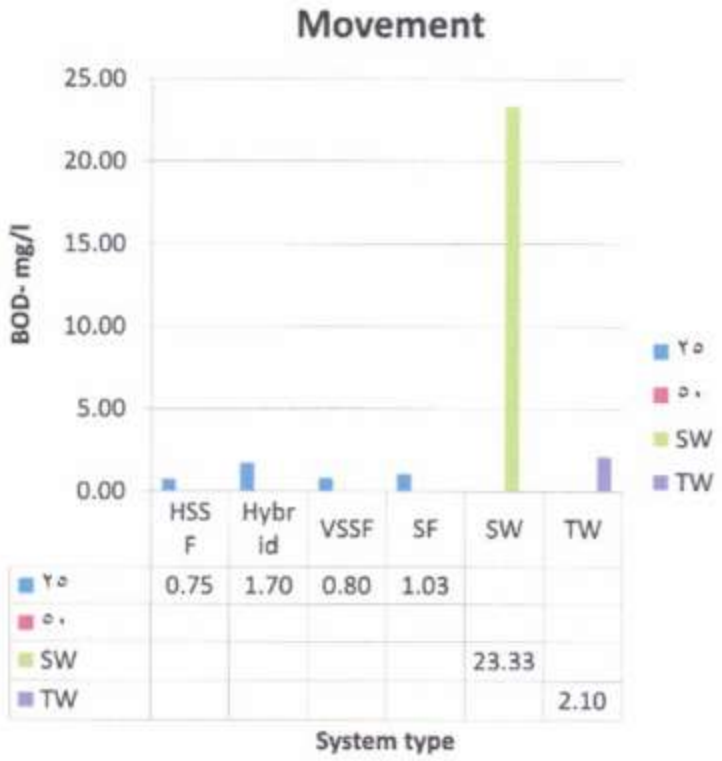
Movement



	HSSF	Hybrid	VSSF	SF	SW	TW
after1 day	0.80	1.70	0.80	1.30		
after2 days	0.65			0.50		
SW					23.33	
TW						2.10

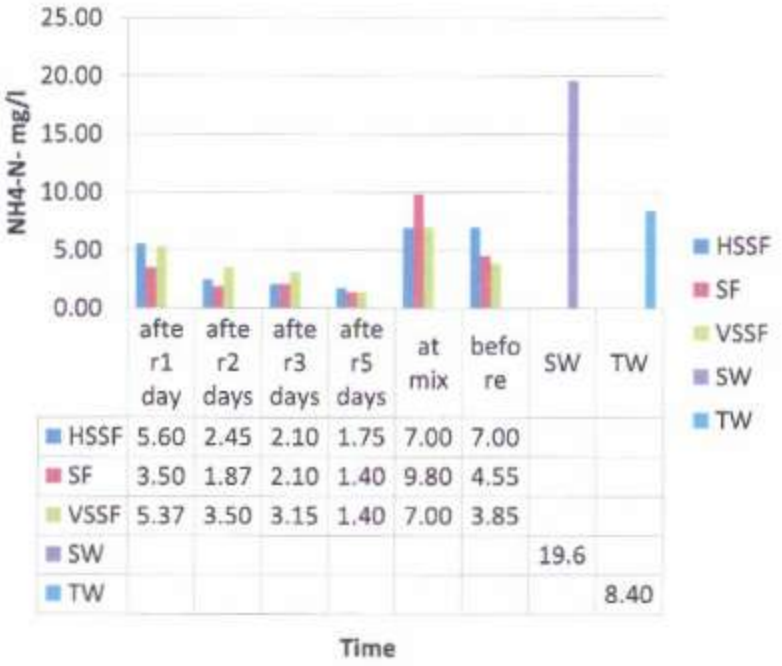
BOD with loading rate percentage:



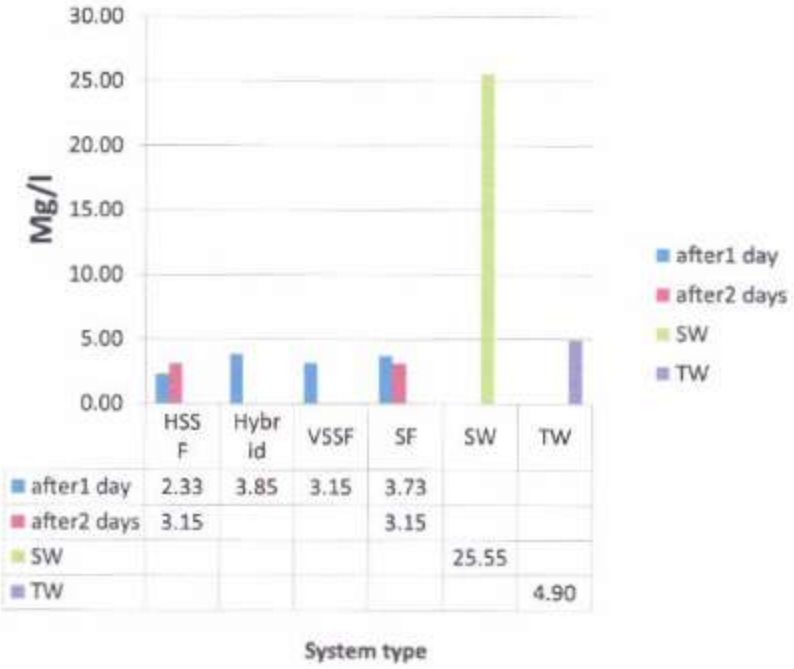


NH4-N with the type of system

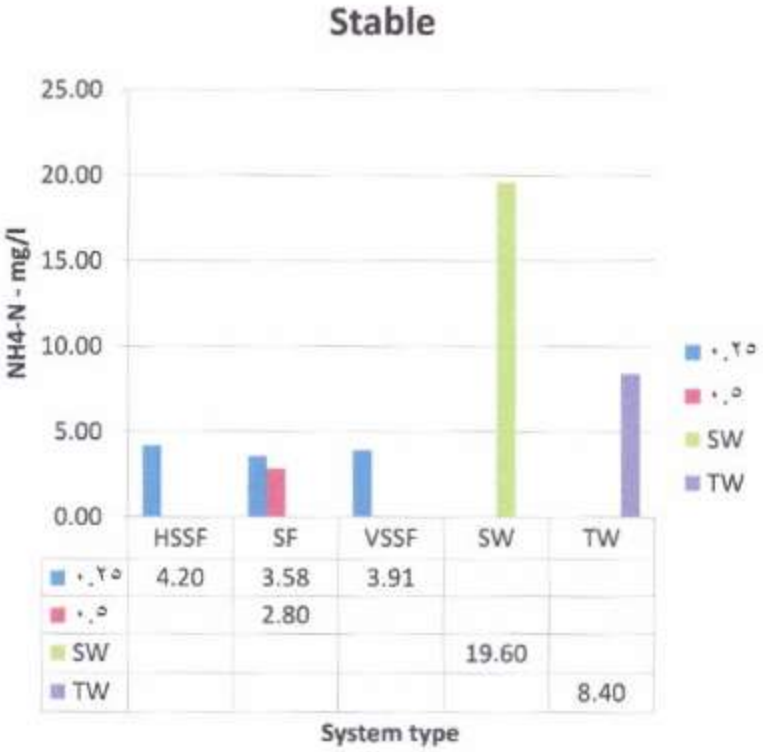
Stable

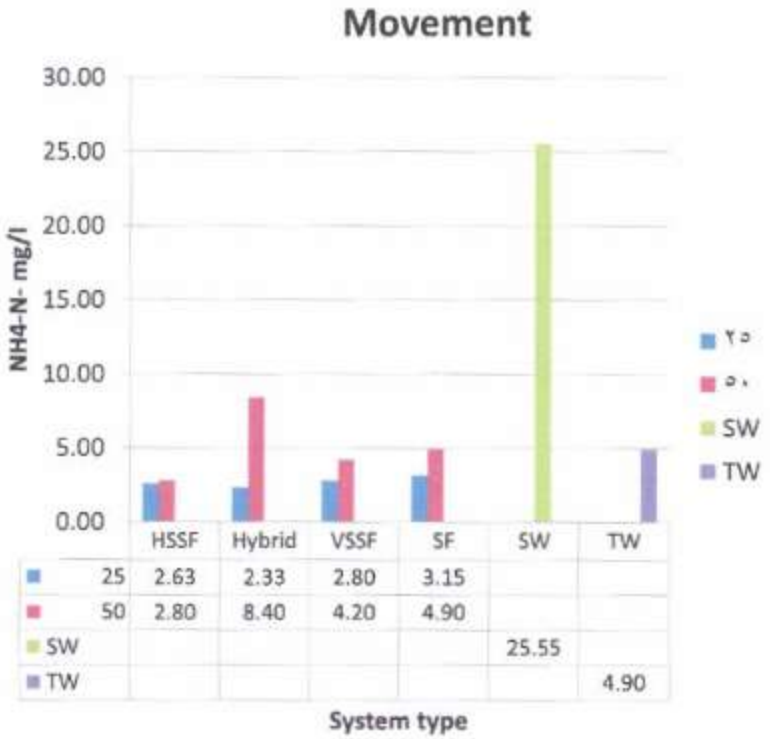


Movement

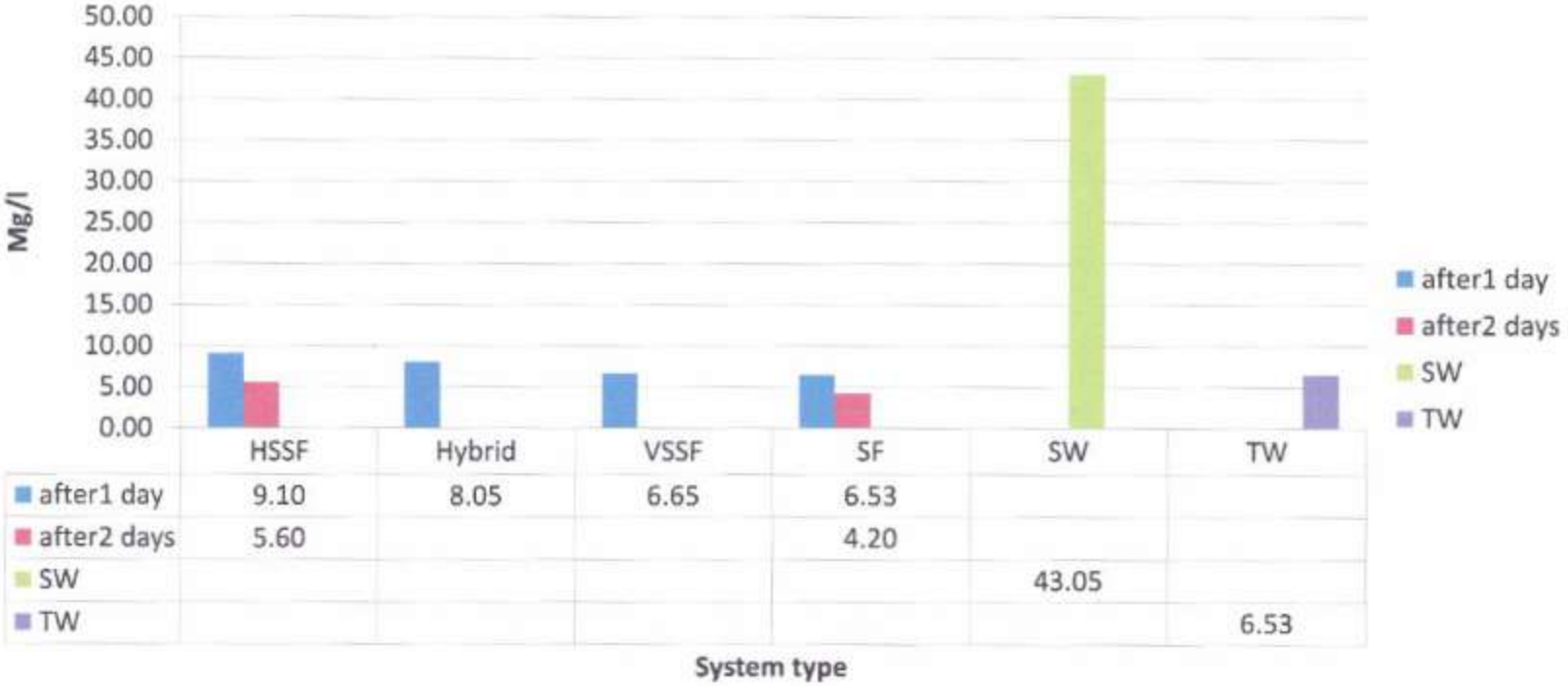


NH4-N with loading rate



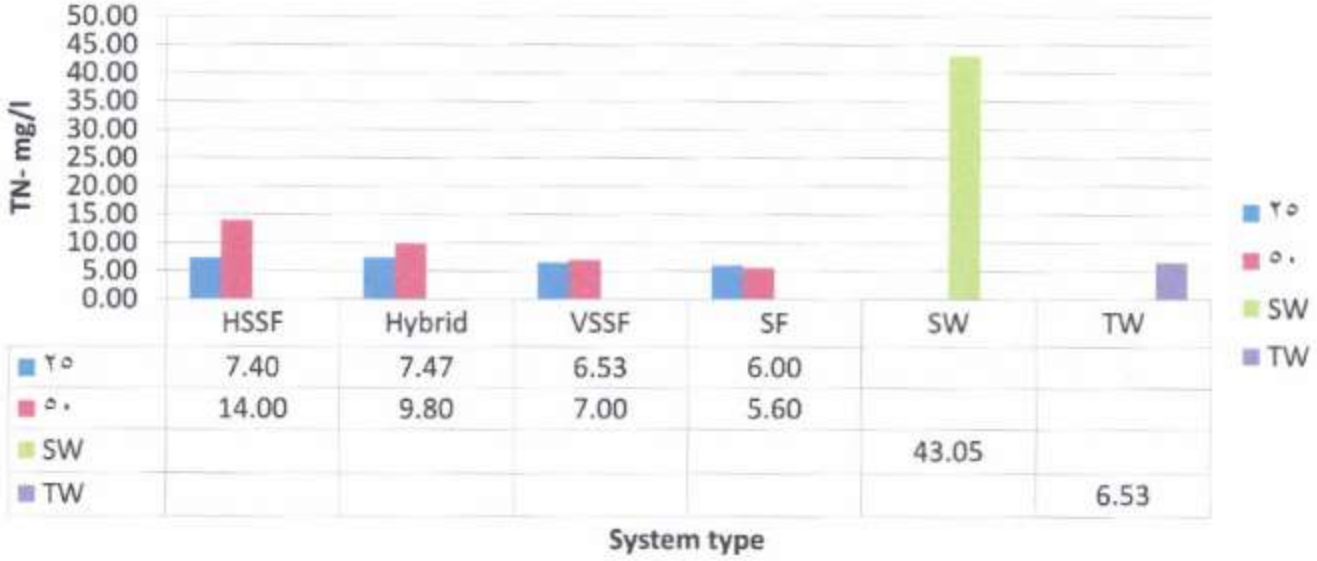


TN-with the type of system in movement operation method



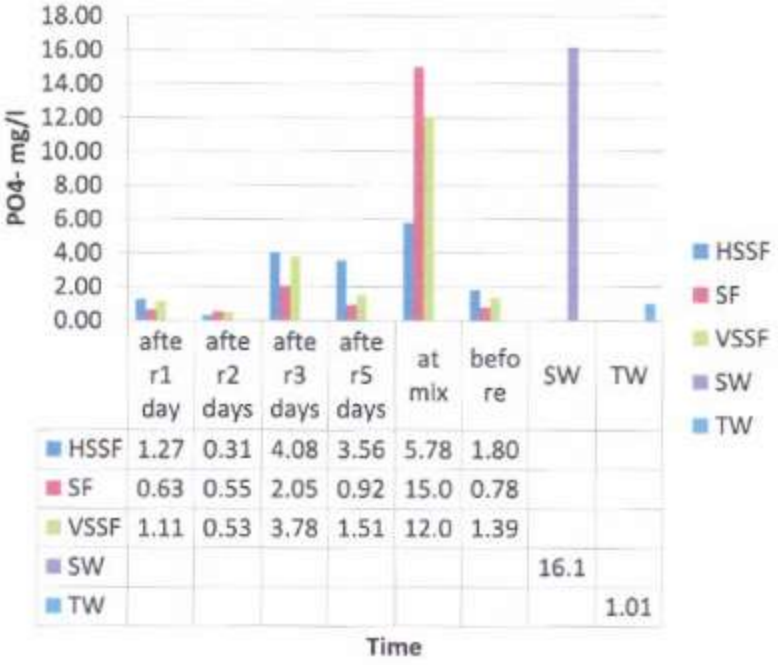
	HSSF	Hybrid	VSSF	SF	SW	TW
after1 day	9.10	8.05	6.65	6.53		
after2 days	5.60			4.20		
SW					43.05	
TW						6.53

TN with loading rate percentage



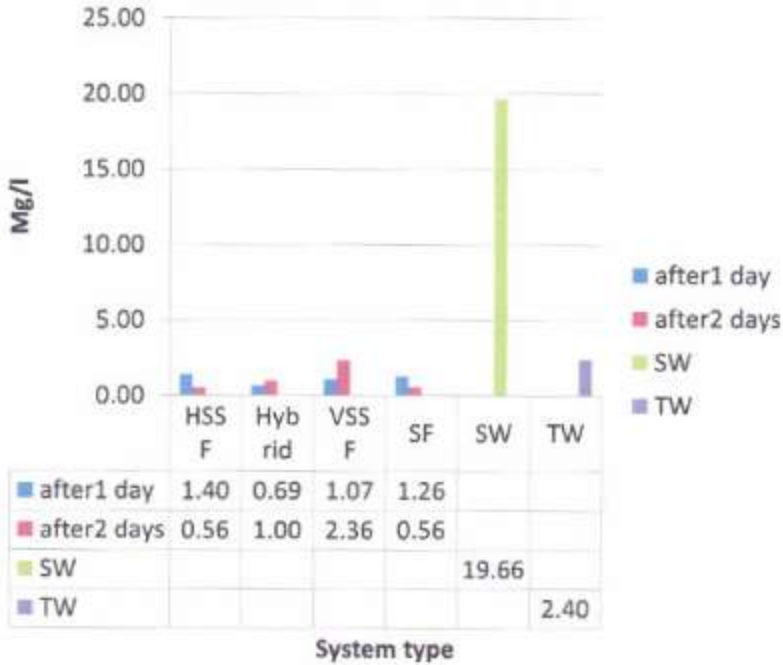
PO_4-with type of system

Stable



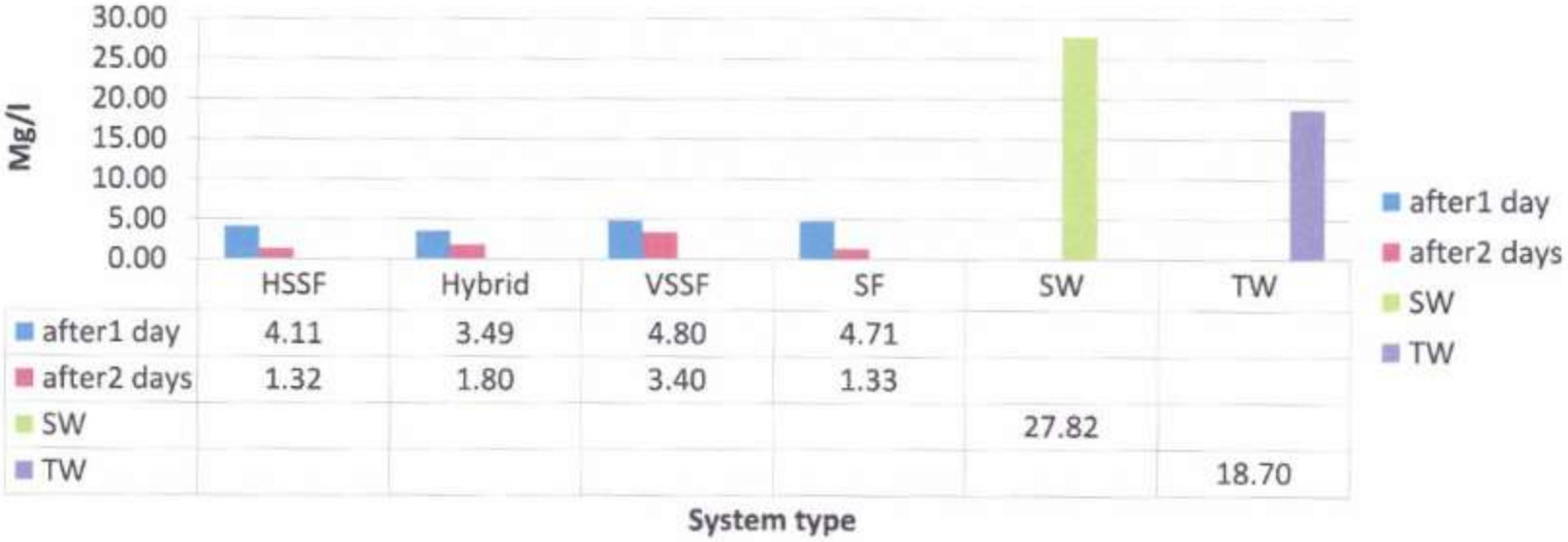
	after1 day	after2 days	after3 days	after5 days	at mix	before	SW	TW
HSSF	1.27	0.31	4.08	3.56	5.78	1.80		
SF	0.63	0.55	2.05	0.92	15.0	0.78		
VSSF	1.11	0.53	3.78	1.51	12.0	1.39		
SW							16.1	
TW								1.01

Movement



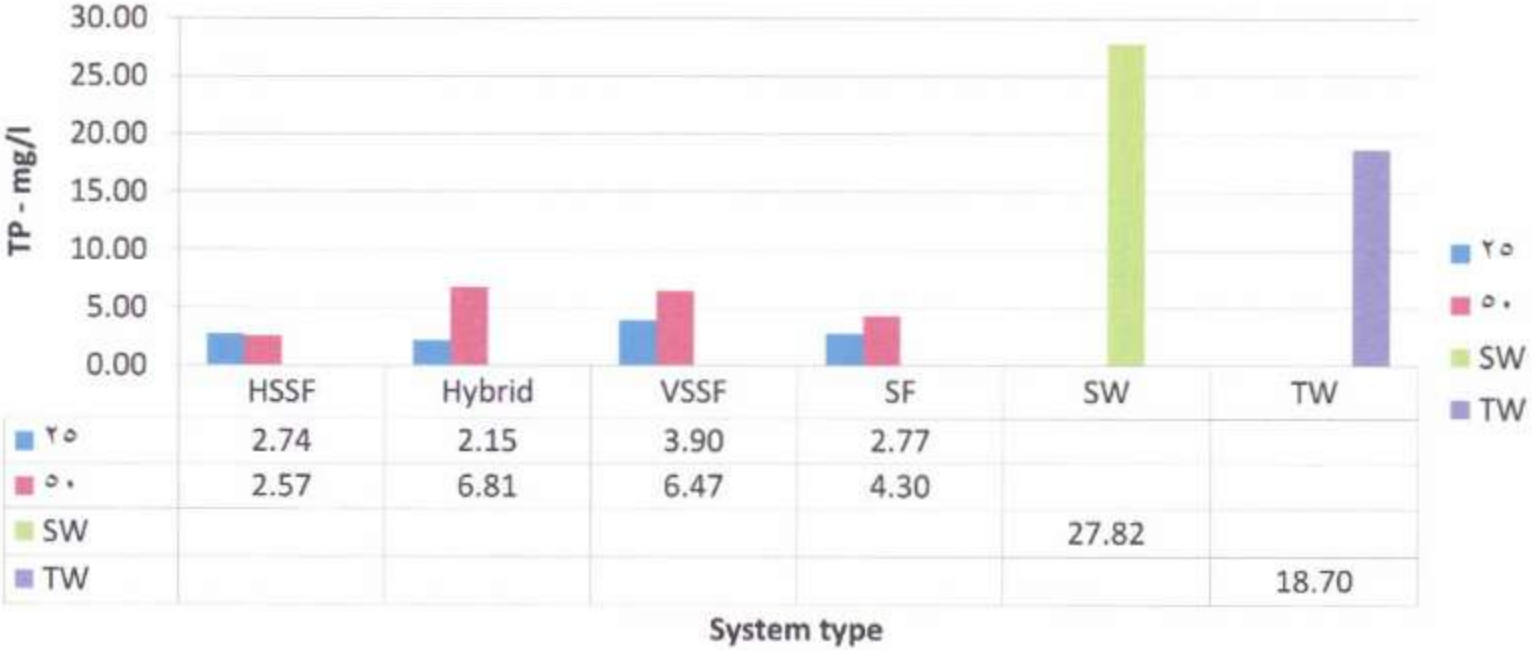
	HSSF	Hybrid	VSSF	SF	SW	TW
after1 day	1.40	0.69	1.07	1.26		
after2 days	0.56	1.00	2.36	0.56		
SW					19.66	
TW						2.40

TP-with type of system in movement operation



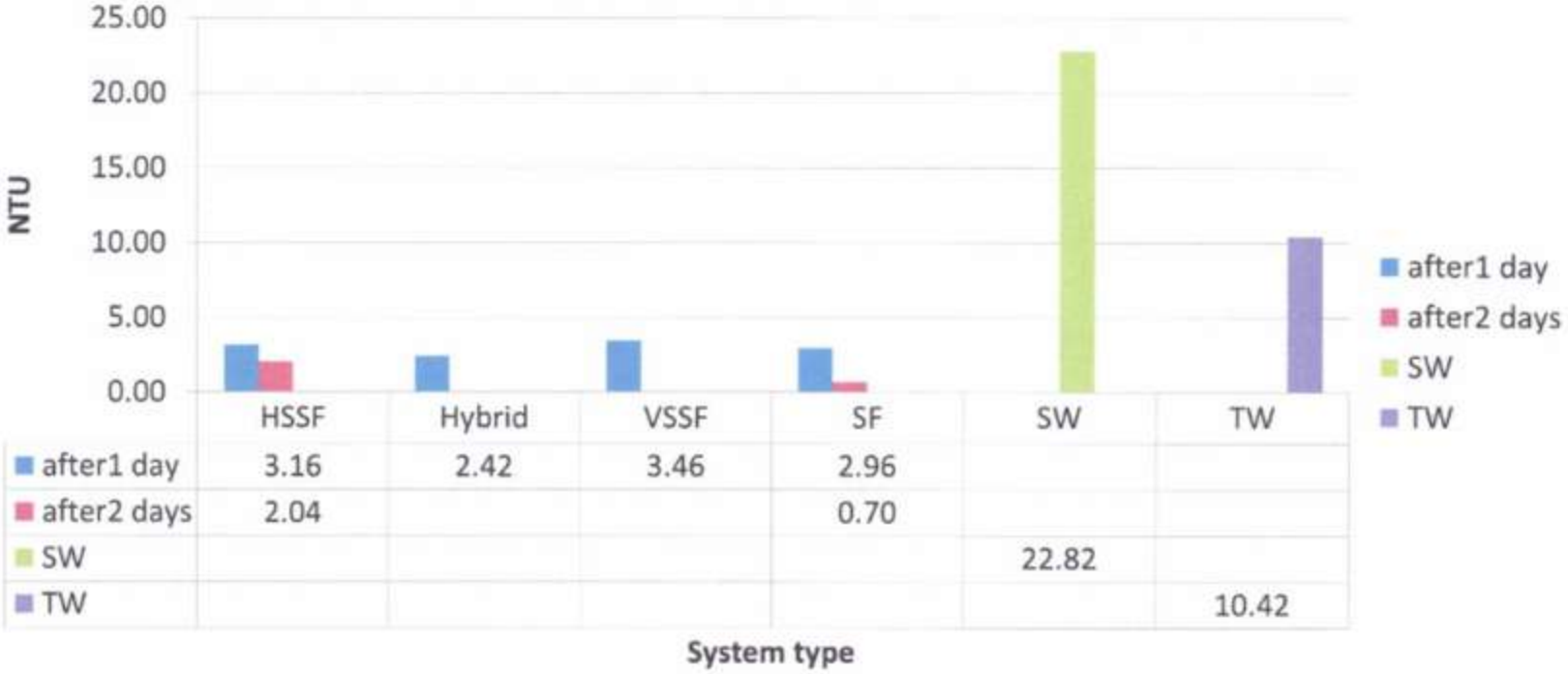
	HSSF	Hybrid	VSSF	SF	SW	TW
after1 day	4.11	3.49	4.80	4.71		
after2 days	1.32	1.80	3.40	1.33		
SW					27.82	
TW						18.70

TP with loading flow rate percentage

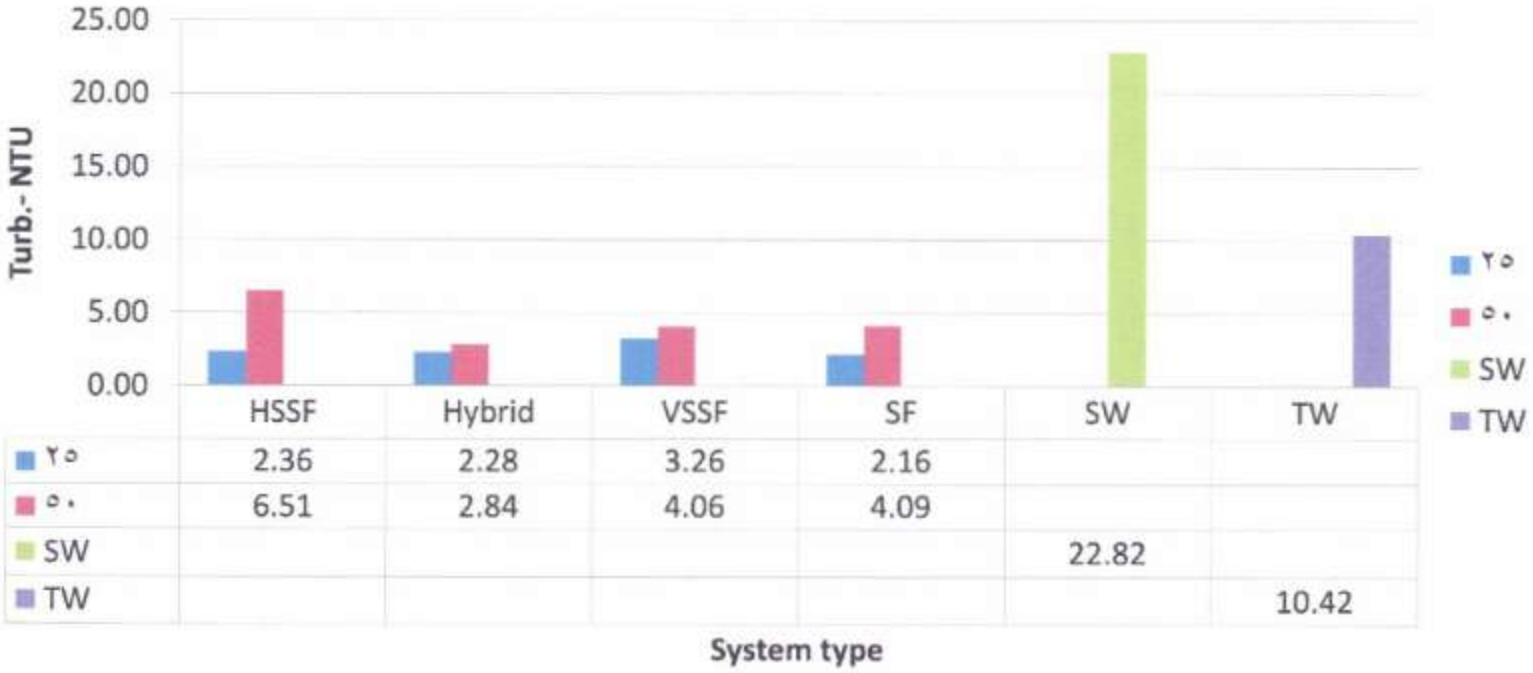


	HSSF	Hybrid	VSSF	SF	SW	TW
٢٥	2.74	2.15	3.90	2.77		
٥٠	2.57	6.81	6.47	4.30		
SW					27.82	
TW						18.70

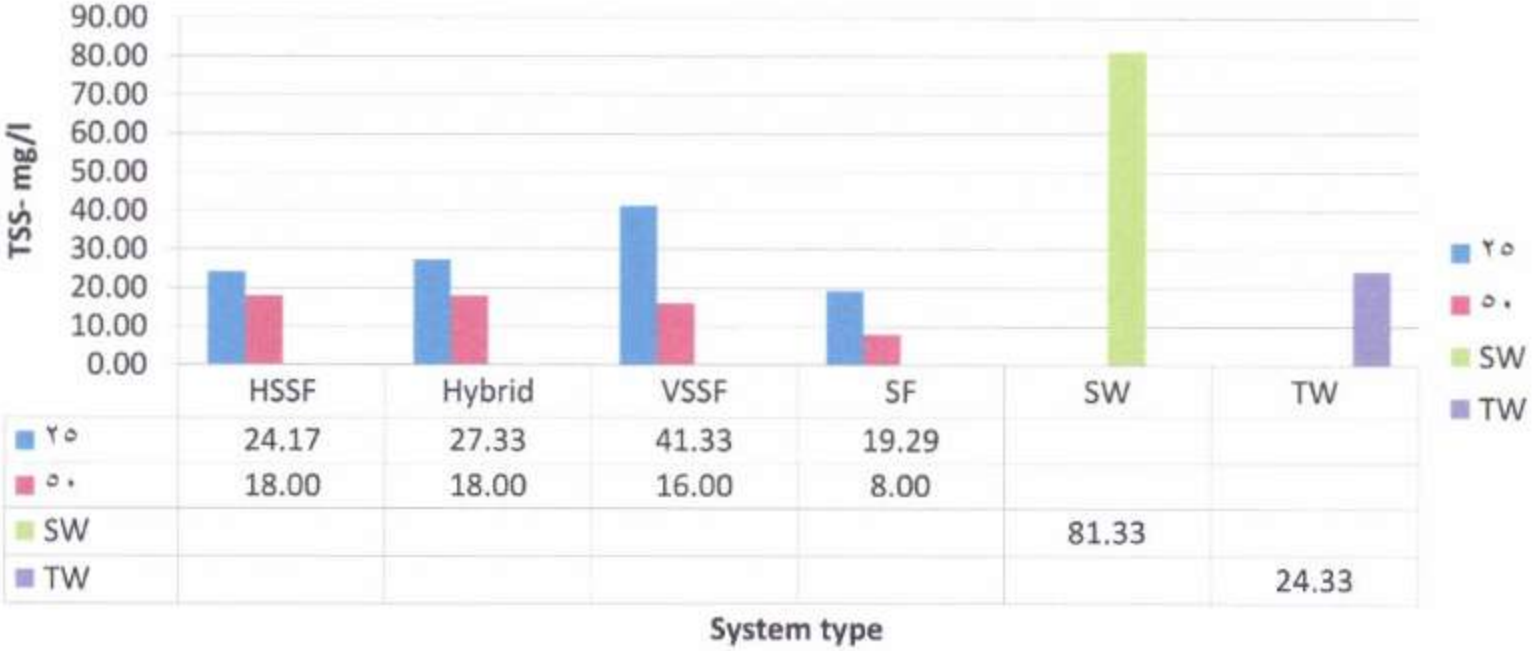
Turb.with type of system in movement operation



Turbidity with loading flow rate percentage

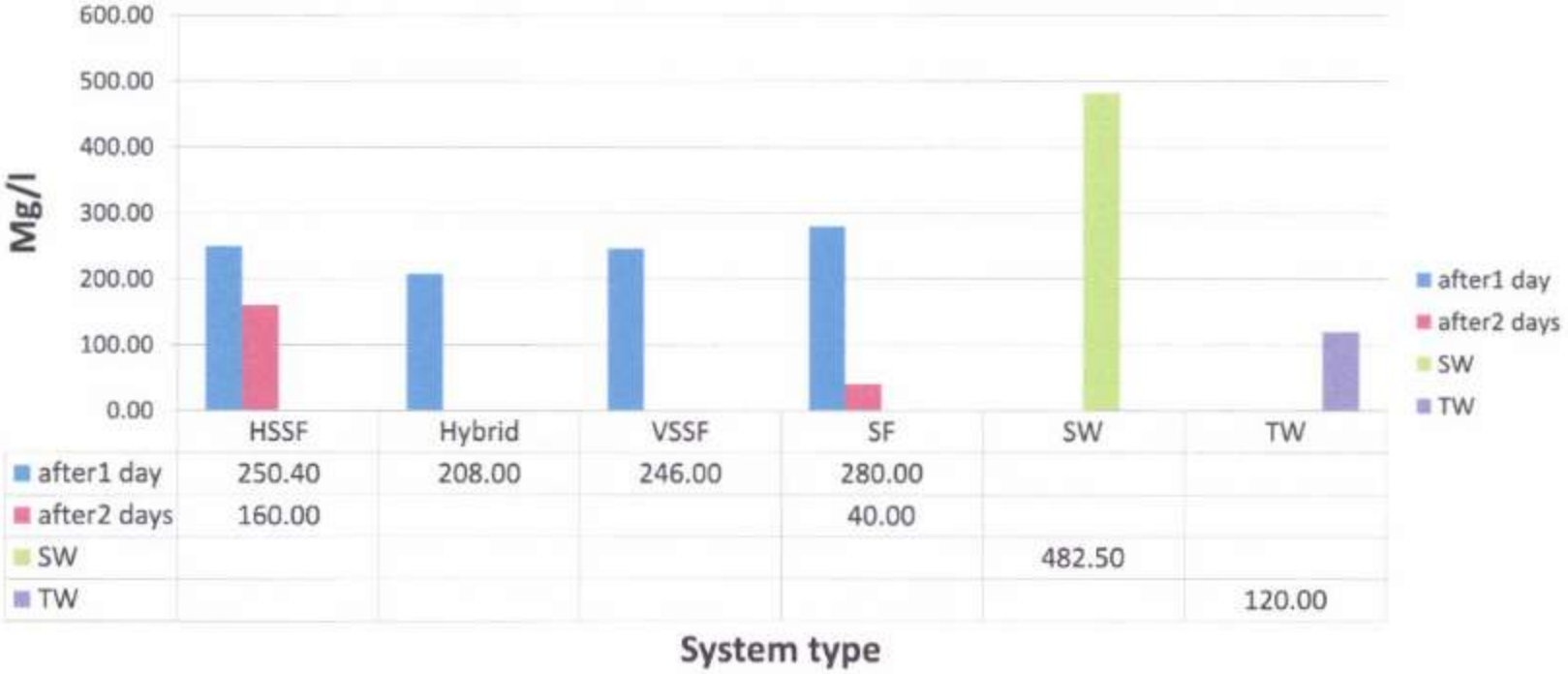


TSS with loading flow rate percentage



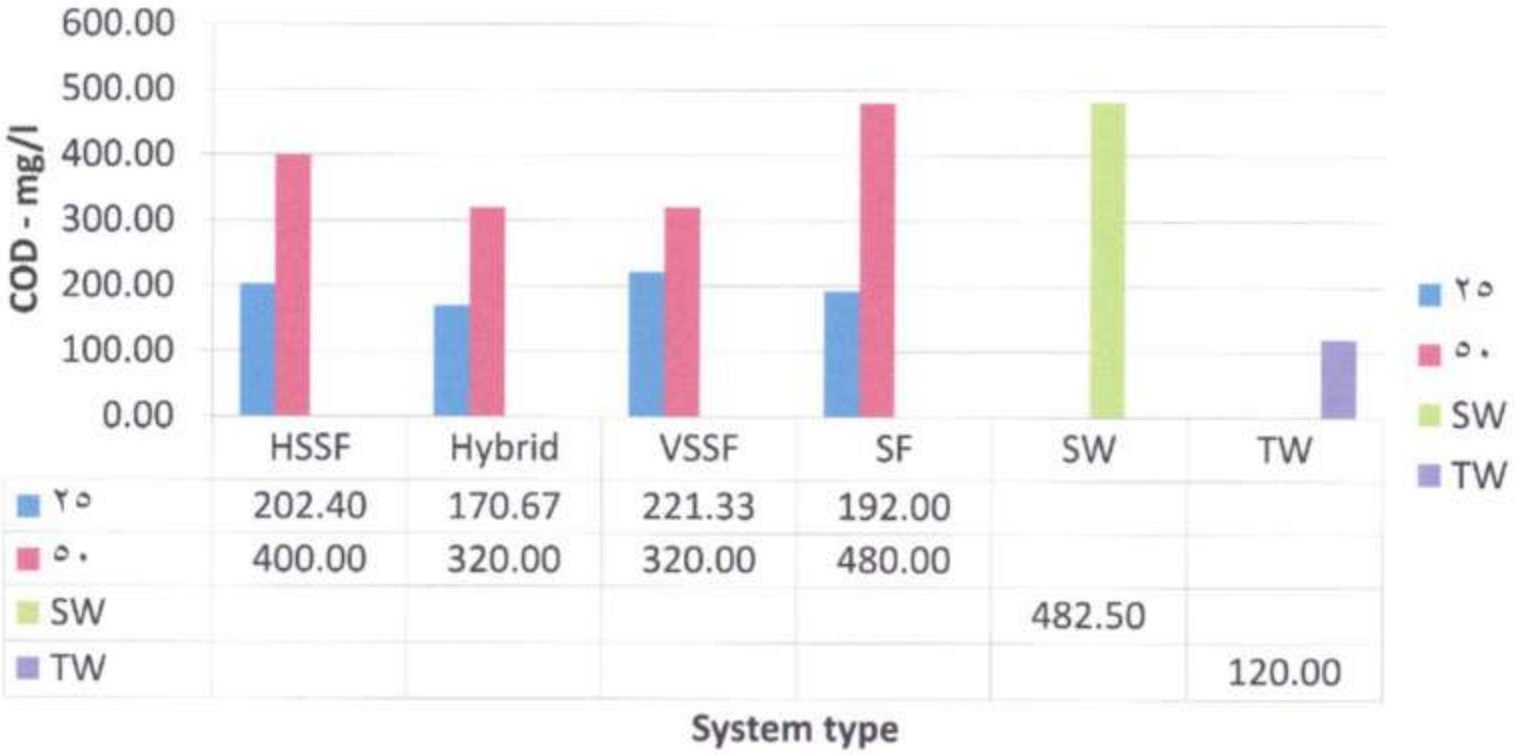
	HSSF	Hybrid	VSSF	SF	SW	TW
٢٥	24.17	27.33	41.33	19.29		
٥٠	18.00	18.00	16.00	8.00		
SW					81.33	
TW						24.33

COD with type of system in movement operation



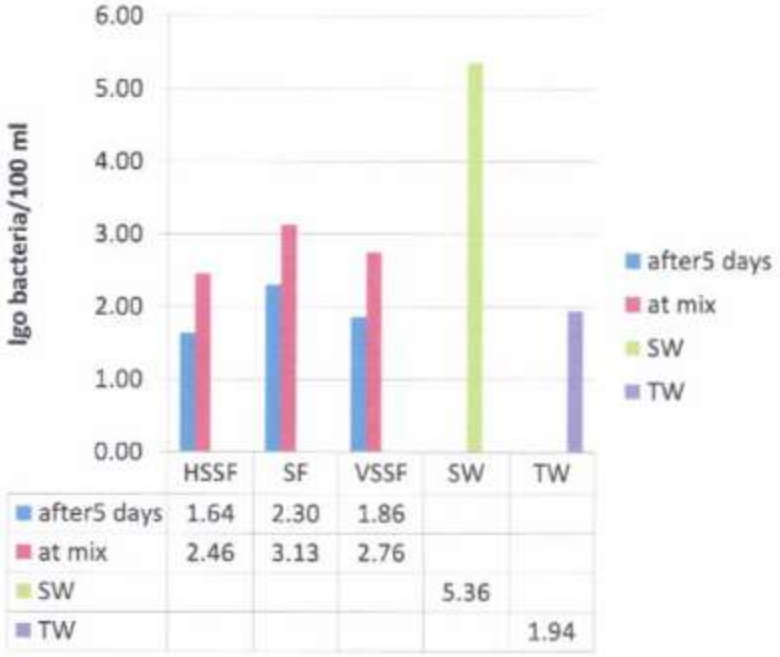
	HSSF	Hybrid	VSSF	SF	SW	TW
after1 day	250.40	208.00	246.00	280.00		
after2 days	160.00			40.00		
SW					482.50	
TW						120.00

COD with loading rate



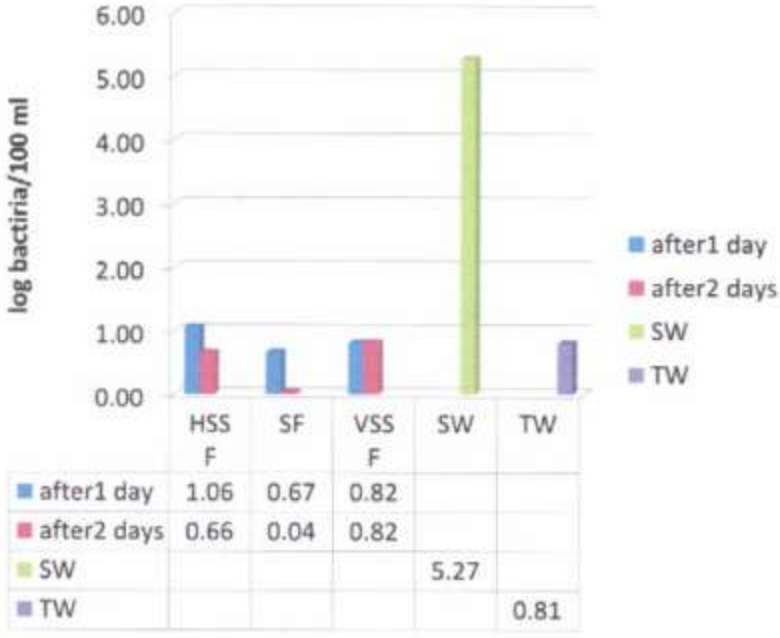
Fecal coliform bacteria with system type

Stable



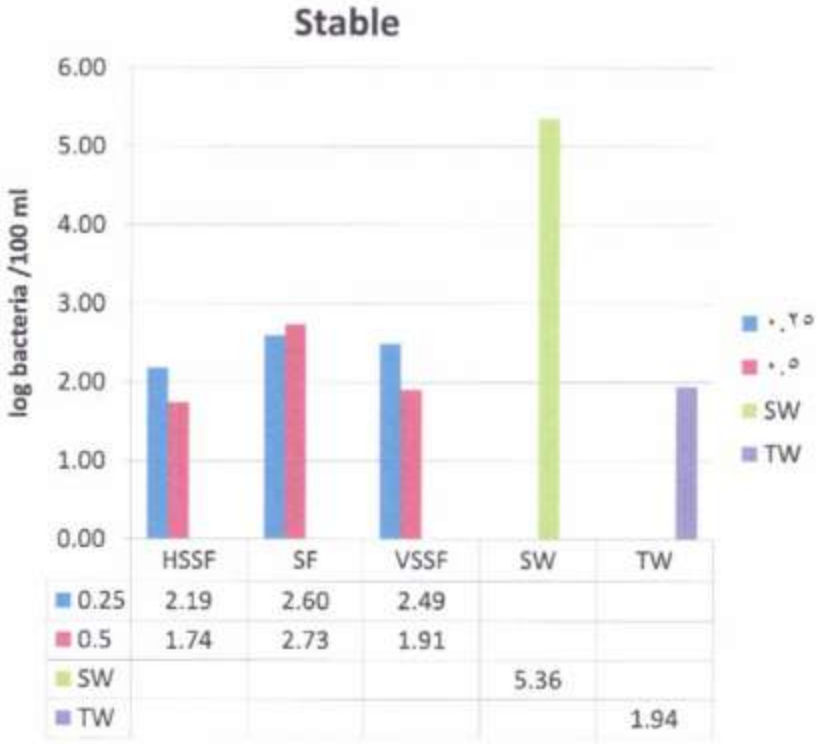
	HSSF	SF	VSSF	SW	TW
after5 days	1.64	2.30	1.86		
at mix	2.46	3.13	2.76		
SW				5.36	
TW					1.94

Movement



	HSSF	SF	VSSF	SW	TW
after1 day	1.06	0.67	0.82		
after2 days	0.66	0.04	0.82		
SW				5.27	
TW					0.81

Fecal coliform with loading rate



Comparison of untreated wastewater with US-EPA (2006) Standards and present study results.

No.	Parameters	EPA standards	Present study results	Maximum values	Minimum values
1	DO	4-5 mg/l	6.90 mg/l	10.40	ZERO
2	TDS	500-1000 mg/l	NGV		
3	TSS	25-80 mg/l	25.00 mg/l	118	3
4	BOD5	5-8 mg/l	1.70 mg/l	45	0.10
5	COD	8-10 mg/l	208.00 mg/l	800	40
6	Phosphate	0.05 mg/l	0.85 mg/l	28.25	0.10

Adopted from: (Sehar et al., 2015)

Recommendations

1. Adoption of this pilot by local authorities, with wide scale implementation in all provinces of the country to reduce the volume of pollutants that flow directly into the rivers.
2. The treated water could offer a new source of irrigation, and could particularly be used to tackle the desertification problem.
3. Different kinds of substrate could be evaluated in order to choose the most efficient one. This could enhance the constructed wetland system's treatment effectiveness.
4. They can be used to treat wastewater in remote places which are difficult to link with the general system of wastewater treatment.
5. They could be used as an advanced step after conventional wastewater treatment to enhance the quality of treated water.
6. Constructed wetland systems could create new habitat for a variety of species, especially marshlands species. They could also increase green land areas.
7. Constructed wetland systems are considered environmentally friendly as they require less energy for operation compared to conventional systems.

Conclusion

1. Implementation of the constructed wetland system indicated that the overall requirements such as weather, affordable land, cheap local material and labor are suitable for wide scale application.
2. An integrated system is more efficient at treating wastewater compared to separate systems as it achieved a high removal of pollutants in a very short time.
3. *Certophyllum demersum* was an excellent choice as a submerged plant as it significantly increased the level of DO within the SF system. This helped to improve produced water, and it also proved useful for increasing the pH level.
4. Using a different diameter of substrate from the local gravel helped the system to avoid the clogging which normally occurs within constructed wetland systems.
5. It was found that a vertical flow system enhanced the dissolved oxygen level especially when the wastewater fed into the system using drip irrigation.