Design of On-site Restaurant Wastewater Treatment System

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1.Background



- A Thai-Isaan restaurant in Khon Kaen, is classified as Type B under the Ministry of Natural Resources' regulations.
- The restaurant generates wastewater with high levels of BOD, TSS, and FOG.
- Current wastewater treatment system only uses a grease trap (3 m³), which is insufficient to meet discharge standards.

2.Constraints

- Restaurant Area: Approximately 1,300 square meters.
- Regulatory Classification: Category B (Ministry of Natural Resources). [1]
- Effluent Quality Standards (Category B):

 $BOD \leq 30 \text{ mg/L}$

TSS \leq 40 mg/L

 $FOG \leq 20 \text{ mg/L}$

3.Site information

- Wastewater Volume: Approximately 16 cubic meters per day.
- Initial Wastewater Characteristics:
 - TSS = 945 ma/L
 - FOG = 507.2 mg/L
 - BOD = 2,898 mg/L
- Limitation: insufficient space due to aesthetic and operational concerns in the restaurant area.
- Treatment Goals: Reduction of FOG and BOD levels to meet standard.
- Design concept:
 - Three units will be installed under kitchen area
 - Two units will be placed on ground in the parking area (away from the service zone).

4.Engineering design

The wastewater treatment system comprises 5 units

- Unit 1 Grease Trap
- **Unit 2** Sedimentation Tank
- Unit 3 Equalization (EQ) Tank
- **Unit 4** Anaerobic Filter
- Unit 5 Activated Sludge

Unit 1: Grease Trap

- A preliminary treatment unit is designed to capture grease and oil from wastewater, preventing excessive [2]
- accumulation before entering the main treatment system. • Grease Traps: one existing (3 m³) and one newly designed
- (5 m³) resulting in an effluent FOG of 11.41 mg/L.

	Model	Width (m)	Length (m)	Width:Length
	WUT-3000	1.71	1.89	0.90
	WUT-5000	1.85	2.25	0.82

Source : https://wave.co.th/product/wgt-2/



Grease Trap 5,000 L

Unit 2: Sedimentation Tank

- A sedimentation tank in this design is to prevent floating solids and aid in settling suspended solids. [3]
- The system aims to remove SS for the next treatment stage.
- Sedimentation Tank: Prefabricated 3 m³ tank with a 4hour retention time.

Model : ST-3000	Value	Unit
Diameter	1.76	m
Height	2.03	m
Effective volume	3,000	L







Unit 3: EQ Tank

- EQ tank is used to store wastewater and regulate the flow rate to ensure consistency before convey wastewater to the treatment system.
- Equalization Tank: 16 m³ capacity.



Parameter		Symbol	Value	Unit
Volume of Equalization		V	20	m ³
S	ubmersible pump	Pump	2	machine

Source : https://wave.co.th/product/fibertank-wsa-capsule/

Unit 4: Anaerobic Filter

- A biological treatment system contains media to support microbial growth, enhancing BOD and nitrogen removal without oxygen.
- The systems can be designed to be compact & requires less space. [3]
- Anaerobic Filter System: Two sequential tanks of 100 m³ each, using random-flow plastic media, with an effluent BOD of 463.7 mg/L.





Unit 5: Extended Aeration Activated Sludge

- The activated sludge generally consists of two main components: the aeration tank and the sedimentation tank.
- A treatment process retains sludge longer, allowing microorganisms to break down organic matter more effectively while handling lower organic loads. [3]
- Extended Aeration Activated Sludge System: Aeration tank (50.4 m³, 32-hour retention) and sedimentation tank (5.76 m³, 2.88-hour retention), achieving an effluent BOD of 0.67 mg/L.



5. Conclusion

1) Wastewater treatment train

The system consists of five treatment units divided into eight tanks: two grease traps (one existing and one newly designed), a sedimentation tank, a storage tank, two anaerobic filter tanks, and an extended aeration activated sludge system (comprising an aeration tank and a secondary sedimentation tank), with a final effluent BOD concentration of 0.67 mg/L and an FOG concentration of 11.41 mg/L.

2) Hydraulic profile



3) Layout



Ground level

- 5. Anaerobic Filter 1
- 6. Anaerobic Filter 2
- 7. Extended Aeration Activated Sludge
- 8. Aeration Tank
- 9. Sedimentation Tank

6. References

[1] กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม. 2554. กำหนด ประเภทของอาคารเป็นแหล่งกำเนิดมลพิษที่ จะต้องถูกควบคุมการ ปล่อยน้ำเสียลงสู่แหล่งน้ำสาธารณะหรือออกสู่สิ่งแวดล้อม. [Online][Cited on 18 July 2024] Accessible from: https://www.pcd.go.th/laws/11239/ [2] กรมควบคุมมลพิษ. 2551. น้ำมันและไขมันจากบ่อดักไขมัน. [Online][Cited 20 July 2024] From:https://www.pcd.go.th/wpcontent/uploads/2020/0 5/pcdnew-2020-05-20 03-07-21 734988.pdf [3] Metcalf & Eddy. 2004. Wastewater Engineering Treatment and Resource Recovery, p.267-1069. McGraw-Hill Education: United States of America