April 7, 2010

Gil Wood
4930 Old Page Road
Room E140, MC-143-02
Durham, NC 27709

Dear Gil,

I have been ask by the Catalytic Hearth Coalition (CHC) to provide you with information regarding the efficiency of catalytic cordwood stoves in respect to efficiency related programs such as the Energy Star Label and the Home Star Program, as well as, efficiency considerations that may be part of a new NSPS. Simply put, as a group, catalytic cordwood stoves (and inserts) are more efficient than their non-catalytic counterparts. As you know, this has been recognized for some time as manifested in the default efficiency values of 72% for catalytic woodstoves as compared to 63% for non-catalytic woodstoves in the current NSPS [40 CFR §60.536 (i)(3)].

I would like to call your attention to three new bodies of research that have further documented the benefit of catalyst technology, both in the terms of efficiency and particulate emissions. These are: 1. A catalyst longevity study conducted by OMNI for the CHC. 2. A survey/review of burn rates and particulate emissions rates of certified wood heaters conducted by Ferguson, Andors & Company for the Hearth, Patio and Barbecue Association (HPBA) with additional data reduction done by OMNI. 3. A review of U.S. socio-demographic and climate data conducted by OMNI that illustrates the prevalence of burning conditions under which catalyst heaters are expected to outperform non-catalytic models. A brief summary of the findings of each study is provided here. More detailed information can be provided at your request.

Catalyst Longevity
Catalyst longevity in the earliest woodstove models was believed to be short (on the order of five years) and was the basis for promulgating a lower particulate standard (4.1 g/h) for catalytic stoves as compare to that for non-catalytic stoves (7.5 g/h). The rationale for the lower catalytic stove standard was that as the catalyst degraded with time the emissions would increase and, on the average, over the lifetime of the appliance, the emissions would be similar between catalytic and non-catalytic woodstoves. It is the contention of the CHC that well designed modern catalytic woodstoves "protect" the catalyst from thermal stress and direct flame impingement and that catalyst longevity is not an issue. OMNI measured emissions from two woodstove models with used catalysts removed from residences. Only a very modest deterioration in particulate emissions was seen in the older catalysts (eight and nine years old for the two stove models, respectively) as compared to new catalysts. While limited in number, OMNI's tests suggest that catalyst degradation in a well designed stove, within reason, is not an issue.

Low Burn Rate Performance
Ferguson, Andors & Company working with the HPBA attempted to obtain individual burn rate and corresponding emission rate data for all currently manufactured certified wood heaters. Data for many stove models were successfully obtained. OMNI calculated emission factors (g/kg) from these data as

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emission factors are a better indicator of the completeness of combustion than emission rates. While not a definitive indicator, lower emission factors would tend to correlate with higher combustion efficiencies. Overall thermal efficiency is the product of combustion efficiency multiplied by thermal efficiency. Consequently, if all else were equal, stoves with lower emission factors would tend to have higher efficiencies. As expected, the mean emission factors for catalytic stoves were lower than for non-catalytic stoves at all burn rate categories specified by the Method 28 test procedure. Notably, the mean emission factors for catalytic stoves were much lower than for non-catalytic stoves at the lower burn rate categories suggesting a disproportionally better performance of catalytic stoves than non-catalytic stoves at lower burn rates.

Low Burn Rate Occurrence and Cold Starts

As noted, catalytic stoves appear to operate disproportionally better at lower burn rates than non-catalytic stoves. Review of surveys conducted by the Energy Information Administration (EIA), American Housing Survey (AHS), Simmons Marketing Research, and HPBA reveals that: (1) 22% of housing units with occupants reporting using a woodstove are in the lowest heating degree day category (<4000 HDD). (2) 24% to 32% (depending on the survey) of housing units with occupants reporting owning or using a woodstove are in the South census region. (3) 45% of woodstove fires are reported as occurring during non-winter months (spring, summer, or fall). While burn rates in the lowest category are not the most common scenario, they are likely to occur a significant fraction of the time, particularly in milder climates and during the margins of the heating season. The burn rate distribution developed for the current NSPS does not take milder climates or the margins of the heating season into consideration.

It is believed that catalytic stoves achieve their emission reduction potential sooner than non-catalytic stoves after the start of a fire because only the catalyst needs to be brought up to temperature not a large mass of metal and firebrick in the area of secondary combustion needed for emission reduction and high efficiency with a non-catalytic stove. Review of EIA and HPBA surveys reveals that at a minimum 42% to 52% of woodstove fires begin with a cold start. The current NSPS testing procedure (Method 28) uses a hot start only.

Summary

As a group, catalytic stoves have higher efficiencies and lower particulate emissions than non-catalytic stoves. Their efficiencies are disproportionately higher and their particulate emissions are disproportionately lower than non-catalytic stoves at lower burn rates and with fires that begin with cold starts. Neither low burn rates nor cold starts are adequately addressed in the current NSPS. Catalyst longevity does not appear to be an issue with well designed stoves.

Gil, if you have any questions or need more information please do not hesitate to contact me.

Sincerely,

James E. Houck, Ph.D.
President