



Particulate Emissions Results from Burning Shelled Corn in Pellet-Fired Room Heaters

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Particulate Emissions Results from Burning Shelled Corn in Pellet-Fired Room Heaters and Multi-Fuel Fired Room Heaters

With the exploding popularity of pellet-fired appliances in the last 3 years, burning different types of bio-mass has also increased. This may have gained media attention when the National Energy Bill was introduced and the term “switch grass” became popular. With recent media coverage of bio-mass fuels and the need for clean burning renewable energy, burning corn is becoming more popular throughout the United States and Canada. Shelled corn traditionally has been used for farm animal feed, but this same product can be used for heating purposes. This product is readily available at most feed stores in 40 or 50 lbs. sacks.

Wood pellet-fired appliances are tested using EPA Method 28 fueling protocol. This method only specifies using “wood” pellets. It has been known that pellet-fired heaters traditionally are clean-burning appliances. It is not unusual to have a weighted average of a pellet-fired appliance in the range of 1-3 grams/hr.

There have been a number of studies reviewing the air emissions from pellet stoves. In the year 2000, Dr. James Houck in conjunction with others, wrote a paper titled “Low Emission and High Efficiency Residential Pellet-Fired Heaters”. This paper reviewed a number of these studies. His key conclusions by reviewing the pellet stove emission data are:

- New-technology pellet stoves produce much less CO than uncertified cordwood stoves.
- New-technology pellet stoves produce much less PM than uncertified cordwood stoves.
- The emission factors for both CO and PM are lower for new-model pellet stoves than for earlier models.
- Not all PM emitted from pellet stoves are PM₁₀ or PM_{2.5}. Approximately 84% of PM is PM₁₀ and about 81% is PM_{2.5}. PM₁₀ and PM_{2.5} emission factors, if based on total PM measurements, should be adjusted accordingly.

- The chemical makeup of PM emitted from top-feed pellet stoves and under-feed pellet stoves is different, and the chemical makeup of PM from both technology types is different from that emitted from cordwood stoves. Consequently, total
- PM emissions are not accurate surrogates for emissions of specific organic compounds such as those identified as “air toxics.”
- Pellet stoves generate less solid waste than cordwood stoves.
- The high efficiencies and low emissions of PM and CO characteristic of new-technology pellet stoves, combined with low greenhouse gas impacts, low acid precipitation impacts, and minimal solid waste issues, make pellet stoves an environmentally sound home space heating option.

With the increasing trend toward burning bio-mass other than wood pellets, manufacturers are designing or re-designing their products to accommodate corn, switch grass, wheat, barley, sunflower seeds and even cherry pits. Also, new fuels are being designed from agricultural and silvacultural by-products. Since emissions are a critically important performance parameter and corn is currently the most popular and readily available non-wood biomass fuel, pellet stove manufacturers have undertaken a survey study and analysis of existing corn-burning emissions data. The objective of this study was to establish a good statistical comparison with wood-pellet emissions. To accomplish this goal, all of the pellet stove manufacturers were asked to submit any and all corn-burning emissions results they have collected for compilation and statistical analyses.

Because EPA Method 28 does not specify the use of any other bio-mass fuels, EPA certification of appliances using other bio-mass fuels is not accommodated at this time.

Hearth Products and Barbeque Association (HPBA) contracted OMNI-Test Laboratories, Inc (*OMNI*) to compile emission results from heating products capable of burning shelled corn. The members of the HPBA Corn Caucus were requested to submit emissions data to *OMNI* for review and to report the results. *OMNI* received 5 data points from 5 different manufacturers of corn-burning appliances. All five of these data points were from room heaters. The results are blinded for reporting at the request of the manufacturers.

Each of the data-contributing manufacturers submitted data for only one test run each. Except for using the corn fuel, all the reported tests were performed using the Method 28 fueling protocol and the Method 5G emissions sampling system. As required for all EPA certification tests, all results were converted to Method 5H equivalents. As

presented in the table below, the particulate emissions ranged from the room heater appliance from 1.37 g/hr on the low end to 4.84 g/hr on the high end.

Appliance Type	Burn Rate (kg/hr)	Emission Rate (g/hr)	Moisture content (DB)	g/MJ	Emission Factor (g/kg)
Stove A	1.0	4.8	9%	0.41	4.8
Stove B	1.6	3.1	14%	0.17	1.93
Stove C	1.2	2.8	11%	0.20	2.33
Stove D	1.0	1.4	9%	0.12	1.40
Stove E	1.1	1.7	9%	0.13	1.54
Average	1.18	2.76	10%	0.20	2.40

Conclusion:

The results compiled from the 5 data points suggest that corn is a clean burning fuel although in some cases not as clean as wood pellets.

It should be noted that the compiled results do indicate that if EPA's Method 28 was changed to allow corn to be used as a test fuel, all the appliances would pass EPA's 7.5 g/hour woodstove standard.