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Waste Management in Restaurants: A Review

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1. INTRODUCTION

1.1. Background Indian Restaurant Industry

The restaurant industry in India is growing at a faster rate with the diverse culinary habits, wide range of cuisines and the diverse cooking techniques being some of the main factors behind its growth. High standard of living and the change in the lifestyle of the people stimulate more and more consumers for flocking various restaurants. Recent surveys have shown that there has been a growing trend among the Indians to taste various types of gastronomical delights. This has also led to the growth of restaurants which serve regional and international delicacies.

India's hotel, restaurant and institutional sectors have been benefiting from India's strong economic growth, foreign investment, rising incomes, a young population and changing consumer consumption patterns. While opportunities for foreign food exporters in the market are improving, the sector for imported food products is comparatively smaller, due in large part to ongoing import restrictions and strong competition from domestic foods.

India has a vast hotel sector, but only a small percentage of hotels are considered three stars and above. The overwhelming majority of hotels are small traditional outlets that provide inexpensive accommodations for travellers and source all of their food locally. Of the estimated 300,000 hotels in India, only 2,050 are considered the modern or "organized" hotel sector. (Mishra, 2011) Nevertheless, as foreign and domestic travel has increased manifold in recent years, the number of modern hotels that carry at least small amounts of imported foods on their menus has also multiplied. Now, Hotels can obtain a special license that enables them to purchase food items (and other items such as equipment and furniture) duty-free subject to their foreign exchange earnings. Hotels tend to use the duty-free licenses to purchase the items with the highest import tariffs and may not use the licenses to purchase food.

Traditionally, Indians used to eat at home and eat Indian food. Those who ate outside the home either ate street foods from the enormous number of street stalls or from the informal eateries that are common across India. Eating out in restaurants was reserved for special occasions. However, India appears to be in the early stages of a significant transformation in

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the restaurant sector. Indian consumers are eating out more frequently and younger generations are shedding the prejudice of their elders against international franchises and foreign foods. With only an estimated 100,000 modern restaurants (20 or more seats, wait staff, menus) in India, there is plenty of room for growth in the industry. It i estimated that Indians spend 7 to 10 percent of their food expenditures outside their homes in restaurants, cafeterias and other food establishments. (Mishra, 2011)

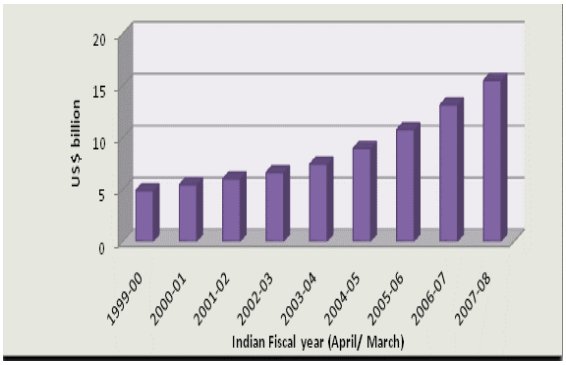

Fig1. *Value of the Food Service Sector(Mishra, 2011)*

Of the estimated 300,000 hotels and resorts in India, just 2,050 hotels constitute the "organized" or modern sector accounting for about 150,000 rooms. Most of these hotels are in the larger or metropolitan cities and major tourist or business destinations. India has various world class domestic hotel chains and several international chains have also established

a presence through franchising or partnerships with Indian firms. These branded hotels are mostly placed in the premium segment (5 star and above) and mid-range segments (3-4 star), which cater to business and leisure travellers. With the growth of tourism sector and business travel in India, several international brands are exploring the possibility of entering or expanding in the country.

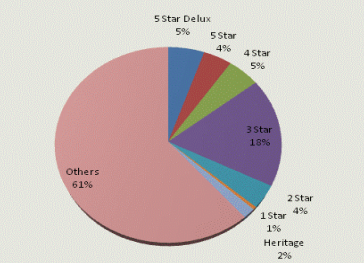

Fig2. *Profile of Organized Hotels in India*

It is difficult to assess the number of restaurants in India as the sector is largely considered to be the "unorganized" sector where small restaurants and street side stalls are common. There are approximately 100,000 restaurants in the "organized" or modern sector, which are restaurants with more than twenty seats and a restaurant menu. Indians have traditionally preferred multi-cuisine restaurants where a family or group can order a range of different cuisines. A typical multi-cuisine restaurant might have Chinese, various regional Indian dishes and European style foods on the menu. That trend is changing as restaurants serving a single cuisine are becoming increasingly popular. The Indian "organized" or modern sector is expected to grow at 8-10 percent annually for next few years because of increasing urbanization and increasing disposable incomes. International fast food and local multi-unit restaurant groups are driving the expansion in the restaurant industry. South India is also emerging with the growth of multi-unit chains that supply reasonably-priced ethnic food with a quick-service concept.

After a slow start, Western-style fast food restaurants have grown rapidly at 15-17 percent annually in recent years. Most foreign and local chains are doing well in major cities, and are expanding into mid-sized Indian cities referred to as tier-two and tier-three cities. Most of these fast food chains have added a variety of Indian-styled products to suit local preferences. Although these chains procure most of their products locally, several products such as French fries, specialty cheeses, some meats and seafood, flavours, condiments, and other ingredients are often imported. Over the past few years, the „coffee shop" culture has spread via chains like Costa Coffee, Mocha, Barista and Café Coffee Day in major cities. These chains are currently sourcing syrups, nuts and some bakery ingredients from foreign origins.

2. Environmental Concerns

A major issue concerning us in this regard is the disposal of the waste generated from the restaurant facilities. The solid and liquid wastes generated are very high in pollutant levels and cannot be discharged directly into municipal dumping sites or rivers.

Some 18,000 tonnes of carbon emissions are generated by food-related road traffic each year, much of it linked to restaurants; 75 per cent of the 600,000 tonnes of glass bottles junked every year by restaurants, cafés, bars, hotels and clubs never gets even close to a recycling plant; and a third of the food ordered by the trade is thrown away. So, right now, that distracting dinner for two is very much part of the problem. (McIvor, 2010)

Metropolitans, with their limited land area and high population density, face a major challenge in the disposing of municipal solid waste. This is especially urgent given the exponential generation of waste that resulted from the economic growth achieved in the last 40 years of development. As the trend continues to grow, already scarce land resources would need to be set aside to build more expensive incineration plants and landfills.

Besides incineration and recycling, the strategy of waste minimization which is aimed specifically at reducing waste at source before it is produced is also adopted. These measures are taken to achieve the ideals of a zero landfills and zero waste society. As Delhi is renowned for being a food haven, the food retail industry can be considered a major contributing factor in the generation of waste. Analyzing the waste from a food and beverage outlet will give a better understanding of the waste profile in order to devise ways of reducing and utilizing the waste. Environmental impacts of food waste in landfills are far greater than of packaging in landfills. In fact, food waste is 5 times more impactful in a landfill than packaging waste.

Food waste in landfills creates methane gas, which is a greenhouse gas 20 times more potent

than CO2. All the resources that go into growing, producing, and shipping food is wasted if it's not consumed and thrown away. Wastewater is generated from washing of raw food materials, washing of utensils, washing of floors, etc. which is also a major environmental concern.

3. GENERATION AND CHARACTERIZATION OF WASTEWATER

Restaurant wastewater is the raw sewage which contain high density organic, suspended solids, oil and grease. It has high BOD, COD, suspended solids, oil and grease which pose serious harm to the environment and human health. This type of wastewater not only increases the load of wastewater treatment plants, but also affects the discharge capacity of urban drainage pipe, add to the pipe clearing cost, deteriorate the water quality, and threaten the environment and human health. Oils, fats and grease coat the inside of wastewater pipe. Solid food particles in wastewater stick to the oil and grease on the inside of the pipe which clogs the pipes in the facility. Oil and grease traps are used to control certain amount of oil and grease. These devices employ the principle of gravity; the lighter fats and oil immediately separate, rise to the top and remain trapped in the retention area of the tank. The heavier, clean water portion of the flow is allowed to exit and be discharged in to drain lines. Therefore it is significant to treat the wastewater generated in the kitchen unit of the restaurant. It has environmental and social benefits, which not only protect ecological environment and also relieve the harm to urban drainage pipe.

3.1. Quantification of Wastewater

The primary source of wastewater in a restaurant is washing of utensils, washing of hands by customers and occasionally washing of floors. The quantity of effluent generated from kitchen is given in table 1.

3.2. Characterization of Wastewater

Washing and cleaning of a variety of items including cooking pots, serving pots, different varieties of utensils etc are done in restaurants. Therefore the restaurant wastewater composition is greatly dependent on the variety of items washed. The wastewater generated is of interest from the standpoint of environmental impact in terms of both wastewater volume and contaminant loading. The major contaminants in the wastewater are suspended solids, oil and grease, leftovers, Biochemical Oxygen Demand and Chemical Oxygen Demand.

Table1. *Quantity of Effluent Generated from Restaurants based on seating capacity*

S. No.	Restaurant Name	No. of Seats	Total water consumption (Liters per day)*	Water consumption in kitchen (Liters per day)**	Wastewater generated through kitchen (Liters per day)
1.	Restaurant A	80	5600	2400	1920
2.	Restaurant B	150	10500	4500	3600
3.	Restaurant C	40	2800	1200	960
4.	Restaurant D	200	14000	6000	4800

* 70 liters per seat, as per manual on water supply and treatment by CPHEEO, Govt. of India; Clause 2.2.8.3, pp.11

** 30 liters per seat or 7 liters per meal by CPHEEO, Govt. of India

Table2. *Characteristics of Liquid Waste from a typical Indian Restaurant*

Parameter	**Value**
BOD_5 (mg/l)	1000 – 2000
TSS (mg/l)	300 – 625
Oil & Grease(mg/l)	100 – 300

3.3. Effects of Direct Discharge into Sewers/Inland Water Bodies:

The main restaurant wastes that can affect the publicly owned treatment works (POTW) are:

3.3.1. Fats, Oils and Grease (FOG) :

Most wastewater collection system blockages can be traced to FOG. Blockages in the wastewater collection system are serious, causing sewage spills, manhole overflows, or sewage backups in homes and businesses.

3.3.2. Solids:

Untreated wastewater makes water turbid and reduces light penetration and hence reduces the photosynthetic process of micro plants in the water body. They can also constrict sewer flows and contribute to bad odour and potential pipe failure.

3.3.3. BOD/ COD Ratio:

BOD/COD ratio is the conventional index. As a first approximation it could be said that higher this ratio, better the biodegradability. Lower this ratio, lower the biodegradability. However this general expected behaviour has to be checked by pilot scale experimentation for industrial effluents characterized by a small BOD/COD ratio. The principal deleterious effect of this effluent on streams and water courses is their deoxygenating which poses as a threat to the aquatic life and our limited water resources.

4. TREATMENT OF WASTEWATER

The unit provided for Effluent Treatment Plant (ETP) for treatment of wastewater prior to discharge in public sewer should comply with the requirements of pollution control board. Treatment starts from collection of wastewater as described in section 4.1. ETP should be designed on the basis of combined primary, secondary and tertiary treatment system. Secondary and tertiary treatment sections are designed on the basis of biological treatment process of organic matter operated on a continuous mode. The ETP includes oil and grease trap, collection cum equalization tank, reaction tank, chemical dosing tank, settling tank, multimedia filter, activated carbon filter, sludge holding tank, sludge drying beds, blower and pump. In general, wastewater is collected in collection cum equalization tank, transferred to reaction tank where dosing of chemical is done as per requirement and wastewater is put for reaction. Then wastewater is transferred to settling tank for settlement of flocs/sludge. The supernatant is passed through the multimedia filter followed by activated carbon filter. Finally the treated water is disposed off. The sludge is transferred to sludge drying beds and dewatered there. The consolidated sludge is removed and disposed of in an eco-friendly manner.

4.1. Treatment Process Description

As per the operational procedure of treatment plant handling, the effluent generated is collected into collection cum equalization tank. It is then pumped to reaction tank. The desired chemical dosing is mixed properly. The chemical added for this purpose include lime, sodium meta- bisulphate and polyelectrolyte. The lime is added to make the pH in the range of 8-8.5.Coagulant is added at the rate of about 200mg/l. These chemicals are mixed within separate reaction tanks and are added by gravity into the reaction tank, as an aqueous solution through respective valves to achieve proper control. The mixed effluent is then settled within the settling tank, where the flocculated particles are allowed to settle down. The settled solids in the settling chamber is allowed to flow to a set of sludge drying beds for dewatering and the dewatered sludge is packed in plastic bags and stored in a container designed for the purpose. The clear filtrate from the sludge drying bed is taken back to the equalization tank for further treatment.

4.2. Treatment Scheme

The Effluent Treatment Plant consists of the following treatment units:

1. Oil and grease trap.
2. Collection sump.
3. Equalization tank.
4. Bar screen.
5. Aeration tank.
6. Multimedia filter.
7. Activated carbon filter.
8. Dosing tanks.
9. Raw water storage tank.
10. Sludge holding tank.

4.2.1. Oil and grease trap

The wastewater from the kitchens is pre-treated separately for removal of oil and grease. For this purpose an O & G trap have been provided for the respective streams. The outgoing streams of O & G trap, guestrooms, common toilets, floor washing, restaurant and other sources join together at the bar screen chamber of the ETP.

4.2.2. Bar Screen

Raw sewage from the source is manually received into the bar screen chamber by gravity. Screen provided removes all floating and big size matter such as plastic bottles, polythene bags, glassed, stones etc; which may otherwise choke the pipeline and pumps.

4.2.3. Equalization Tank

Usually, sewage generation is more during morning hours and evening hours. Visually no sewage is generated during night hours. Any biological system needs constant feed for bacteria to work efficiently. Hence, it is important to put an equalization tank to collect the excess flow during peak hours and feed sewage in lean hours. Provision of air grid is made for thoroughly mixing of sewage to make it of homogenous quality and to keep the

suspended matter in suspension and to avoid septic condition.

4.2.4. Transfer of sewage

The sewage transfer pump of non submersible type is provided. The operation of the pump is controlled manually. The sewage from equalization is transferred to aeration tank.

4.2.5. Aeration Tank

Here provision of air grid is made for thoroughly mixing of sewage to make it of homogenous quality and to keep the suspended matter in suspension and to avoid septic condition. Here the organic matter gets converted into new bio-mass. After activated sludge process the effluent is gravitated to clarifier.

4.2.6. Tube settler

The main objective of the settling tank is to separate water and sludge in achieving high suspended solid concentration for recirculation purpose. For this purpose tube settler is provided. Tube settler is a hopper bottom tank fitted with PVC synthetic tubular media. The solids are settled at the bottom of the tank and clear water from the top overflows to clear water tank. The clear water is transferred to chlorine contact tank. The solid settled at the bottom is returned back to the aeration tank partially. The excess sludge is collected in sludge holding tank and fed to sludge filter press. The sludge cake from the filter press is disposed off and filtrate from the filter press is returned to the equalization tank.

4.2.7. Treated water collection tank

The treated water is collected from the tube settler and further pumped through the multimedia filter and activated carbon filter. Generally, the treated water is used for horticulture and miscellaneous uses or to sewerage system.

4.2.8. Sludge

The sludge from the tube settler is partially taken into aeration tank and excess sludge is removed once in a day and transferred to sludge holding tank and fed to sludge drying beds.

5. SOLID WASTE MANAGEMENT

5.1. Solid Waste Classification

Solid waste can be further classified into:

- **Biodegradable** (Wet) waste comprising of food, vegetable and non vegetarian waste
- **Non biodegradable** (Dry) waste comprising of plastic bottles, papers, plastic wrappers, HDPE, LLDPE bags etc.

Solid wastes are segregated in different coloured dustbins based on the composition of waste to be disposed off. This segregation at source helps in the bigger problem of solid waste management. The various colour codes used are: Green for paper / Cardboard; BLUE for Plastics; RED for Food waste for composting purposes; BLACK for general mixed waste.

5.2. Management of Solid Waste:

Restaurants generate a tremendous amount of solid wastes including paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes and hazardous wastes. Simple procedures such as assessing and monitoring the types and amounts of garbage thrown away each day can lead to significant savings for the restaurant, as well as monitoring and resizing your dumpsters and roll-offs. The first step in reducing the amount of waste a restaurant produces is to conduct a waste audit. Waste audits allow to physically see what waste is being produced. Most foodservice operations throw out a massive amount of garbage, most of which could be diverted. Most restaurants are "over serviced" meaning they have too many dumpsters or too frequent pick-ups. 75% of material in today's landfill is recyclable or compostable, while 50-70% of the weight of a foodservice operation's garbage consists of compostable food items. Food packaging makes up most of the remaining weight of the garbage's bins, but account for around 70% of the volume of foodservice trash. (Consulting, 2013) A foodservice operation without recycling, composting or any waste reduction program can reduce their disposal cost by at least half by implementing simple, structured practices.The strategy applied should be to rethink, then reduce, then reuse, then recycle. Recycling varies across the country as to what is collected and how it is collected. At a minimum, fryer oil and materials that are toxic such as fluorescent lights, old thermostats, batteries, unused chemicals, paints and miscellaneous hazardous materials should be recycled. Many municipalities have also implemented electronic recycling programs along with national programs from a variety of electronics companies and we take care of e-waste as well.

In order to be truly sustainable, the environmental plan must serve the dual purpose

of minimizing impact while driving profitable growth.

6. INNOVATIVE APPROACH TOWARDS WASTE MANAGEMENT IN RESTAURANTS

A compact biogas plant, developed by Apropriate Rural Technological Institute, Maharashtra uses waste food rather than dung/manure as feedstock, to supply biogas for cooking can be used. The plant is sufficiently compact to be used in limited space available in some of the restaurants.

The design is not very complex and can be fabricated using locally available materials. In general the following parts would need to be obtained locally:

- 1000 Litre and 750 Litre plastic tanks. If not available then cement and brick tanks can be constructed.
- PVC pipes of various diameters, commonly used in plumbing.
- Biogas cook stove (This would generally be available in countries where the biogas technology has been promoted by the governments).

Most biogas plants which are currently in operation in India and elsewhere are designed for animal manure as their main feedstock, and are therefore used in rural areas. Whereas in cities, a majority of the people use LPG or kerosene for cooking, the immediate benefit from owning a compact biogas system is the savings in cost as compared to the use of kerosene or LPG for cooking. The up-front cost of a biogas system is higher than for LPG, since an LPG bottle plus a two burner stove costs only INR 5,000 (approx. USD 100) whereas the compact biogas plan plus a biogas stove costs about INR 10,000 (approx. USD 200). However, the operational cost for biogas is only about INR 2 per day if waste flour is used as feedstock, and can be zero if the plant uses only food wastes. This is much cheaper than LPG, which costs about INR 30 per day, even with the current subsidy of 50%. Biogas can easily replace 50% of the LPG used by a family. Some families who use a pressure cooker for cooking and collect food waste from their neighbours have replaced all their LPG use. (Karve, 2012). Methane burns with a blue flame, without producing any smoke or soot. It is therefore an environmentally friendly cooking system. Thus, introduction of the new efficient, compact biogas system would not only help urban households in utilizing their domestic wet waste, but also help prevent millions of premature deaths of women and children in rural households due to indoor air pollution caused by smoke and soot from burning fuel wood in traditional chulhas. This markedly impacts the health of the people in the kitchen (mainly women) positively. Further reductions in pollution and energy use arise from not having to transport LPG cylinders to be re-filled. The small amount of solid residue produced by the biogas plant makes a good fertilizer. On a global scale, it is well known that the replacement of fossil fuels reduces the emission of greenhouse gases. For a typical urban household, biogas saves 100 kg of LPG or 250 litres of kerosene per year, which is equivalent to 300 to 600 kg CO_2 per year. A rural family could save about 3 tonnes of wood per year, which would generate about 5 tonnes CO_2 if burnt. (Karve, 2012)

6.1. Advantages of ARTI Biogas System over conventional Biogas plant

Biogas systems are those that take organic material (feedstock) into an air-tight tank, where bacteria break down the material and release biogas – a mixture of mainly methane with some carbon dioxide, which could be used as fuel. The current practice of using low calorie inputs like cattle dung, distillery effluent, municipal solid waste, or sewerage, makes methane generation in conventional biogas plants highly inefficient. Through this compact system, it has been demonstrated that by using feedstock having high calorific and nutritive value to microbes, the efficiency of methane generation can be increased by several orders of magnitude. Operating the system on this simple tenet also brings in many more advantages over the conventional systems: As a result of the higher efficiency, the size and cost of the new system are also lower. While the conventional biogas system occupies about 4 cubic meters of space, the compact biogas system is about as large as a domestic refrigerator. It is an extremely user friendly system, because it requires daily only a couple of kg feedstock, and the disposal of daily just 5 litres of effluent slurry.

In cities, waste food is often discarded and its rising heap attracts flies and rodents, thus creating a public health hazard. The compact biogas plant technology developed by ARTI readily accepts highly digestible organic materials such kitchen waste as feedstock and can easily blend into the urban lifestyle.

Table3. *Comparison of Conventional Biogas Systems vs. ARTI Biogas System (Karve, 2012)*

	Conventional Biogas Systems	**ARTI Biogas system**
Amount of required feedstock	40 kg + 40 lit water	1-1.5 kg + 15 lit water
Nature of required feedstock	Dung	Any starchy material
Amount and Nature of slurry to be disposed of	80 lit, sludge	15 lit, watery
Reaction Time for full utilization of feedstock	40 days	48-72 hours
Standard size for household	4000 lit	1000-1500 lit
Capital Investment per unit including stove	INR 20,000	INR 10,000
Running Expenses per meal	INR 25	0 to INR 5

A single plant produces sufficient biogas to at least halve the use of LPG or kerosene for cooking in a household, as well as a small amount of solid residue which can be used as fertiliser. This compact biogas plant could be replicated anywhere where there is the space for the plant, and the temperature is sufficiently high. (Karve, 2012)

7. DPCC GUIDELINES

As per the decisions taken by DPCC, the Restaurants, Eating Houses, Sweet Shops, Dhabas, Hotels [RESDH Sector] and Banquet Halls/ Party Lawns are required to comply with Effluent standards, provide Effluent Treatment System and also comply with other requirements as mentioned below**:**

Note: Following General Requirements are to be followed by all the above mentioned units as applicable:

1. The units located in the sewered areas shall ensure that effluent is discharged into the Public/Municipal / DJB Sewer and shall al so submit the proof regarding connection of their drainage system to the Public / Munici pal / Delhi Jal Board Sewer from the concerned Authority (DJB/MCD/NDMC/DCB)
   OR shall submit an Affidavit that the unit is having proper connection of their drainage system to the Public / Municipal / Delhi Jal Board Sewer.
2. The units shall also submit License from Local Health Authority (MCD/NDMC/ Delhi Cantonment Board) and from Delhi Police under the "Delhi Eating Houses Registration Regulations, 1980".
3. The units shall adopt Good House Keeping practices, shall properly channelize the fugitive emissions including emissions from cooking & kitchen operations by providing proper ducting / hood arrangement and proper exhaust system and emissions shall be discharged at least 2 meter above the roof of the building , properly handle , manage and dispose the solid waste generated and comply with the provisions of the Water (Prevention and Control of Pollution) Act,1974, as amended to date , the Air (Prevention and Control of Pollution) Act,1981, as amended to date and the Environment (Protection) Act, 1986, as amended to date and Rules made there under.

8. BEST ENVIRONMENTAL MANAGEMENT PRACTICES

Best Environmental Management practices which can be practiced for restaurant sector are mentioned below.

Hierarchy of Options

- Source reduction (methods to prevent wasted food and other discards)
- Donation to food banks (feed people)
- Onsite composting or other processing technology
- Collection for delivery to farms (feed animals)
- Collection for delivery to farms (direct land application)
- Collection for centralized facility creating fertilizers, soil amendments (composting) or mulches
- The three main restaurant wastes that can affect the publicly owned treatment works (POTW) are grease, solids, and janitorial cleaners. These wastes can constrict sewer flows and contribute to bad odour and potential pipe failure, which will drive away your customers and require taxpayer funds to repair.

Sr. No	Category / Type of Unit	Effluent Treatment System / Effluent Standards
1. a) b) c)	Restaurants/ Eating Houses /Dhabas and other such establishments. (Having Seating Capacity less than 36) Sweet Shops/ Halwais and other such establishments (with Annual Average Production of less than One Tonne/Day) Banquet Halls/ Party Lawn (with Floor Area less than 100 m^2)	➢ *Connected to /Discharging Effluent into Public/ Municipal/ DJB Sewer.* ➢ *Having Kitchen and / or Laundry.* Proper **Oil and Grease Trap cum Settling Tank** for holding the effluent arising from kitchen and washing activities for at least 4 hours duration. The unit shall submit Photographs of the Oil & Grease Trap cum Settling Tank.
		➢ ***NOT** Connected to /Discharging Effluent into Public/ Municipal/ DJB Sewer.* ➢ *Having Kitchen and / or Laundry.* Proper **Oil and Grease Trap cum Settling Tank for** holding the effluent arising from kitchen and washing activities for at least 4 hours duration **and Septic Tank.** The unit shall submit Photographs of the Oil & Grease Tank cum Settling Tank and Septic Tank.
2. a) b) c)	Restaurants/Eating Houses /Dhabas and other such establishments. (Having Seating Capacity less than 36) Sweet Shops/ Halwais and O ther such establishments (with Annual Average Produ ction of less than One Tonne/Day) Banquet Halls/ Party Lawn(with Floor Area less than 100 m^2)	➢ *Connected to /Discharging Effluent into Public/ Municipal/ DJB Sewer.* ➢ *Having Kitchen and / or Laundry.* **Effluent Treatment Plant(ETP)** including proper Oil and Grease Trap for the effluent arising from kitchen & washing activities and shall comply with the following General Standards for discharge of effluent into Public Sewers: (i) pH -- 5.5 - 9.0 (ii) TSS $\leq$ 600 mg/l (iii)BOD $\leq$ 350 mg/l (iv) O&G $\leq$ 20 mg/l The unit shall also submit **Adequacy Report** for the Effluent Treatment Plant from any of the Empanelled Consultants of DPCC and **Effluent Analysis Report** from any of the Empanelled Laboratories of DPCC.
		➢ ***NOT** Connected to /Discharging Effluent into Public/ Municipal/ DJB Sewer.* ➢ *Having Kitchen and / or Laundry.* **Effluent Treatment Plant (ETP) / Sewage Treatment Plant (STP)** (for the waste water generated from Toilets/ Bathrooms etc.) including proper Oil and Grease Trap for the effluent arising from kitchen & washing activities and shall comply with the following **standards** for discharge of combined effluent , as prescribed by MOEF vide Notification Dated **04.11.2009** : (i) pH -- 5.5 - 9.0 (ii) TSS $\leq$ 100 mg/l (iii) BOD $\leq$ 100 mg/l (iv) O&G $\leq$ 10 mg/l The unit shall also submit **Adequacy Report** for the ETP/STP from any of the Empanelled Consultants of DPCC and **Effluent Analysis Report** from any of the Empanelled Laboratories of DPCC.

Employer must ensure that all employees know the difference between an indoor drain, which leads to a sewage treatment plant, and an outdoor drain, which leads directly to the ocean. All employees must be aware of what cannot be discharged to the storm drain or an indoor sewer drain. Additionally, be sure to teach employees to recycle all items that are recyclable.

8.1. Grease

Any facility generating grease is required to have an interceptor or grease trap to prevent grease from entering sewer pipes. The size of the grease trap is based on the quality and quantity of wastewater flowing from facility. Likewise, the pump interval varies with the type/size of the unit and the amount of grease generated by the establishment.

- ***Interior Grease Trap:*** Grease traps are plumbing devices designed to intercept most greases and solids before they enter the wastewater disposal system. Weekly cleaning of the traps should be preferred.
- ***Exterior Grease Trap:*** Placed outside the facility, where sufficient area is available. Underground units are preferred.

8.1.1 Grease Control/Disposal

- Plumbing/Grease/Drain Additives
- Proper maintenance of a properly sized grease interceptor.
- Products used must be composed of active bacteria and be designed to decompose the grease in the grease trap/grease interceptor (GT/GI).

8.2. Solids

Solids include anything other than sanitary wastewater that has the potential to enter the sanitary sewer. In restaurants, this is typically food waste. Solids can either constrict sewer pipes or interfere with wastewater treatment at the POTW. Restaurants are not permitted to have food grinders or sink garbage disposal units. These allow for significant quantities of solids to enter the sanitary sewer system and/or your grease interceptor.

These solids will increase the number of times your interceptor/trap is required to be cleaned each year, which costs more money. Filtering drain plugs/screens that allow for drainage of water, but not solids, is required on all sinks and floor drains in the kitchen. Employing this best management practice will greatly help to correctly dispose of all food waste outside of the sanitary sewer. Food waste must either be composted or disposed of as regular waste in your trash dumpster.

Trash enclosures should be maintained to prevent solids and liquids from the dumpsters from entering a storm drain. Ensure that dumpsters are water-tight. Make sure employees are not throwing fluids in the dumpsters and that the area is kept clean and free of solids and trash. Tallow bins/drums must be covered and spills of waste oil must be prevented around the tallow bin or drum. Never hose down dumpsters or trash enclosures where the water is draining to a storm drain.

8.3. Janitorial Cleaning

While cleaning a restaurant, there are some key things to do to minimize Waste water and minimize the damage to the sanitary sewer system.

- **Proper Cleaning Methods:** Wherever possible, utilize dry cleaning techniques. Always sweep the floor and pick up debris prior to washing. Rather than rinsing down floors and equipment and sending large quantities of wastewater containing janitorial cleaners to the sanitary sewer, use a mop and bucket to apply the cleaners, and only pour the bucket water down the drain. Never hose down an outdoor area. If it is must clean an outdoor area, pressure wash only when needed and divert the water from pressure washing to landscaping or a sanitary sewer cleanout. Hose or wash-down water should not enter a storm drain.
- ***Choose a Safe Cleaning Solution:*** Select fewer, more multipurpose cleaners that are safer for worker health, your sewer pipes, and the environment. Green Seal Certified products tend to be the safer products.
- ***Dilute Properly:*** Make sure that cleaners are diluted as indicated in the instructions.
- ***Floor Mat, Equipment, and Exhaust Filter Washing:*** All drains in areas where floor mats are washed must route through the grease interceptor or trap (typically inside drains). Never clean floor mats, equipment or exhaust filters outside in an area where the wash water may flow to a street, gutter, catch basin, storm drain, or waterway.

9. MORE OPTIONS AVAILABLE TO REDUCE WASTE

1. Talk to suppliers about using reusable packing. Smaller, local farmers and suppliers are often more interested and structured to work with reusable packing for food packaging compared to large distributors.
2. Develop a composting program.
3. Develop a comprehensive recycling program if there is not one already in place.
4. Call around and find recycling or reuse option for miscellaneous items.
5. Bottles and cans are not the only things that can be recycled. Old cracked restaurant pans, broken tongs and anything make of at least 75% metal can usually be put in the metal recycling bin. Contact local recycler to confirm that they can accept these items.
6. Use compostable products for items that are normally discarded in-house such as straws,

stir sticks and drink skewers, then compost them.

7. Find products that come in less packaging, and also more recyclable packaging.
8. Use reusable options with everything possible. Coffee filters, coffee cups, drink coasters, etc.
9. Replace bottled beers with keg beer and bottled or canned soda with bag-in-box syrups or 5 gallon pre-mixed soda kegs. Most people will tell you the premix tastes better, but they are getting harder to find.
10. Develop a relationship with a food donation program in the area.
11. Donate old tableware, kitchen utensils and equipment to a church, school or soup kitchen.
12. Buy in bulk - while this is standard operation for most foodservice facilities, consider all the products not normally taken into account for bulk purchases such as alcohol and cooking wine.
13. Discontinue use of any non-essential products like paper place mats, frilly toothpicks and practices like putting two straws in cocktails.
14. Have staff distribute disposable items like napkins and plastic forks rather than placing them in self-serve stations.
15. Use napkin dispensers that dispense one napkin at a time.
16. Invest in nice wood tables rather than using linens or other table covers. This small upfront cost saves thousands of rupees in linen services every year.
17. Buy cleaning chemicals in concentrated form and reduce the number of chemicals on site by using multi-purpose cleaners.
18. Have employees use reusable cups for their own drinks.
19. Offer discounts to customers that bring a reusable coffee mug.
20. If applicable, charge a deposit and allow neighboring workers to take plates and utensils back to their offices.
21. Reduce the amount of excessive takeout packaging - a sandwich wrapped in paper inside a paper bag worked just fine up until the 80's, it can work again.
22. In quick serve operations where the customer is disposing of waste, make obvious, easy to understand labels on each bin for "bottles," "cans," "plates and silverware" and "garbage only." Because some people see everything as garbage - even your reusable silverware, labels may need to be more specific to identify waste like "paper cups and wrappers only." Also, make the garbage can opening small so guests do not just dump their entire contents in the garbage. Better yet, use a bus tub for garbage so staff can remove any silverware or recyclables thrown into the "garbage only" container.

10. CONCLUSIONS

Following conclusions are drawn from the study:

1. Considering the very high amount of oil/ grease and TSS present, the wastewater is beyond the treatment capacity of municipal treatment plants; hence it becomes mandatory to have their own effluent treatment plants with the units.
2. Environmental pollution takes place due to solid waste. This solid waste could be put to better use than thrown in landfills. Hence, for total waste management in restaurants solid waste management is an integral part. The biogas system by ARTI is a very cheap and effective means for solid waste management in restaurants.
3. Wastewater from restaurants is passed through Oil and grease trap, Collection sump, Equalization tank, Bar screen, Aeration tank., Multimedia filter, Activated carbon filter, and Dosing tanks after which it is safe to be disposed.
4. The water once treated from the above units meets all the norms for safe disposal into any water body with a with a COD of less than 250mg/L, BOD of less than 30mg/L and TSS of less than 100mg/L.
5. Owing to the large number of restaurants in Hauz Khas village the environmental load on nearby water bodies and landfills increases and causes municipal and civil problems.
6. Minimum treatment should be given to the wastewater by setting up ETPs in/near the restaurants for their environmental friendly disposal.

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