IMPLEMENTATION OF GAS BASED TANDOOR IN HOTELS AND RESTAURANTS

Background

One of the critical environmental complications India is facing today is air pollution, which has posed a major challenge particularly in urban centres. In recent years, Indian cities have experienced a phenomenal growth in terms of population, industry, vehicular growth and commercial activities. Apart broad emission source category of air pollution in an urban area there could also be some localised sources which could contribute significantly towards air pollutant load.

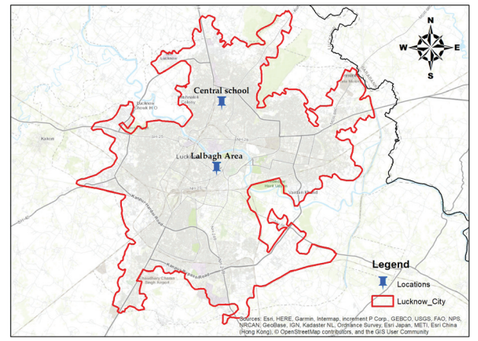
Being the capital city of Uttar Pradesh and a major center of trade, commerce, industry and education, Lucknow has experienced a substantial economic growth in recent years. The burgeoning population coupled with rapid growth in terms of vehicles, construction, and energy consumption has resulted in serious environmental impacts in Lucknow. Air pollution source apportionment study of Lucknow city conducted by TERI in 2022 suggests that apart from prominent sources of air pollution, localised sources such as hotel and restaurants sectors and roadside eateries also contributes towards PM_{10} and $PM_{2.5}$ emission load. Use of conventional or coal based tandoor is very common in hotel and restaurants to cook tandoor/grilled food items. However, the coal based tandoor not only generates significant quantity of smoke in the ambient environment causing air pollution but also increases the exposure risk of workers operating the tandoor. To effectively address localised sources of air pollution, introducing gas tandoor in hotel and restaurants will bring air quality improvements and health benefits in regions affected with higher levels of air pollution.

Aim and Objectives

To implement targeted interventions for mitigating localized air pollution and improving air quality in commercial areas.

Survey Analysis

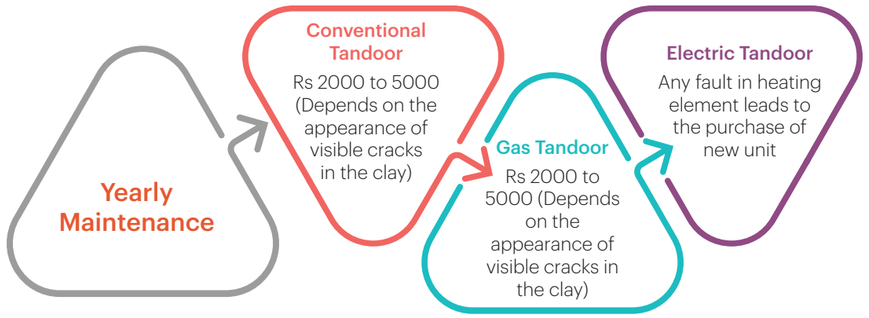
Methodology: Lal Bagh and Central School area of Lucknow city was selected for conducting baseline survey due to the presence of conventional coal fired tandoor using hotel and restaurants. In total, 44 units of hotels and restaurants within the identified areas were surveyed and responses were collected to understand the technical feature, purchasing cost, fuel consumption pattern, capacity of food preparation, durability, merits and demerits, and willingness of restaurant owners to shift from conventional tandoor to gas/electric tandoor. Additionally, seating capacity wise average coal consumption in conventional tandoor using hotel and restaurants were also collected.



Survey Locations

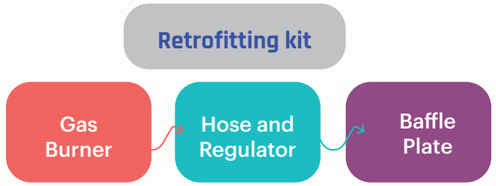
Comparative monthly saving analysis

- Monthly savings from gas based tandoor when replaced with coal fired tandoor is Rs 7,600
- Monthly expenditure from electric based tandoor when replaced with coal fired tandoor is Rs 20,000



Retrofitting solution

Existing conventional coal based tandoor can be transformed to gas tandoor by introducing retrofitting solution. This newly introduced technology does not require any permanent fixing tool and highly cost-effective. The overall cost of retrofitting with installation is Rs 5,000 for small drum size (2 feet × 2 feet) and Rs 7,000 for large drum size (3 feet × 3 feet) tandoor having BIS/ISI Quality mark burner with gas connection kit.



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UPPCB

Survey outcome

	Coal Fired Tandoor	Gas Tandoor	Electric Tandoor
Technical Specification	**Market availability**: Available in drum and square shaped **Purchase cost**: Rs 5,000 to Rs 35,000* (Includes Stainless Steel tandoor cost) **Capacity**: 10-12 rotis can be prepared at a time **Purchase cost of charcoal**: Rs 24/kg to 44/kg	**Market availability**: Available in drum and square shaped **Purchase cost**: Rs 18,000 to Rs 35,000* (Includes Stainless Steel tandoor cost) **Capacity**: 10-12 rotis can be prepared at a time **Purchase cost of LPG cylinder**: Rs 1800**	**Market availability**: Available in square and rectangular shaped **Purchase cost of Tandoor**: Rs 48,000 to Rs 50,000 **Cost of heating element**: 9kW copper element is used for heating that costs around Rs 15,000 **Capacity**: 15-20 rotis can be prepared at a time
Merits	Easy to operate Maintains taste of the food (rotis/naan are properly cooked) Add smoky flavour to cooked items	Less pollution compared to charcoal based tandoor	Use electricity to operate Takes less time to reach cooking temperature Requires no pre-heating
Demerits	Use of polluting fuel such as coal/charcoal Long term health issues	Workers have lack of knowledge to operate Rotis/naan items are not properly cooked Fails to incorporate smoky flavor to food	High capital cost Requires three phase electric connection in restaurants to operate High electricity consumption Requires safety measures during operation Fails to add smoky flavor to food Workers have lack of knowledge to operate

*Purchase cost varies according to seating capacity of restaurants/eateries

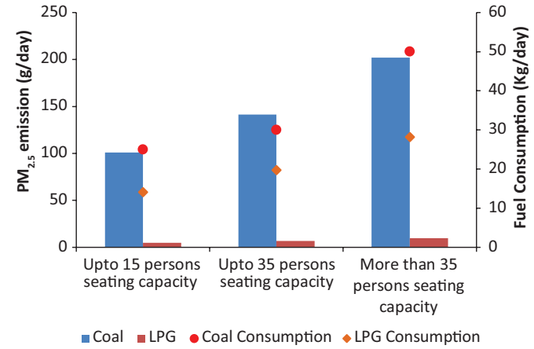
** Purchase cost depends on market price of commercial LPG cylinder

Survey Highlights

- Conventional coal fired tandoor is commonly used in hotels and restaurants of Lalbagh and Central School area as it is easy to operate and maintains the quality of food prepared. However, coal fired tandoors is highly polluting in nature and affects the health of workers and surrounding environment.
- Gas based tandoor is less polluting compared to coal tandoor but not in demand due to market unavailability and workers lacks adequate knowledge to operate.
- Electrical tandoor is a good option to replace coal tandoor and creates no pollution. However, electric tandoor includes high capital investment. Workers lack adequate knowledge to operate and require three phase electric connection. Moreover, any fault in the heating element will lead to purchase of new tandoor unit.

Emission reduction potential of gas tandoor

One of the identified sources contributing to the deteriorating air quality in Lucknow city is due to extensive use of poorly designed and inefficient conventional coal fired tandoor. According to survey analysis, particulate matter (PM2.5) emission from coal using tandoor was estimated as 101, 141 and 202 g/day for 15, upto 35 and more than 35 seating capacity restaurants respectively. Assuming that replacing conventional coal fired tandoor with gas tandoor, the particulate matter (PM2.5) emission is expected to reduce down drastically by 95%, thereby indicating significant air quality improvements.



Comparison between coal and gas based tandoor

Techno-economic analysis of different types of tandoor

Considering the survey findings, a techno-economic assessment was carried out for conventional, gas and electric tandoor. The monthly expenditure cost was observed to be minimum for gas based tandoor compared to conventional and electric tandoor and shows significant fuel saving and cost benefit in the long run.

Electric Tandoor

Gas Tandoor

Conventional Tandoor

Comparative analysis of monthly expenditure on use of conventional, gas and electric tandoor in Lucknow city.

Tandoor Type	Fuel cost	Fuel consumption	Monthly expenditure	Capital Expenditure
Conventional (Coal)	Rs 30 per Kg	25 Kg per day	Rs 22,500	Rs 18,000 to Rs 35,000*
Gas (LPG)	Rs 1800 per LPG cylinder	8 cylinders per month	Rs 14,400	Rs 18,000 to Rs 35,000
Electric	Rs 15 per unit of electricity consumption	8 hours per day	Rs 32,400	Rs 48,000 to Rs 50,000

* Purchase cost varies according to seating capacity of restaurants