



Removal of Odorous Compounds of Hospital Effluents

Andrzej Mydlarczyk
Research Specialist
Water Research Center



Introduction

- A study was carried out to assess the removal efficiency of odorous compounds from the wastewater of hospitals in Kuwait.
- Samples were collected from the outlet of wastewater from Maternity Hospital.
- Aerobic treatment was carried out for 12 and 24 hours periods in two bioreactors using a different intensity of aeration (DO equals 2 and 4 mg/l).

Background

- Efficiency of hospital wastewater treatment were investigated all over the world (Prayitno et al., 2014)
- Su et al., 2015 have indicated advantage of rotating biological contractor over conventional methods.
- Beier et al., 2012 have found many advantages of membrane bioreactor technology for treatment of hospital and healthcare institutions' wastewater.
- Tuc et al., 2016 investigated how antibiotics are treated in wastewater treatment plants and how they behave in sewage network.
- In the frame of this project, activated sludge method was studied as most economical among existing methods for treatment of wastewater generated from hospitals.

Wastewater Sampling & Field Measurements

- Samples of hospital wastewater were collected from manhole in front of Maternity Hospital in Kuwait,
- Manual method of grab sample collection was applied,
- Field wastewater parameters (temp, pH, EC and DO) analyses were carried out near the sampling site.

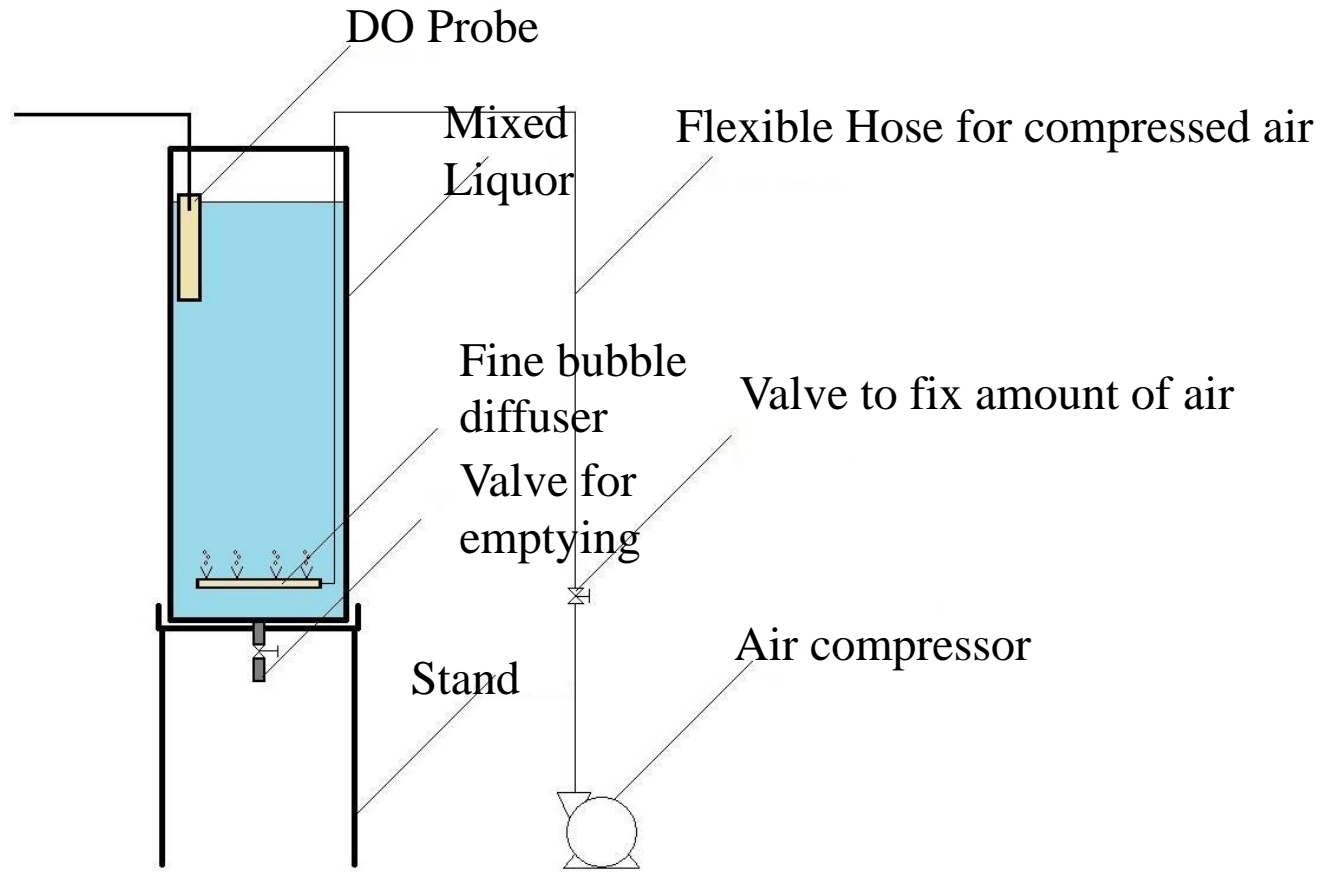
Wastewater sampling from hospital



Design and operation of biological reactor

- The bioreactors were constructed with following diameters 20 x 20 x 45 (cm),
- A compressor was applied for air delivery,
- Process was carried out for 12 and 24 hours,
- The bioreactor units were operated under two levels of DO (2 and 4 mg/l),
- Quality of effluent was monitored after each term of aeration.

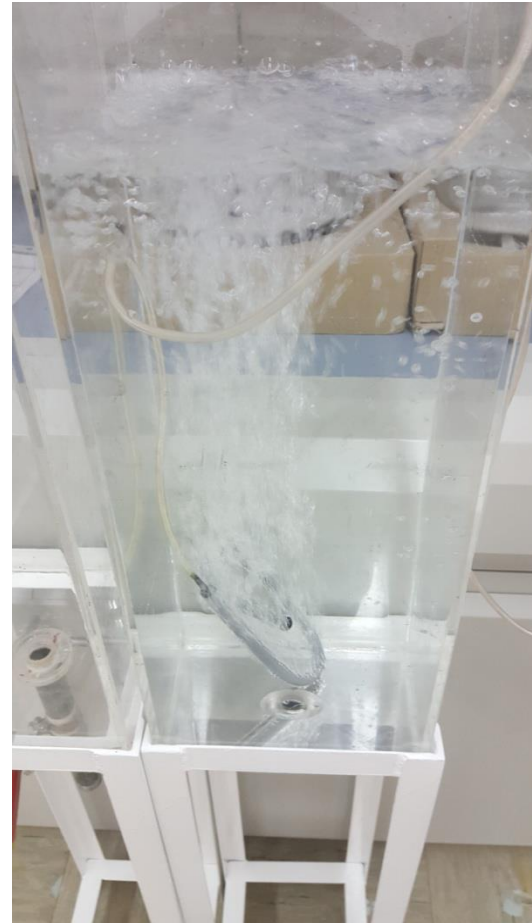
Schematic diagram of bioreactor system



Operation of bioreactor

- Samples of hospital wastewater (9 liters) was mixed with the same volume of activated sludge in two bioreactors,
- Mixed liquor of bioreactors was aerated for two periods – 12 and 24 hours,
- After aeration, half an hour sedimentation period was followed by sampling of effluents.

Process of aeration using air compressor



Two Biological Reactors



Results and Discussion

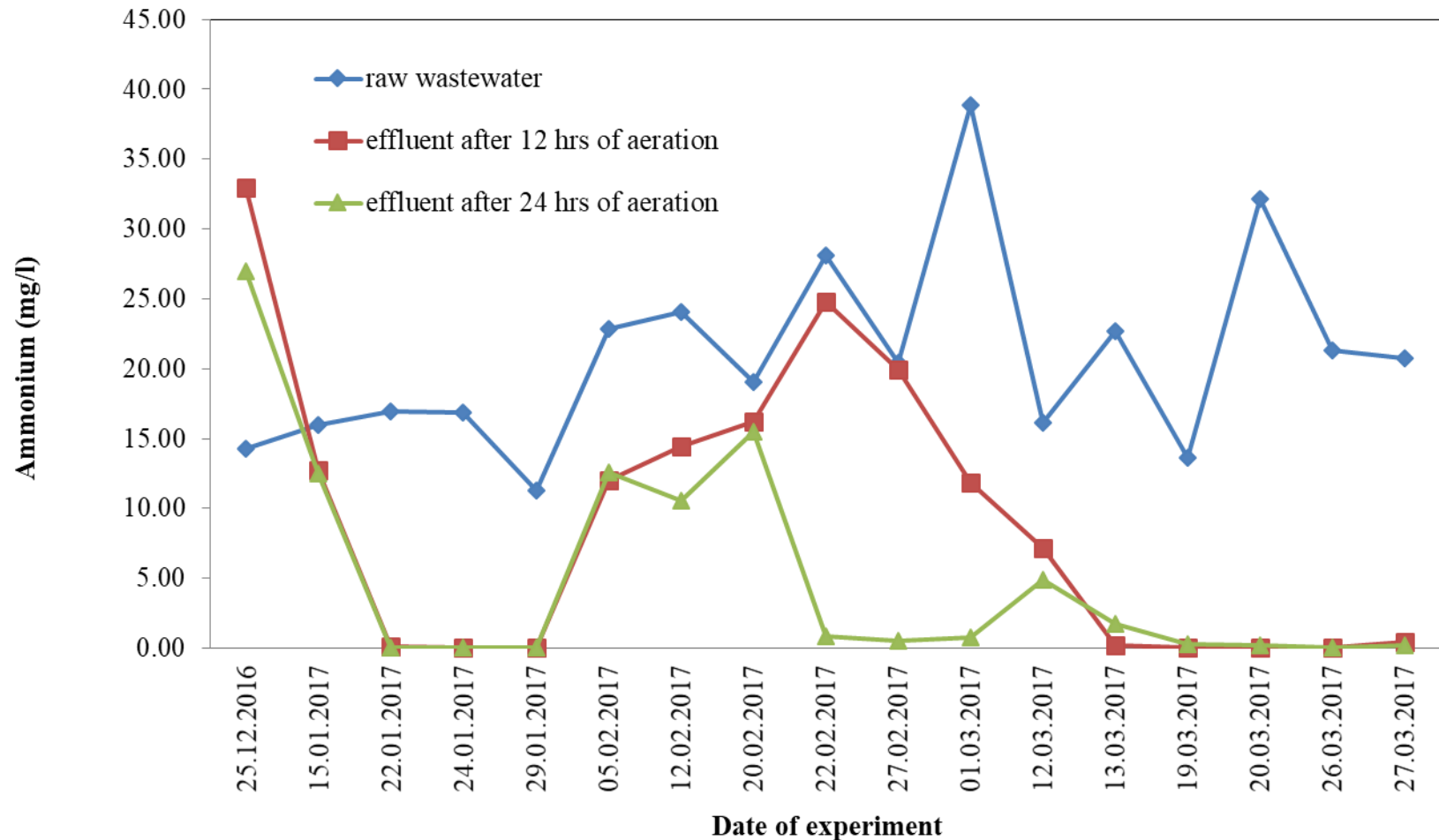
- Parameters (ammonium and sulfides) were selected as representation of odorous compounds in the wastewater.
- For evaluation of removal efficiency the formula was applied:

$$Efficiency = \frac{C_{raw\ ww} - C_{effl.}}{C_{raw\ ww}} * 100 \%$$

- $C_{raw\ ww}$ = concentration in raw wastewater in mg/l,
- $C_{effl.}$ = concentration in effluent in mg/l.

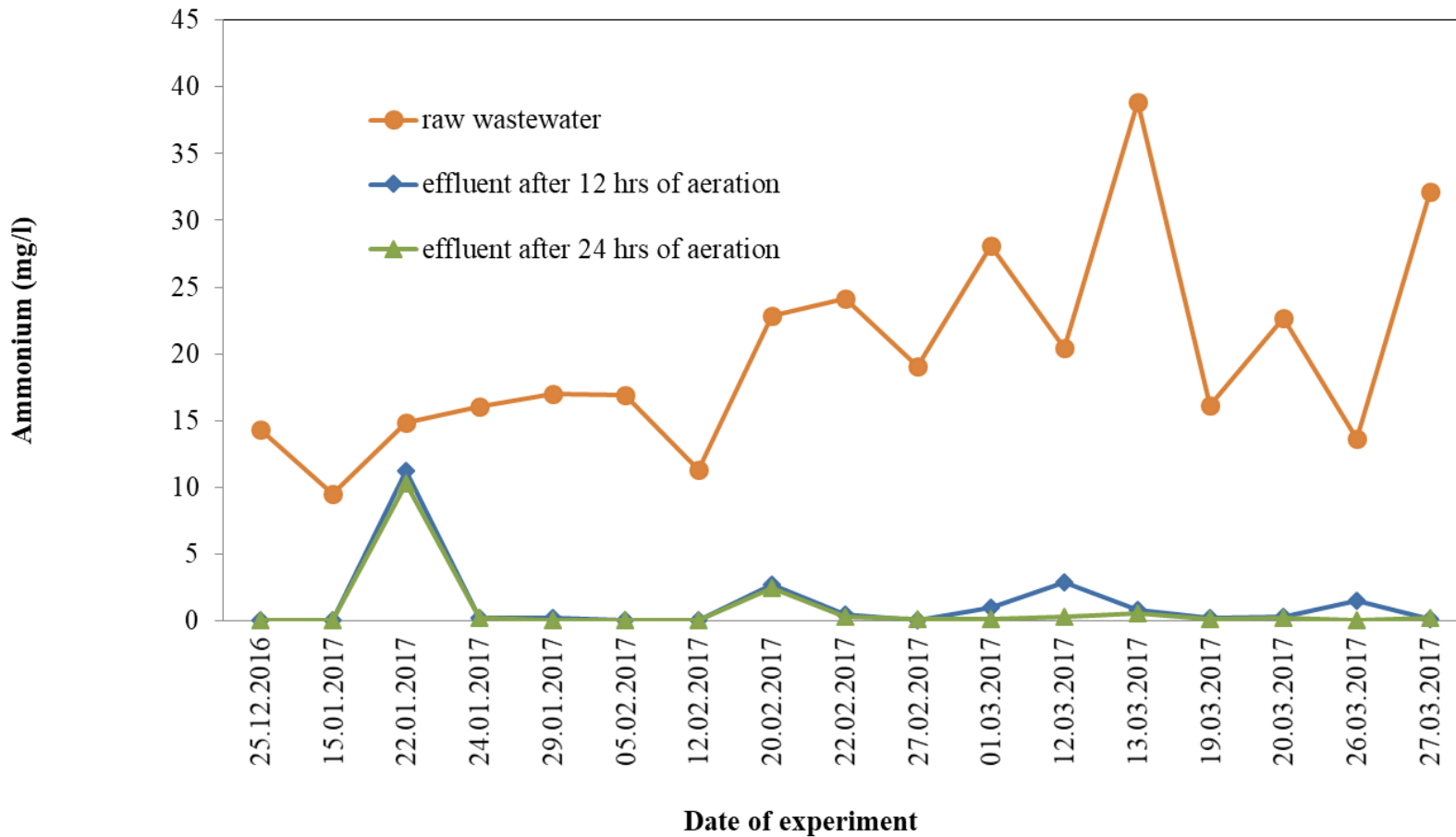
Results and Discussion

Ammonium Concentration Before and After Treatment (DO 2 mg/l)



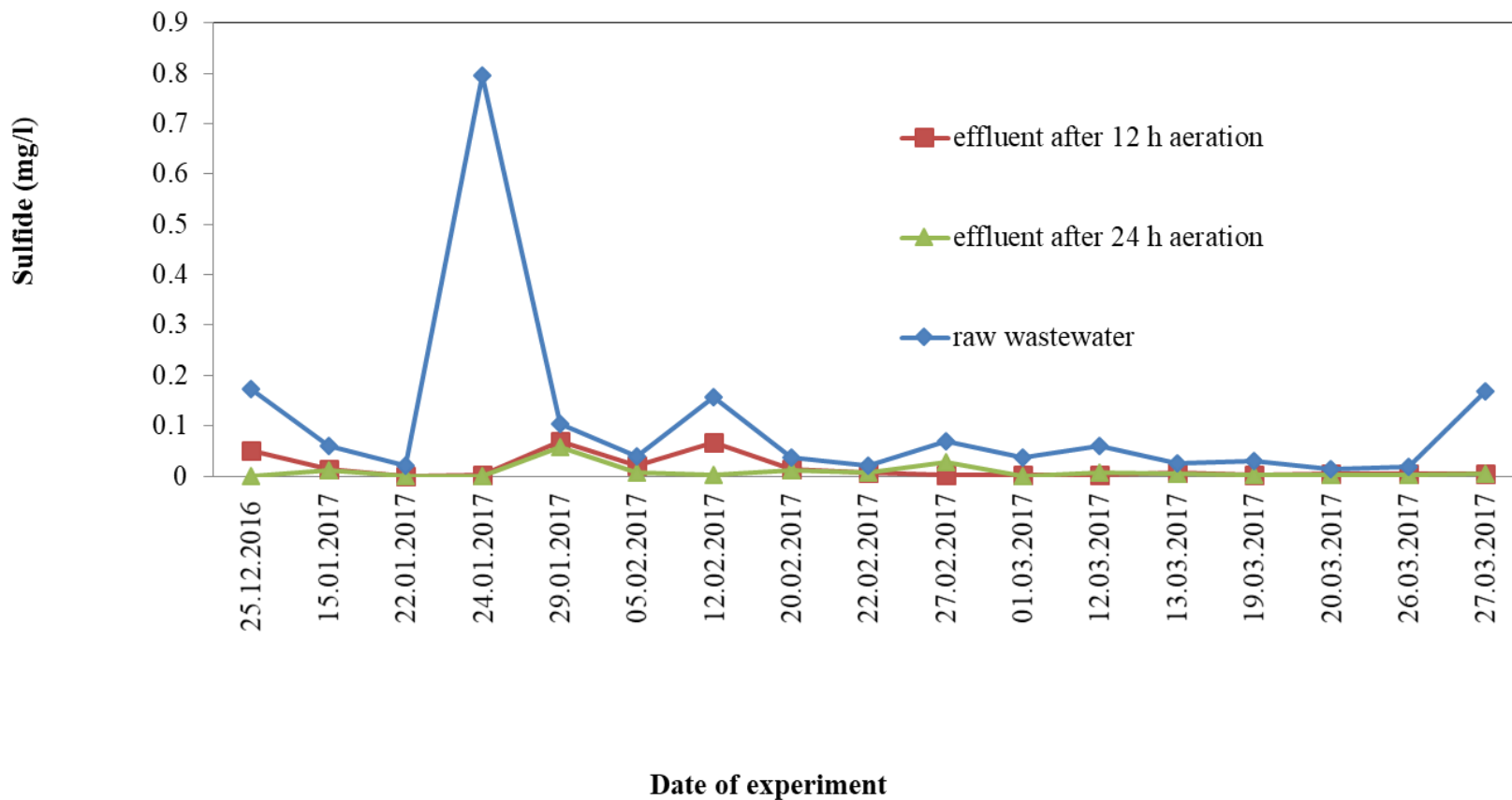
Results and Discussion

Ammonium Concentration Before and After Treatment (DO 4 mg/l)



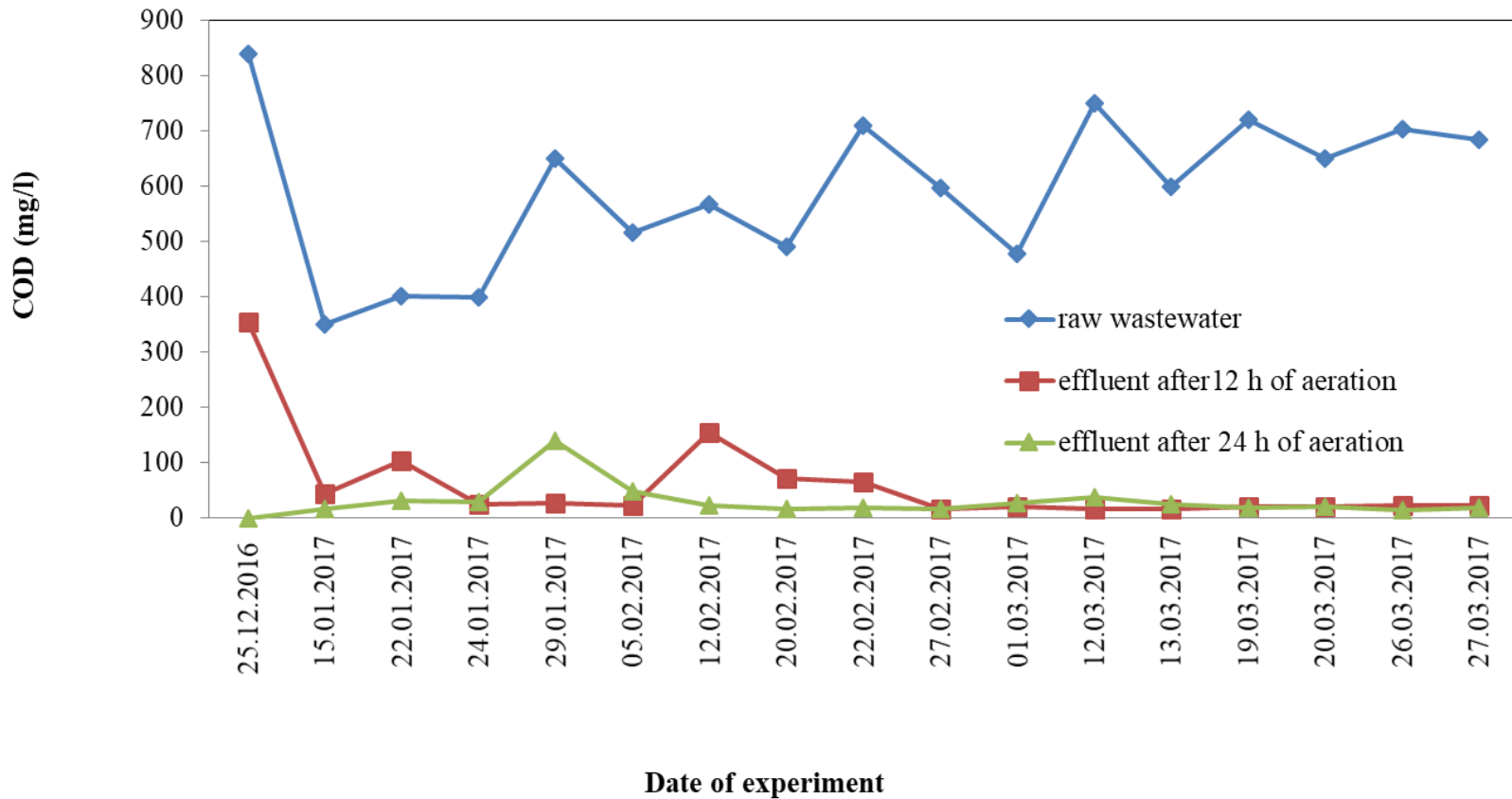
Results and Discussion

Sulfides Before and After Treatment (DO 2 mg/l)



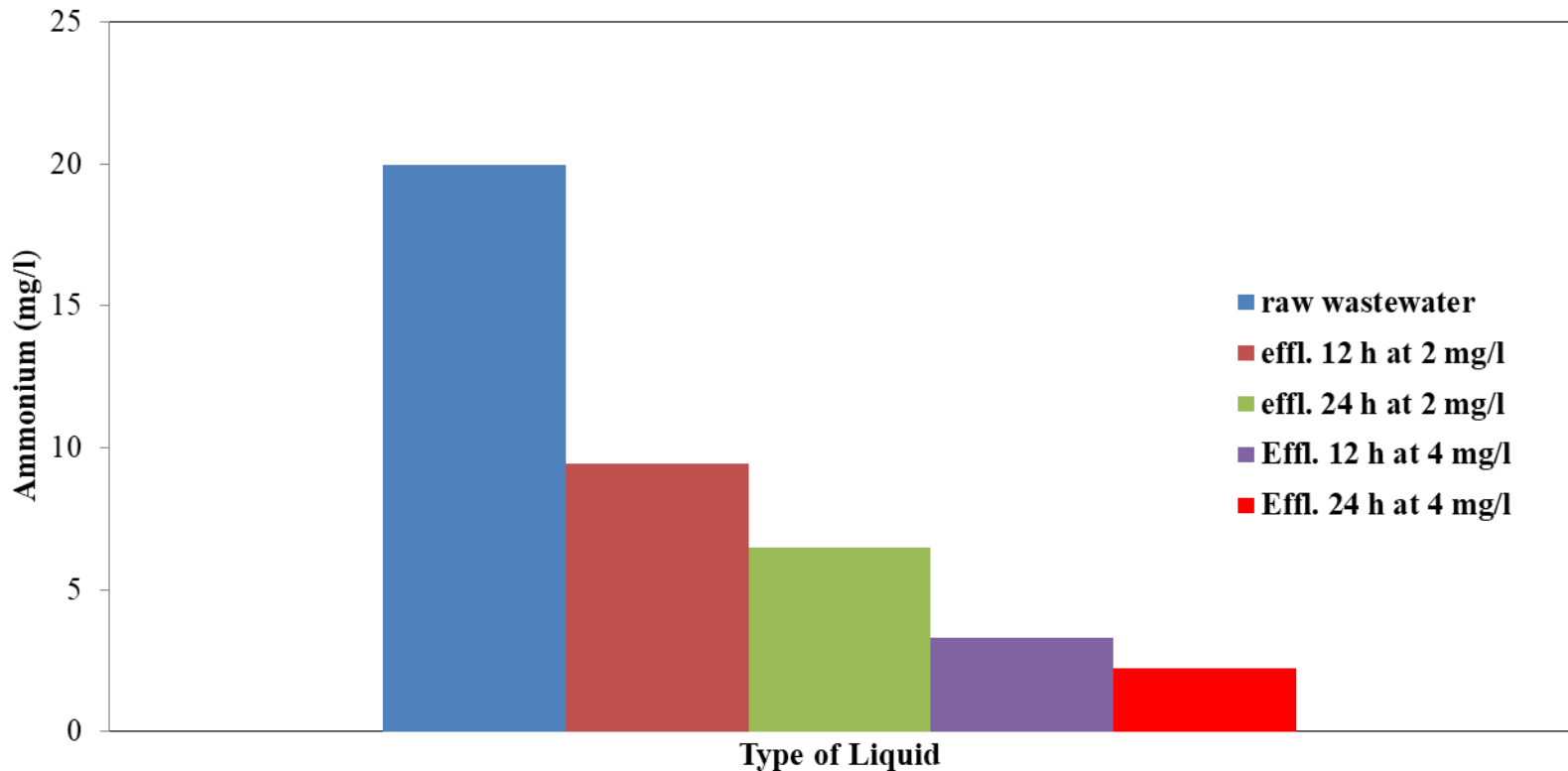
Results and Discussion

COD Concentration Before and After Treatment (DO 2 mg/l)



Results and Discussion

Mean Concentrations of $\text{NH}_4\text{-N}$ Before and After Treatment (DO 2 and 4 mg/l)



Results and Discussion

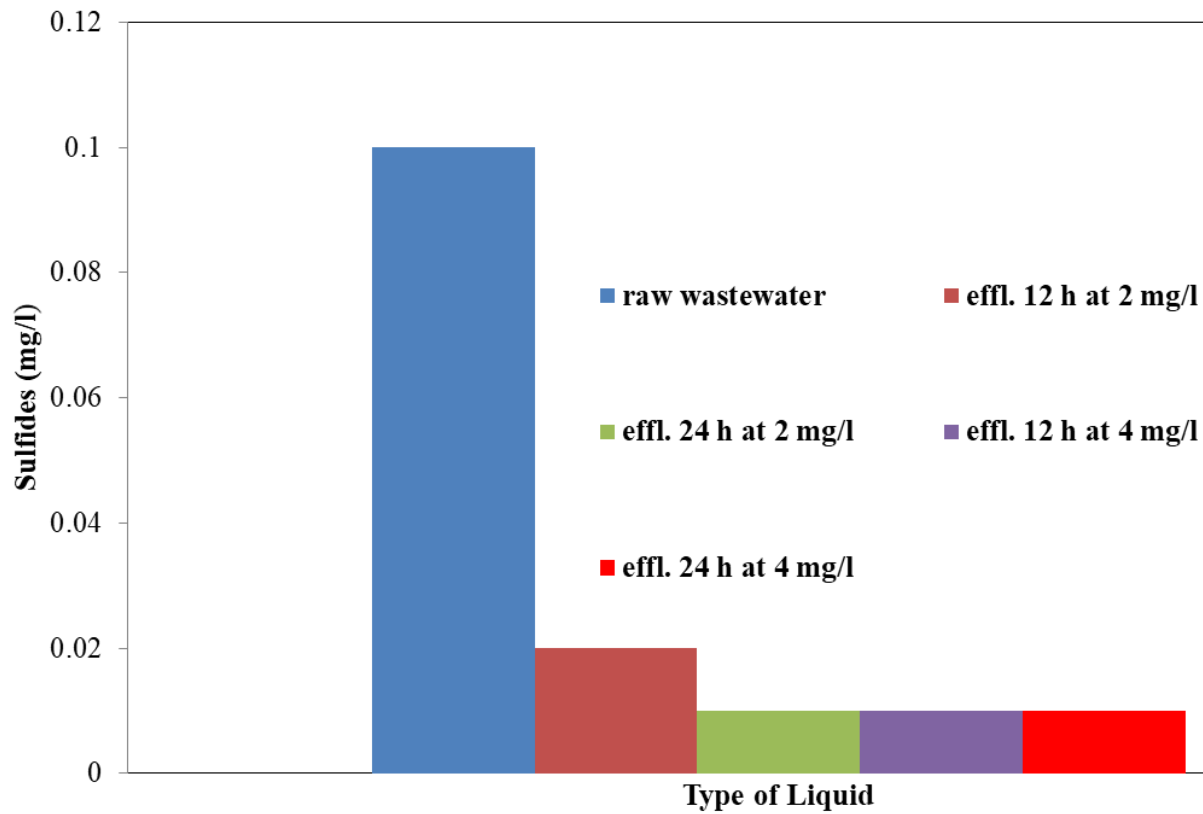
Statistical Analysis of NH₄-N Concentration

	Raw Wastewater	Effluent 12 h @ 2 mg/l DO	Effluent 12 h @ 4 mg/l DO	Effluent 24 h @ 2 mg/l DO	Effluent 24 h @ 4 mg/l DO
Range	9.45–38.9	0 – 32.95	0 - 27	0 – 14.85	0 – 23.1
Mean	19.98	9.43	6.48	3.29	2.24
STD	7.2	9.8	8.5	4.9	5.8
CV (%)	36	103	131	148	259
% Mean Removal Efficiency		66.08	85.96	76.53	97.44

DO = dissolved oxygen; STD = standard deviation; CV = coefficient of variation.

Results and Discussion

Mean concentrations of sulfides



Results and Discussion

Statistical Analysis of Sulfides Concentration

	Raw Wastewater	Effluent 12 h @ 2 mg/l DO	Effluent 12 h @ 4 mg/l DO	Effluent 24 h @ 2 mg/l DO	Effluent 24 h @ 4 mg/l DO
Range	0.015 - 0.796	0 - 0.109	0 - 0.061	0 - 0.058	0 - 0.03
Mean	0.10	0.02	0.01	0.01	0.01
STD	0.2	0.03	0.02	0.02	0.01
CV (%)	200	150	200	200	100
% Mean Removal Efficiency		76.76	82.54	83.64	93.85

DO = dissolved oxygen; STD = standard deviation; CV = coefficient of variation.

Conclusions

- The mean removal efficiency for ammonium nitrogen reached 97.44 %.
- For sulfides, these mean values exceed 83% for 12 hours of aeration and 93% for 24 hours of aeration if DO was fixed for 4 mg per liter.
- The mean removal efficiency for COD was above 97%.
- The obtained results of effluent parameters: $\text{NH}_4\text{-N}$, sulfide and COD, all met KEPA standards for irrigation water in Kuwait.

Recommendations

- The quality of wastewater generated from hospitals should focus on the concentration levels of antibiotics, pharmaceuticals, radioactive materials and pathogenic bacteria.
- Quality of wastewater generated from hospitals should be monitored before discharging to public sewage network.
- On-site biological treatment units should be applied within hospital premises.
- The quality of treated effluent should meet hospital requirements (washing, flushing).

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**Thanks
for
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Kind
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