

## Indoor Air Quality Monitoring at Rural Areas of Mandya District

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**Abstract--** Amongst the five essentials of life viz., air, water, food, shelter and cloth, air is the most important one for human beings. Though, air is abundantly available, it invariably contains pollutants/contaminants. The indoor air pollutants (IAP) structures a significant segment of the complete presentation of inhabitants to different pollutants in family units.. IAP is gases, vapors and particulate. These materials incorporate bio-aerosols, particles, Volatile organic carbons, organic and inorganic fumes. The impact of various domestic fuels used and its emission in indoors of Hanakere village of Mandya district is carried out. A rearranged indoor air contamination is made utilizing the poll that was readied identified with kind of stoves, sort of fuel utilized in kitchen, standard of conduct of cooking part and so forth. To study the magnitude of indoor air pollution in rural areas, particularly the concentration of particulate matter, a simplified measuring instrument called SKC personal air sampler is used. It is observed that fuels used for domestic cooking in preferential order is Kerosene, LPG, Cowdung cakes, Biomass, and coal. The quantity of fuel used varied depending on no. of occupants and quality of fuel used. convergence of RSPM having streamlined size under  $1\mu\text{m}$ , which can cause spherulites.

**Key Words:** IAP, RSPM, Aerodynamic size.

### 1.INTRODUCTION

The indoor air of dwellings usually has elevated level of air toxins than in environment. People spend 80-90% time indoor, unfortunately it was not given much importance. The indoor air poisons (IAP) structure a significant segment of the all out introduction of inhabitants to different toxins in families. The wellsprings of IAP can be inhabitants, their exercises, different apparatuses, materials utilized in development and penetration of poisons from outside. . The introduction - reaction of these toxins in inside relies upon the age rate, the encompassing fixation, the volume of the indoor condition, blending effectiveness of the indoor space and the rot paces of the contaminations.

#### 1.1 Source of IAP – Household Energy

Indoor air contamination sources are the one that discharges particulates and gases into the air, are the essential driver of indoor air quality issues in family units. Ill-advised ventilation can increment indoor air toxin levels to unsavory range by not intersection of enough natural air to weaken outflows of indoor sources. Due to this reason even not much air carried out reducing indoor air pollutants from indoors of residential environment. The combustion of fuels in indoors for domestic purpose was found to be the most significant source of indoor air pollution. It was found that the 82% of Sulphur dioxide ( $\text{SO}_2$ ), 38% of Nitrogen dioxide, 88% of VOCs and 96% of particulate matter emissions is contributed to the country's emissions by house hold sector.

## 1.2 Effects of IAP

There are confirmations that show poor indoor air quality represents a genuine risk to human well being. Bio mist concentrates causes respiratory illnesses, extending from unfavorably susceptible rhinitis, asthma to irresistible maladies, for example, histoplasmosis, balstomycosis and aspergillosis [5]. Inorganic gases like NO<sub>2</sub>, SO<sub>2</sub> and Ozone mainly affect the respiratory system while organic gases like CO, CO<sub>2</sub> and CFC's can cause headache and affect the pulmonary functions.

## 1.3 Emission of House hold Fuels

### 1.3.1 Particulate Matter(PM)

Particulate Matter (PM)/Particulates is the term utilized for a wide scope of particles that are sufficiently little to be conveyed by the air and along these lines can be taken in by individuals. These particles can be strong or fluid, or a blend of both. The size of particles may extend from 0.005µm to 100µm in breadth.

### 1.3.2 Suspended Particulate Matter(SPM)

Suspended Particulate Matter (SPM) are particulate issues with streamlined measurement in excess of 10 micrometers, are generally possess as Total Suspended Particulate Matter (TSPM).

### 1.3.3 Respirable Suspended Particulate Matter(RSPM)

Respirable Suspended Particulate Matter are the particulate issues with streamlined distance of size not exactly or equivalent to 10 micrometers. As far as possible for surrounding RSPM focus as indicated by World Health Organization (WHO) is 65 µgm-3 and that of indoor fixation is 35 µgm-3 [4].

### 1.3.4 Gaseous Pollutants

**a)Carbon Monoxide:** Carbon monoxide is the most inexhaustible vaporous contamination transmitted through anthropogenic sources[1] into troposphere. It is lackluster, unscented and boring gas which is available in little focuses (0.1ppm) in characteristic climate and makes some living arrangement memories of around a half year.

**b) Sulphur Dioxide:** Sulfur dioxide (SO<sub>2</sub>) is one of the significant toxins released by different poison sources. It responds photochemically or chemically with different toxins. SO<sub>2</sub> is an unpleasant and highly irritating gas, when it is present in concentrations greater than 1ppm and adversely affects human.

## 1.4 Specific objectives

- 1.To inventorize types and quality of fuel used in rural area for cooking and domestic purposes.
- 2.Selection of households' indoor points and ventilation aspects for data collection and monitoring.
- 3.Quantitative and qualitative assessment of Suspended Particulated Matter(SPM) and Respiration Suspended Particulate Matter (RSPM) for indoor from different fuels.

4. Quantitative and qualitative assessment of gaseous emissions for indoor from different fuels.

5. Statistical regression analysis for correlation assessment.

6. Exposure risk assessment evaluation studies and developing a relationship between pulmonary diseases, particulate and gaseous emissions.

## 2. Methodology

The available relevant details about the indoor air pollution are considered for this work including the sources of indoor air pollution, types of fuel and health risks due to exposure.

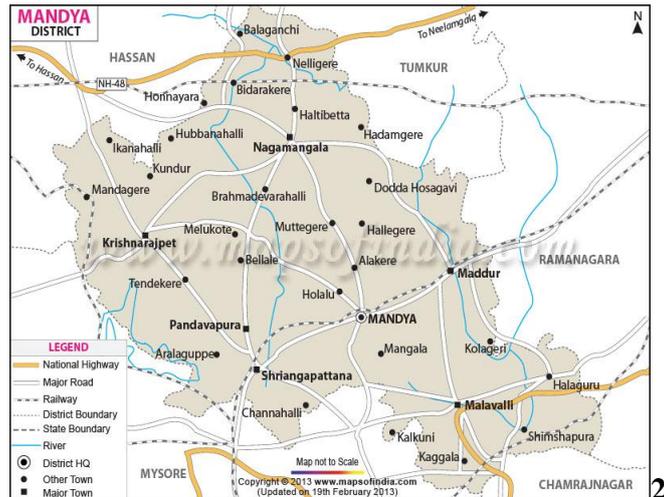
### 2.1 Summary of experimental protocol

Sl. No	Methodology
1	Selection of different fuel used households
2	Identification of indoor locations of different households
3	Sampling of pollutants both at indoor and ambient conditions
4	Analysis of collected air samples
5	Assessment of analysed data
6	Review of models for IAP modelling and health risks
7	Morphological study of particulates collected in indoors of different fuel
8	Statistical analysis
9	Correlation development between indoor pollutants and health risks posed by them

**2.2 Information on study area :** In the present work, Hanakere town of Mandya city is considered as the investigation territory. It is spread over a region of 128.42 Km<sup>2</sup> Mean Sea Level (elevation) of Mandya city is 765m, Latitude is 12.3024° N and Longitude is 76.6386° E. shows the examination territory alongside testing areas.

### 2.3 Selection of Sampling Stations

The testing stations were considered in and around parts of MANDYA city for five unique energizes i.e., Kerosene, Biomass, Cowdung cakes, Coal and LPG in various families. Table 4.2 shows the details of sampling stations.



## 2.4 Air sampling equipment

Indoor and encompassing examining of PM were completed at the same time for a times pan of 2 hours before cooking, during cooking and in the way of cooking in indoor areas of various family units and 8hr inspecting for surrounding condition, individually. The hardware utilized for the indoor air examining are Handy sampler (APM 821) Personal Air Sampler (APS2).





**Fig. Personal Air Sampler**

## **2.5 Determination of the Pollutants Concentration**

### **2.5.1 Determination of Suspended Particulate Matter**

The concentration of air inhabitants such as SPM, SO<sub>2</sub> and NO<sub>2</sub> measured in indoors using Handy Sampler (APM 821) shown in Plate 4.1. This instrument works on the principle of Stroke's law, offers basic approach to collection of SPM. The flow rate was maintained at 2.5 L/ min. Using the standard procedure, concentration of SPM was determined.

### **2.5.2 Determination of Particulate Matter (PM)**

Particulate Matter (PM)/Particulates is the term made used for a wide scope of particles that are sufficiently little to be conveyed by the air and in this manner they can be taken in by individuals. These particles can be strong or fluid, or a blend of both. The size of particles may go from 0.005 $\mu$ m to 100 $\mu$ m in breadth. PM10 are particles that are of 10 $\mu$ m or less in width. PM2.5 are particles of size 2.5  $\mu$ m or less in proportional circular width. The better particulates has the capability of making the best danger human wellbeing on the grounds that these can travel most profound into the lungs[3].

Indoor particulate issue is a blend of issues like residue (Carbon) transmitted by burning sources, small fluid or strong particles in mist concentrates, contagious spores, dust and a poison discharged by microscopic organisms (endotoxin).

### 2.5.3 Determination of Indoor RSPM by Personal Air Sampler

Single-stage Personal Air Sampler is utilized for the highly efficient collection of PM<sub>10</sub>, PM<sub>2.5</sub>, or PM Coarse(10-2.5). Personal Sampler is the equipment used for indoor RSPM sampling which consists of two parts pump and cyclone head.

Principle of operation: The contaminated air is drawn by small diaphragm pump through the sample collector placed near the breathing zone. The pump can aspirate at least 1m<sup>3</sup> of air in eight hours. Thus ensuring that an adequate amount of the contaminant is collected for analysis and ensuring that even for the most toxic substances statistically significant number of particles is collected. The battery capacity will give an eight hour run with most sample collectors.

Procedure of sampling is as follows:

- 1.Initially flow rate of 2.5 L/min is fixed in the pump
- 2.The conditioned, pre - weighed filter paper of 37mm diameter is placed in the filter cassette of the cyclone head.
- 3.The sampler is switched on and sampling time is fixed for two hours before, during and after cooking period.
- 4.Then the filter paper is weighed for the final weight Using the following equations indoor concentration of PM is found,.
- 5.Volume of air sampled,  $V = (Q/1000) * T$  (4.1)
- 6.Concentration of Particulate Matter,  $C = (\text{Final weight of filter paper} - \text{Initial weight}) / V$  (4.2)

Where, T = Time period in hours Q = Flow rate in m<sup>3</sup>/min

Volume of air sampled,  $V = Q * T$  (4.3)

Concentration of respirable dust,  $C = (\text{Final weight of filter paper} - \text{Initial weight}) / V$  (4.4)

Where, T = sampling time period in hours

## 3. RESULTS

### 3.1 Calculation of particulate matter concentration:

#### PM<sub>2.5</sub> concentration of Hanakere biomass sample:

Village	Sample	Initial weight(gm)	Final weight(gm)	Particulate matter concentration( $\mu\text{g}/\text{m}^3$ )
Hanakere	LPG	0.0581	0.0584	83.33
	1	0.0571	0.059	500
	2	0.0575	0.0599	666.67

Table1-particulate matter concentration

### 3.2 Suspended Particulate Matter (SPM) concentration:

The SPM fixation in indoor is observed utilizing helpful sampler by gravimetric technique. The indoor concentration profiles of SPM emitted by households using kerosene as fuels was found to be less ( $300 \mu\text{g m}^{-3}$  during cooking) and it has come down .

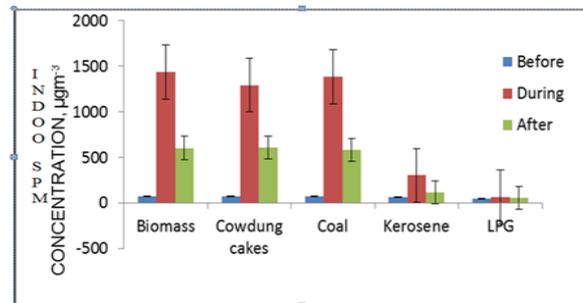


Chart1-Indoor SPM concentration for different fuels

### 3.3 Respirable Suspended Particulate Matter (RSPM) Concentration:

The emission of RSPM in households using biomass has shown a significant variation in its concentration before, during and after cooking activity. It was found that during cooking activity high concentration of RSPM were measured ( $1484 \mu\text{g m}^{-3}$ ) while it got reduced after 2hr of cooking activity about 67% ( $486 \mu\text{g m}^{-3}$ ).

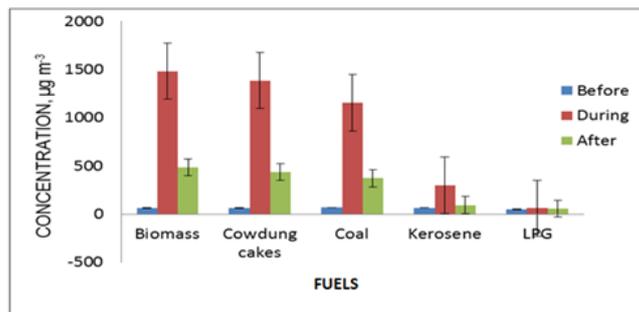


Chart2-Indoor RSPM concentration for different fuels

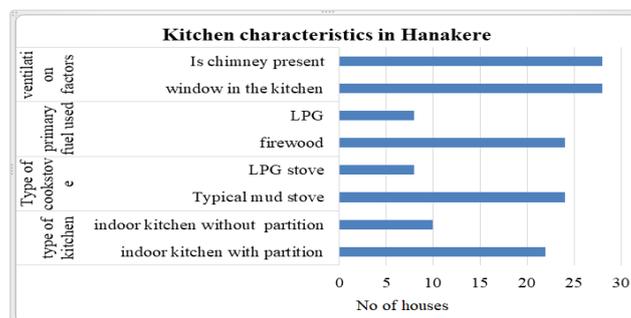


Table-2: Representing various parameters of kitchen obtained from questionnaire survey

## 4. Conclusions

1. Fuels used for domestic preparation in advantageous order is LPG, Kerosene, Biomass, Cowdung cakes and Coal and also the amount of fuel used varied reckoning on no. of occupants and quality of fuel used.

2. The occupants area unit exposed terribly high pollutants level for nearly 2 hours of average preparation amount. It absolutely was discovered that even once preparation conjointly concentration of involved pollutants remains to in higher vary compared to standards. This confirms that the occupants area unit exposed to pollutants not solely throughout cycle even once finishing preparation activity.

3. The grouping of RSPM having mechanics size however 1 $\mu$ m, which may be spherulites[2]. These spherulites were a great deal of in focus all through burning of biomass in contrast with kerosene. The outcomes zone unit showed the nearness of spherules. These might likewise cross the air hindrance inside the metastasis tract, which can cause wellbeing impacts like aggravation and interior organ disturbance.

4. When we calculated PM for various sample obtained from Hankere village in Mandya district the values of PM from biomass is around 500-750  $\mu$ g/m<sup>3</sup> and for LPG it's eighty three.33  $\mu$ g/m<sup>3</sup>. therefore it's smart to use LPG rather than biomass.

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