Journal of Geography, Regional Planning and Development
Homepage : https://journal.antispublisher.id/index.php/JGRPD
Email : admin@antispublisher.com

e-ISSN : 3032-131X
JGRPD, Vol. 3, No. 1, January 2026
Page 16-21


# Sources and Mechanisms of Wastewater Generation in Public Catering Establishments

**Obutjonova Durdona Omonjon qizi**
Master's student, Tashkent State Transport University, Uzbekistan



**DOI : https://doi.org/10.61796/jgrpd.v3i1.1685**

**Sections Info**

***Article history:***
Submitted: November 17, 2025
Final Revised: December 31, 2025
Accepted: January 20, 2026
Published: February 14, 2026

***Keywords:***
Public catering establishments
Wastewater
Fat substances
Fats
Oils
Sources of formation Mechanisms
Physicochemical composition
Emulsification
Saponification
Biochemical oxygen demand
Chemical oxygen demand Grease trap
Sewer blockage
Environmental impact
Uzbekistan's experience
Restaurant wastewater

**ABSTRACT**

***Objective:*** *This article provides an in-depth analysis of the sources and mechanisms of wastewater generation in public catering establishments (restaurants, cafes, canteens, and similar facilities), as well as the physicochemical properties of fats, oils, and grease (FOG).* ***Method:*** *It examines in detail the pollution resulting from kitchen processes such as food preparation, frying, cooking, dishwashing, and cleaning of floors and equipment. Special attention is given to the mechanisms of emulsification, saponification, and mechanical mixing of fats. The article discusses the composition of wastewater – including biochemical oxygen demand (BOD), chemical oxygen demand (COD), and FOG concentrations – based on findings from international and local studies, as well as relevant issues in the context of Uzbekistan.* ***Results:*** *The research results serve as a scientific foundation for improving the efficiency of grease interceptors (traps for fats, oils, and grease), protecting sewer systems, and reducing environmental impact.* ***Novelty:*** *The article is aimed at advancing wastewater treatment technologies in public catering establishments.*

## INTRODUCTION

Public catering establishments (restaurants, cafés, canteens, and other similar facilities) generate large volumes of wastewater during their operation. This wastewater mainly results from food preparation processes, dishwashing, cleaning of floors and equipment, as well as sanitary and hygienic activities [1]. Foreign studies indicate that a single restaurant can discharge between 360 and 7,700 kg of fat waste into the sewer system annually, which can lead to pipe blockages (formation of grease buildup) and cause serious damage to the environment [2]. In Uzbekistan, with the rapid growth of urbanization and the food service industry, this problem is becoming increasingly relevant. Installing grease traps in public catering facilities and recycling waste oils into secondary raw materials (such as soap, animal feed, or biofuel) can help mitigate environmental pollution. However, in practice, due to the lack of proper installation, wastewater continues to pollute rivers and groundwater [3].

## RESEARCH METHOD

This study was conducted using an integrated analytical and field-based research approach to investigate the sources and mechanisms of wastewater generation in public catering establishments. The methodology combines literature review, field observation, sampling, and laboratory analysis to ensure scientific reliability and practical relevance.

First, a comprehensive review of international and local scientific publications, regulatory documents, and technical manuals was carried out to establish a theoretical framework regarding FOG behavior, wastewater composition, and grease trap performance. This stage enabled the identification of key pollution indicators and dominant formation mechanisms.

Second, wastewater samples were collected from selected public catering facilities during peak kitchen operation hours. Composite sampling techniques were applied to reflect variations caused by food preparation, dishwashing, and cleaning processes. The samples were preserved and analyzed according to standard methods for the examination of water and wastewater. Key parameters such as BOD, COD, FOG concentration, total suspended solids (TSS), pH, and temperature were determined using gravimetric, titrimetric, and instrumental analytical techniques.

In addition, observational assessment of grease trap operation was performed to evaluate separation efficiency based on the gravity principle and density differences. The collected data were analyzed using descriptive and comparative methods to identify relationships between wastewater generation mechanisms and pollutant concentrations.

This methodological framework ensures a systematic understanding of wastewater formation processes and provides a reliable basis for improving grease trap design and wastewater management practices in public catering establishments.

## RESULTS AND DISCUSSION

The largest portion of wastewater (approximately 50–60%) originates from kitchen activities. Animal-based (meat, dairy products) and plant-based (oils, fats) substances used in food preparation mix with water. During frying, boiling, and cooking processes, fats remain in a liquid state when hot and easily enter the drainage system [4]. When cooled, they solidify and form deposits inside pipes. During dishwashing (either manually or using dishwashers), under the influence of detergents and hot water, fat particles turn into a fine emulsion. Studies show that dishwashers further break down fat particles (40–50% of particles are smaller than 45 micrometers), which prevents their complete separation in conventional traps and leads to the formation of grease buildup [5]. During the cleaning of floors and equipment, food residues, fats, and detergents mix together, increasing the organic load of wastewater. Sanitary activities (toilet use and washing) account for the remaining portion of water consumption. The operating principle of grease traps (for example, based on the gravity principle) is as follows: hot wastewater enters the grease trap, where fat substances float to the surface and remain there, while the treated water flows out into the sewer system [6]. This method protects

sewer systems from being clogged with grease, maintains pipe permeability, and reduces the negative impact on subsequent biological wastewater treatment stages. Grease traps mainly operate based on the principle of density difference (gravity) [7]: since the density of fats and oils is lower than that of water, they rise to the surface, while heavier particles settle at the bottom. As a result, relatively purified water is directed into the central sewer system [8].

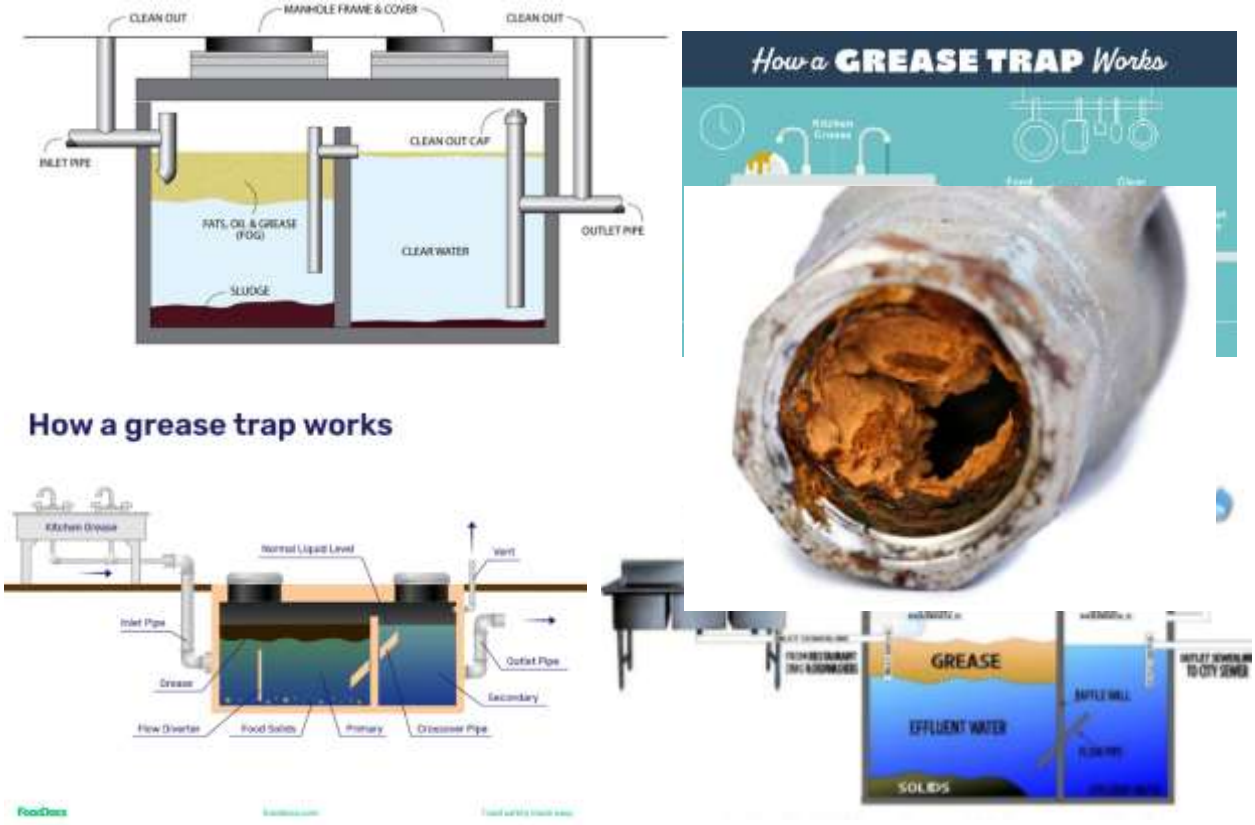


**Figure 1.** Operating scheme of grease traps (for example, based on the gravity principle

**Mechanisms of wastewater generation**

Wastewater pollution occurs through the following main mechanisms

1. Mechanical mixing: Food residues and fats form a suspension with the water flow, which increases the concentration of total suspended solids (TSS) (500–2000 mg/L) [9].
2. Emulsification: Under the influence of hot water and detergents, fats are broken down into small droplets, remain suspended in water for a long time, and make the treatment process more difficult [10].
3. Saponification: Fats react with metal ions (calcium, magnesium) to form soap, which leads to the formation of hard grease deposits in pipes.
4. Hydrolysis and crystallization: The breakdown of fats during frying increases the amount of free fatty acids, which form crystals upon cooling [11].

Such grease accumulations (fatbergs) are most commonly found in areas with a high concentration of restaurants, public catering facilities, and large kitchens. Their

formation occurs as a result of the gradual accumulation of fats, oils, food residues, hygiene products, and other insoluble wastes in sewer pipes over a long period of time [12]. Over time, the solidification of these substances significantly reduces the effective cross-sectional area of sewer pipes or even completely blocks them. The formation of fatbergs leads to a number of negative consequences. In particular, hydraulic resistance in the sewer system increases, resulting in wastewater backflow and emergency situations [13]. This causes violations of sanitary and hygienic standards, the spread of unpleasant odors, and damage to the environment. In addition, the mechanical removal of grease accumulations requires significant financial costs and labor [14].

**Figure 2.** Physicochemical composition of wastewater and properties of fats

Wastewater from public catering establishments has a high organic load:

1. BOD (Biochemical Oxygen Demand): 1000–5000 mg/L (up to 3170 mg/L in some studies).
2. COD (Chemical Oxygen Demand): 2000–10,000 mg/L (maximum up to 9,948 mg/L) [15].
3. FOG (fats, oils, and grease): 100–1,640 mg/L.
4. Total Suspended Solids (TSS): 500–2,000 mg/L.

## CONCLUSION

**Fundamental Finding :** These indicators clearly show that wastewater from public catering establishments contains high concentrations of organic matter and fats. A high BOD value indicates a large amount of biodegradable organic substances in the water, which may lead to increased oxygen consumption at treatment facilities and disruption of biological processes. A high COD value indicates a large proportion of poorly oxidizable organic and inorganic compounds in the wastewater. Fats, oils, and grease (FOG) are considered one of the most problematic components of wastewater. Since the density of these substances is lower than that of water, they float on the surface; however, under the influence of hot water and detergents, they form stable emulsions and become evenly distributed throughout the water volume. In public catering establishments, the generation of wastewater is mainly associated with kitchen and washing processes, with

fats being the main pollutant. **Implication :** A thorough understanding of these mechanisms makes it possible to protect the sewer system, prevent sanitary accidents, and reduce environmental damage through the effective installation and operation of grease traps. **Limitation :** The passage does not specify quantitative thresholds, comparative analysis across different establishments, or variations in operational conditions that may influence BOD, COD, and FOG behavior. **Future Research :** Future research may focus on evaluating the efficiency of different grease trap technologies under varying temperature, detergent concentration, and flow conditions, as well as developing optimized pretreatment strategies to enhance wastewater treatment performance in public catering establishments.

## REFERENCES

[1] H. A. Aziz, T. Y. Ling, and N. A. Rahim, "Micro and macro analysis of restaurant wastewater containing fat, oil, grease (FOG): An approach based on prevention, control, and sustainable management," *Chemosphere*, vol. 317, pp. 137–145, 2023.

[2] E. Salama, J. H. Hwang, and M. M. El-Dalatony, "The role of restaurant wastewater for producing bioenergy towards a circular bioeconomy: A review on composition, environmental impacts, and sustainable integrated management," *Environmental Technology & Innovation*, vol. 27, pp. 102–115, 2022.

[3] L. Lesage-Meessen, D. Navarro, and S. Maunier, "Characterisation of food service establishment wastewater and its implication for treatment," *Journal of Environmental Management*, vol. 249, pp. 109–120, 2019.

[4] T. Wallace, D. Gibbons, and M. O'Dwyer, "Problems with fat, oil, and grease (FOG) in food industry wastewaters and recovered FOG recycling methods using anaerobic co-digestion: A short review," *Applied Sciences*, vol. 8, no. 2, pp. 120–135, 2018.

[5] U.S. Environmental Protection Agency, *Onsite Wastewater Treatment Systems Manual*, EPA/625/R-00/008, Washington, DC, USA: EPA, 2002.

[6] President of the Republic of Uzbekistan, "On measures to further improve the drinking water supply and wastewater management system (draft resolution)," Kun.uz, 2023. https://kun.uz

[7] X. He, F. L. de los Reyes, and M. L. Leming, "Food-service establishment wastewater characterization," *Water Environment Research*, vol. 78, no. 8, pp. 805–812, 2006.

[8] J. B. Williams, C. Clarkson, and C. Mant, "Fat, oil and grease deposits in sewers: Characterisation of deposits and formation mechanisms," *Water Research*, vol. 46, no. 19, pp. 6319–6328, 2012.

[9] Metcalf & Eddy, *Wastewater Engineering: Treatment and Resource Recovery*, 5th ed. New York, NY, USA: McGraw-Hill, 2014.

[10] G. Tchobanoglous, F. L. Burton, and H. D. Stensel, *Wastewater Engineering: Treatment and Reuse*, 4th ed. New York, NY, USA: McGraw-Hill, 2003.

[11] A. K. Mohanakrishna, S. Venkata Mohan, and P. N. Sarma, "Bio-electrochemical treatment of food processing wastewater," *Bioresource Technology*, vol. 101, no. 2, pp. 469–476, 2010.

[12] M. H. Gerardi, *Wastewater Bacteria, Hoboken*, NJ, USA: Wiley-Interscience, 2006.

[13] World Health Organization, *Guidelines for the Safe Use of Wastewater, Excreta and Greywater*, Geneva, Switzerland: WHO Press, 2006.

[14] European Environment Agency, *Urban Waste Water Treatment in Europe*, Luxembourg: Publications Office of the European Union, 2019.

[15] Food and Agriculture Organization of the United Nations, *Water Reuse in Food Processing Industry*, Rome, Italy: FAO, 2018.

***Obutjonova Durdona Omonjon qizi (Corresponding Author)**
Master's student, Tashkent State Transport University, Uzbekistan
Email: durdonaobutjonova@gmail.com