



ETHANOL: A SAFE AND CLEAN COOKING FUEL

INTRODUCTION

Cooking is arguably one of the most important activities carried by us humans to live and cherish. There are many types of fuels that are used throughout the world. They are in all forms of solid, liquid and gaseous. Solid fuels are traditional and are the most polluting of all the types, these include wooden logs, dried cow dung etc., biomass. Gaseous and light liquid fuels are considered the cleaner varieties because of their characteristics of low particulate pollutants and low emissions. Gaseous fuels are also easy to transport, have combustion control, efficient and most importantly safe. But gaseous fuels derived from fossil fuels are not sustainable in long term.

ETHANOL

It can be made with wide variety of biomass materials which are sugar, starch and cellulose based like sugar beet, sorghum, cassava, potatoes, maize, wood etc. It is produced by fermentation of saccharose rich liquids with posterior distillation.

SAFETY PROPERTIES OF ETHANOL

Any fuel which is combustible has hazardous due to the possibility of burns, fires, explosions, poisoning by breathing or consuming and other risks. Bizzo, A.W et al (2004) has listed the main properties related to safety of any cooking fuel as the following

- **Lower and upper combustible limits:** These limits indicate the concentration range in atmospheric pressure where the ignition and combustion can be achieved.
- **Auto-ignition temperature:** This is the minimum temperature required to start atmospheric combustion at the stoichiometric ratio.
- **Specific Gravity to air:** Ratio of gas density to air density.
- **Vapour pressure:** The storage pressure for liquified gases.
- **Wobbe Index:** This is used to assess the liquid – gas interchangeability while flowing through an orifice and flame stability for burners. Extinguishing these flames on stoves without shutting the gas off would cause gas leak and increases the chances of fire and explosion.

- **Toxicity:** How risky is the fuel if consumed.
- **Flash Point:** Minimum temperature required for vapor formation and start a flame.

Table No: 1

Comparing the safety properties of ethanol, methanol and kerosene.

Fuel	Lower combustible concentration limit in air (as % volume)	Upper combustible concentration limit in air (as % volume)	Auto-ignition temperature (°C)	Specific Gravity to air	Boiling point (°C)	Flash Point (°C)
Ethanol	4.3	19.0	365	1.59	78	15
Methanol	7.3	36.0	385	1.11	65	16
Kerosene	0.8	5.4	250	5.0	185 to 206	40 to 55

Source: Bizzo, A.W. et al (2004)

Ethanol is classified as Category 2 flammable liquid as per the 2012 OSHA standards.

COMPARISON OF ETHANOL WITH THAT OF KEROSENE

Kerosene is often subsidised by governments and utilised in many countries as a substitute for traditional dirty cooking fuels. This was considered a viable alternative in many countries including India. Comparing the safety parameters of Ethanol with that of Kerosene would help us draw the narrative of the safety aspects of Ethanol.

The lower combustible concentration for ethanol is 4.3% v/v in air while that of Kerosene is 0.8% v/v, indicating that kerosene would start combusting in low concentrations only compared to ethanol indicating, that ethanol is safer than Kerosene in this aspect. Similarly, the upper combustible concentration required to ignite for kerosene is 5.4% v/v while for ethanol it is 19% v/v. This indicates the efficiency of ethanol fuel as it starts combustion at 5.4% only while for kerosene it takes to reach 19%.

Auto-ignition temperature of ethanol is 46% more than that of kerosene, which indicates that kerosene would catch fire at 250 C at atmospheric pressure while ethanol can withstand upto 365 C. Both Kerosene and Ethanol gases have more specific gravity more than 1, indicating they are heavier than air. Hence, they float to the bottom of floor in the case of leakage which is safe in many aspects. These parameters and metrics prove the safety of the ethanol pitching it as on the safest clean cooking fuels available. Ethanol is often drunk by people as alcoholic beverage, unaware that high concentrations of it can be very dangerous.

Project GAIA has found that ethanol has to be mixed with a small proportion of bitrex, which makes it too bitter for consumption, is the safest and most effective clean cooking fuel. Carbon monoxide and particulate matter released by ethanol fuel in cooking were below the WHO mandated safety levels (Chomanika, K. et al 2022).