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**WATER BOILING TESTS OF M2 WISDOM GASIFIRE STOVE**

**1.0 INTRODUCTION**

The Water Boiling Tests (WBT) with ambient emissions were carried out at the University of Nairobi, Department of Chemistry Laboratories and were conducted on the M2 Wisdom Gasifire Stove:

**2.0 METHODOLOGY**

**2.1 WATER BOILING TESTS.**

These tests were done according to WBT version 4.2.3 Methodology and were completed on **21/02/2015**. The amount of water used was 4.0 litres.

**2.0 EMISSION TESTS**

The emissions were carried out in a typical kitchen environment. The kitchen dimensions were as follows:-

**2.1 KITCHEN DIMENSIONS**

HEIGHT-8.3FT -WIDTH-9.5FT -LENGTH -11.3FT

WINDOWS: - W1-HEIGHT-2.2FT; -WIDTH-2.8FT; W2-HEIGHT-2.8FT -WIDTH-2.1FT

DOORS: - D1-HEIGHT-6.6FT -WIDTH-2.92FT; D2-HEIGHT-6.6FT-WIDTH-4.8FT.

ATMOSPHERIC PRESSURE 627 MM OF MERCURY.

**2.2. CARBON MONOXIDE (CO) AND CARBON DIOXIDE (CO<sub>2</sub>).**

Ambient concentrations of CO CO<sub>2</sub> and PM<sub>2.5</sub> emissions were measure 1 meter away and 1 meter above the stove. Real-time measurements of CO and CO<sub>2</sub> were taken using a TSI IAQ-CALC 7545 (TSI Inc., The TSI IAQ-CALCs were calibrated immediately before deployment with NIST traceable zero and span gases, and again following deployment to check for any potential changes in response.

The reported values were average for each phase: Cold start phase, hot start phase and simmering phases for three stoves.

## 2.3 PARTICULATE MATTER PM<sub>2.5</sub>

The particulate matter (PM<sub>2.5</sub>), and which are particles suspended in the air and with an aerodynamic diameter of less than 2.5 micrometers, were monitored with UCB Particle and Temperature Sensor (UCB-PATs). UCB data logger has a detection limit of between 30- 25,000 µg/m<sup>3</sup>, a logging interval of between 1-240 minutes and a storage capacity of 32768 records. The reported values were average for each phase: Cold start phase, hot start phase and simmering phase

## 3.0: RESULTS

### 3.1 WISDOM GASIFIRE STOVES

The summary of WBT and emissions data results for wood fuelled gasifier stove is summarized in table 3.1. while the IWA rating is given in table 3.2.

Table 3.1: Data for Wisdom Gasifire stoves (4 liters):

| <b>M2 Wisdom Gasifire Stove</b> |                       |   |  |                               |                     |
|---------------------------------|-----------------------|---|--|-------------------------------|---------------------|
|                                 | <b>unit</b>           | <b>HIGH POWER TEST<br/>(COLD START)</b> | <b>HIGH POWER TEST<br/>(HOT START)</b> | <b>LOW POWER<br/>(SIMMER)</b> | <b>AVER<br/>AGE</b> |
| Time to boil                    | min                   | 19                                      | 16                                     | 45                            | <b>17</b>           |
| Burning rate                    | g/m<br>in             | 19                                      | 17                                     | 10                            | <b>16</b>           |
| Thermal<br>efficiency           | %                     | 23%                                     | 29%                                    | 33%                           | <b>28%</b>          |
| Specific fuel<br>consumption    | g/lit<br>er           | 91                                      | 69                                     | 175                           | <b>112</b>          |
| Fuel<br>Consumption             | g                     | 510                                     | 412                                    | 755                           | <b>559</b>          |
| CO <sub>2</sub>                 | pp<br>m               | 403                                     | 616                                    | 665                           | <b>561</b>          |
| CO                              | pp<br>m               | 1                                       | 5                                      | 8                             | <b>4</b>            |
| Particulate                     | ug/<br>m <sup>3</sup> | 145                                     | 905                                    | 94                            | <b>381</b>          |

**Table 3.2: OVERALL TIER IWA RATING OF THE STOVE**

|                              |          | <b>Metric</b>                  | <b>Value</b> | <b>Unit</b>       | <b>Sub-Tier</b> |
|------------------------------|----------|--------------------------------|--------------|-------------------|-----------------|
| <b>Efficiency / Fuel Use</b> |          |                                |              |                   |                 |
| <b>Tier</b>                  | <b>2</b> | High power Thermal Efficiency  | 0.266539     | %                 | 2               |
|                              |          | Low power Specific Consumption | 0.052635     | MJ/min/l          | 0               |
| <b>Emissions</b>             |          |                                |              |                   |                 |
| <b>Tier</b>                  | <b>2</b> | High power CO                  | 0.966768     | g/MJ <sub>d</sub> | 4               |
|                              |          | Low power CO                   | 0.055444     | g/min/l           | 4               |
|                              |          | High power PM 2.5              | 246          | g/MJ <sub>d</sub> | 2               |
|                              |          | Low power PM 2.5               | 0.252771     | mg/min/l          | 4               |
| <b>Indoor Emissions</b>      |          |                                |              |                   |                 |
| <b>Tier</b>                  | <b>1</b> | Indoor emissions CO            | 0.165362     | g/min             | 4               |
|                              |          | Indoor emissions PM 2.5        | 22.38191     | mg/min            | 1               |
| <b>Safety</b>                |          |                                |              |                   |                 |
| <b>Tier</b>                  | <b>2</b> | 10 weighted safety parameters  | 80.5         | Points            | 2               |



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