

Biological Solutions for Breaking Down Fat, Oil, and Grease in Commercial Restaurant Environments

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Abstract: *The daily Restaurant Wastewater (RWW) produced by commercial restaurants contains elevated levels of Fat, Oil, and Grease (FOG), leading to issues such as kitchen sink blockages and sewer line clogs, which result in unpleasant odors and overflows. While grease traps are commonly installed to separate the heavy FOG component from RWW, routine manual cleaning is often necessary to prevent clogging or overflow. This research showcases several case studies in which biological solutions were introduced with the aim of mitigating FOG - related challenges in commercial restaurant settings, offering a cost - effective alternative. The findings highlight that the implementation of biological solutions serves as an ongoing maintenance strategy, effectively preventing issues arising from FOG waste in restaurant kitchens.*

Keywords: FOG, Restaurant Wastewater (RWW), Biological solution, Grease traps, Odor

1. Introduction

Fat, oil, and grease (FOG) in sewers are causing big problems for large cities in developed areas. It's a global issue for sanitation efforts. FOG buildup is bad for health and the environment, leading to smaller sewers, clogged pipes, and possible flooding, especially in combined systems. More than half of flooding incidents are because of FOG causing sewer blockages. FOG also attracts pests like rats and can mess up pumping stations and sewage treatment plants. Even with efforts to stop it, a lot of FOG still gets into sewers, mainly from kitchen practices or poorly maintained oil interceptors.

^[1] Fats, oils, and grease (FOG) are byproducts of cooking, dishwashing, and other kitchen activities. ^[2] Daily activities in restaurant kitchens, including cleaning, washing, and cooking, generate restaurant wastewater (RWW). In addition to elevated levels of chemical oxygen demand (COD), biochemical oxygen demand (BOD), and various nutrients, RWW contains significantly high concentrations of fats, oil, and grease (FOG). ^[3] This emerges as an environmental concern since the combination of low temperatures and pressures in sewer systems may induce the formation of FOG deposits, thereby presenting the potential for blockages in public sewer systems. ^[4] The sewer system's capacity is compromised as FOG solidifies and adheres to the inner walls, resulting in pipe blockages and constraining the flow of wastewater. ^[5]

This study seeks to measure the discharge of restaurant wastewater (RWW) based on the number of covers in a restaurant and examine the feasibility of employing biological solutions to address clogging issues in grease traps, manholes, and similar systems. The biological solution employed in this study involves a synergistic combination of beneficial microorganisms with several key capabilities. This solution has been proven to rapidly diminish fats, oils, and grease. It serves to pre - treat influent in collection systems, providing a natural and non - toxic approach to wastewater treatment.

2. Materials and Methods

This paper investigated the successful application of biological solutions at three distinct sites: a dining restaurant, a quick - service restaurant, and a 5 - star hotel. The objective was to validate the efficacy of the biological solution at these sites in treating FOG in their wastewater and providing a solution to the daily challenges faced by these industries for handling FOG. The biological solution used for this study is formulated with natural surfactants to work on effluent with high FOG levels and to increase biodegradability potential. The organisms have been selected for their capacity to rapidly express lipase and esterase enzymes, along with the natural tensioactive, and rapidly degrade different ester bonds making FOG material available as an energy source for existing biology.

2.1 Trial location 1 - Dining Restaurant in Mumbai, India

Background: A restaurant situated in Dadar, Mumbai, was selected for this trial. The front kitchen of the restaurant comprises two sinks and a butcher station with two drainage outlets. Water from these points flows underground towards manhole 1 and then disperses across manholes 2, 3, and 4 before being discharged into the city sewer line.

Problem: Due to the accumulation of organic sludge (FOG), kitchen sinks and drain pits were frequently clogged. This resulted in the backflow and overflow of the manhole lines which lead to foul odors and required frequent manual cleaning.

Application of biological solution: Right before the restaurant closed each night, biological solution was poured into manhole 1. For this trial, 100 g of the selected biological product was mixed with 20 liters of tap water.

2.2 Trial location 2 - Quick Service Restaurant in New Delhi, India

Background: This multi - cuisine QSR (quick service restaurant) and sweet shop located in Akshardham (AkD), New Delhi, operates from 8: 30 am to 11: 00 pm daily, offering a diverse range of food and beverages.

Problem: The RWW from the kitchen contains fat and oil which flows into an existing grease trap and ETP. This resulted in the choking of pipelines, excess FOG (fat, oil, and grease) in grease traps, high loading in ETP, and foul odor.

Application of Biological Solution: The biological solution was administered in pipelines, drains, and sumps over a two - week period, with kitchen staff conducting daily dosing in all sinks and drains after the 1 am post - cleaning routine. This timing minimized the risk of water presence in the kitchen pipelines, drains, and sumps. Throughout the treatment, diligent monitoring focused on key performance parameters. The evaluation included a comparison of the frequency of pipeline and drain blockages to pre - treatment levels, an assessment of the reduction and elimination of foul odors in sinks and drains based on the perception and judgment of the kitchen team, and a daily analysis of the grease trap to gauge the incoming load and quality of the generated sludge. These metrics served as essential indicators to gauge the efficacy of the biological solution treatment.

2.3 Trial location 3 - Hotel in New Delhi, India

Background: This five - star hotel in New Delhi is one of several properties managed by IHG in India. This hotel

operates multiple kitchens that serve a diverse range of food and beverages at various restaurants, banquet halls, and staff canteens. These kitchens generate approximately 50 m³/day of RWW containing high concentrations of fat, oil & grease (FOG), as well as elevated chemical oxygen demand (COD) and biological oxygen demand (BOD). The RWW from the kitchens encompasses water from rinsing, cooking, and utensil wash. It's important to note that RWW from the bakery is segregated from the RWW generated by all other kitchens. The bakery RWW undergoes treatment in the effluent treatment plant (ETP), while RWW from all other kitchens is collectively treated in the sewage treatment plant (STP). Both streams are equipped with individual grease traps and collection sumps.

Problem: High FOG content generated foul odors in the basement where the RWW sump was located. Choked drains and grease traps adversely impacted the performance of the STP and ETP units downstream.

Solution: A dual product solution was implemented. RWW from the kitchens was treated with the biological solution FOG to reduce FOG and foul odors. A shock dose of the selected biological product was started the initial week into both the bakery and kitchen grease traps. Additionally, the biological solution was sprayed several times a day for one week in the sumps and adjoining areas where the overflow residue was present.

The following dosing program was followed during the trial period:

Table 1: Trial Location 3 - Dosing program for Biological Solution

Duration	Biological Product Dosage [g/day]	Water Volume for Preparation of biological solution	Dosage Points (Manual Dosing)
Day 1 to 7	500 g/d	60 liters	Shock dosing in all drain outlets right after the kitchen is closed
	100 g/d	30 liters	Spray application in grease traps, sumps, adjoining area and overflow drain lines
Day 7 to 11	250 g/d	50 liters	Continuous drip dosing in grease trap for kitchen RWW
	100 g/d	50 liters	Continuous drip dosing in grease trap for bakery RWW

3. Results

Trial location 1: Following a two - week application of the biological solution, several noteworthy improvements were observed. There was a noticeable reduction in sludge build - up inside the grease trap, and a decrease in FOG presence in and around manholes was evident. Moreover, a reduction in unpleasant odors was observed, contributing to a more favorable environment. The application also led to a decrease in maintenance costs, and notably, there was no need for manual clean - up, indicating the efficacy of the treatment.

Trial location 2: Several favorable outcomes were observed at Trial Location 2. Firstly, there were no occurrences of drain choking throughout the treatment period. The removal of unpleasant odors from sinks and drains significantly improved the overall environmental quality. Moreover, there was an initial surge in the load on grease traps during the first 8 days, signifying the effective cleansing of pipelines and drains from accumulated sludge. Additionally, the sludge

load to the grease trap reached a stabilized state, characterized by a soft and low - odor quality, facilitating effortless removal.

Trial location 3: The trial reported by hotel personnel was highly successful, resulting in several positive outcomes. These included cleaner kitchen drains, a reduction in the top layer thickness of fats, oils, and grease (FOG) in grease traps, improved performance in the sewage treatment plant (STP) downstream of the grease traps, and a notable reduction in unpleasant odors within the premises. These observations collectively underscore the effectiveness of the trial in enhancing overall sanitation and operational aspects of RWW management.



Figure 1: Trial Location 1 - Manhole 1 before application of Biological Solution



Figure 2: Trial Location 1 - Manhole 1 after 2 weeks application of Biological Solution

4. Conclusion

The application of the biological solution proved to be a cost-effective and efficient method for addressing FOG accumulation within grease traps and manholes. The elimination of manual cleaning requirements at all trial locations resulted in significant cost savings associated with drain pit and grease trap maintenance. Throughout the trial period across multiple sites, the biological solution

successfully cleaned pipelines, reduced drain choking incidents, and eliminated unpleasant odors. The consistent positive feedback from restaurant owners, store employees, maintenance and operations teams, and kitchen staff served as a robust validation of the achieved performance outcomes. Overall, the comprehensive success of the biological solution highlighted its value in enhancing cost efficiency, operational convenience, and environmental conditions in diverse settings. The study's conclusion highlights that the consistent implementation of biological solutions in commercial kitchen settings on a daily basis can significantly mitigate the problem of drain and pipe clogging caused by elevated levels of FOG.



Figure 3: Trial Location 2 - Before treatment



Figure 4: Trial Location 2 - After 10 days of treatment with Biological Solution

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