

# Surface-Mediated Emissions Suppression in Solid Biomass Fuels Using Low-Cost Mineral Additives for Safer Cooking Practices

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## Background and Question

### Cooking with Biomass Fuels

- 2 billion people **lack access to clean cooking materials** like electric cookstoves and have to use solid biomass fuels for heat, claiming **3.2 million lives** annually, primarily from women and children in low/middle-income countries.
- **Incomplete combustion** causes the release of **carbon monoxide**, particulate matter, VOCs, and NO<sub>x</sub> which cause **respiratory** and **environmental harm** by contributing to ozone and smog formation.

### Prior Research

- All existing research has focused on inaccessible internal binders to reduce emissions that aren't feasible for most people.

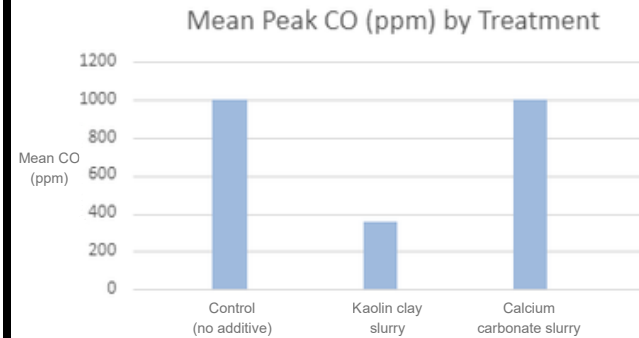
### Question

- How does the application of a calcium carbonate and kaolin clay slurry affect carbon monoxide and particulate matter emissions in charcoal briquettes?

### Hypothesis

- Both Kaolin and calcium carbonate will cause at least a 30% reduction based on the effects seen with internal additives.

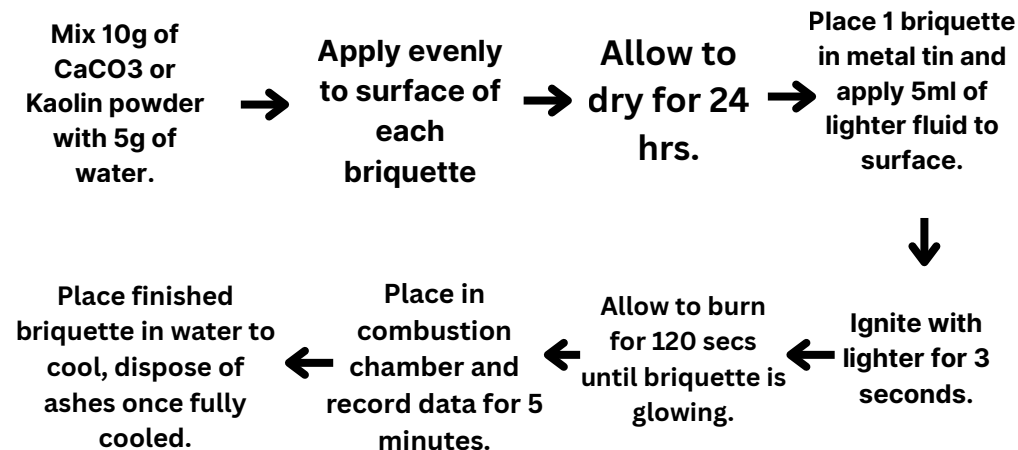
## Results and Analysis



P=0.0000381

- The group treated with kaolin clay had mean CO emissions of 360.75 ppm compared to 1000 ppm in the control and calcium carbonate group.
- **>63.9% reduction in CO emissions from kaolin group**
- The sensor maxed out at 1000 ppm, meaning that the reductions may have been even greater.
- T-test statistical analysis found a p-value of **0.0000381**, suggesting results are **statistically significant**.

## Methodology



## Conclusions and Implications

- The use of **kaolin clay to reduce charcoal briquette emissions** is statistically **supported** and could be implemented by **households, NGOs, or governments**.
- CO and PM are positively correlated, so the reduction in CO could mean a much **lower risk of CO poisoning, lung harm, and environmental damage**.
- **Calcium carbonate is not effective** for the reduction of emissions in charcoal briquettes.
- Other mineral **compounds similar to kaolin** clay could show similar results and improve health and environmental outcomes.
- It is **still important to transition to clean cooking** with gas/electric and for biomass cooking to be done outdoors rather than indoors, however this works as a **transitional solution** to alleviate **pollution**.