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# OWB Emissions Modeling—What's It All About?

A number of states, organizations and manufacturers have, over the years, performed air pollution computer modeling of outdoor wood boiler (OWB) emissions to predict the impacts of the emissions on, for example, a neighbor's property. Essentially, air pollution modeling is the scientific discipline of predicting how air pollutants emitted at one location will travel and disperse through the atmosphere to other areas. These modeling exercises have been the source of controversy due in part to the complexity of the science. Several modeling studies have already been performed to simulate the OWB problem. Some of these studies differ in their approaches, such as the method of representation of the modeled 'domain'. The model 'domain' refers to the manner in which the atmosphere and the passage of time in the mathematical simulation are represented. However, assuming more basic model inputs, such as the stack parameters for an OWB, are held constant for two different studies, similar impact predictions between two different studies should lend credibility to the overall effort to predict the OWB impacts.

The Vermont Agency of Natural Resources has performed its own modeling (see report dated July 18, 2008) and believes that the modeling, combined with laboratory test data and field studies performed by NESCAUM and others, demonstrates that particulate emissions from OWBs are at levels that can cause significant health impacts. The following discussion attempts to explain some of the confounding factors that make interpreting air modeling results difficult for the general public (and experts too for that matter). <u>*Note that these modeling studies are not really intended for a general audience, as they are necessarily very specialized in nature.*</u>

Air pollution modeling is a science with large bounds of uncertainty in its predictions, essentially due to the vagaries of airflow regimes near the earth's irregular surface. Predictions by the models are dependent on the data input to the model to define the air pollution source, such as stack height, emission rate and stack gas temperatures. These variables define an initial rise of a plume of air pollution. Atmospheric conditions, such as wind speed, wind direction, and vertical extent of mixing in the atmosphere are some critical variables dictating the subsequent transport and dispersion of the air pollutants. At any given time and location in a modeled 'domain', these variables may not be an *exact* measure of reality. If the model is being properly operated, however, the *average* of these variables from a larger dataset compiled over the course of a year or more should be accurate. Because of this, the modeling is simulated for long time frames generally from 1 to 5 years. In particular, the hills and valleys so prevalent in Vermont present a challenging problem in air pollution modeling. The Vermont OWB modeling has attempted to best simulate the turbulent nature of the atmosphere in these complex terrain settings.

Air pollution computer models may be used for various reasons. The OWB modeling effort estimates the impacts of pollutants emitted from hypothetical sources of air pollution. This information can be used to estimate whether or not pollutants from sources will cause pollutant levels that are a health concern or that exceed certain set standards. Detailed protocols have been established for the use of the various types of air pollution computer models in the air pollution permitting process. These protocols have generally been adhered to for the OWB modeling.

## OWB Emissions Modeling—Interpreting the Results

OWB emission rates are particularly complex due to the diversity of the boilers, the cycling nature of their operation and the highly variable particulate emission rates depending on the model, the type of wood burned, the moisture content of the wood and so forth. It is clear from the modeling that the maximum impacts from some OWBs likely exceed 35 micrograms per cubic meter of air (the federal ambient air standard) depending on the stack emissions and topographical setting. What does this mean? Basically, when the particulate emissions exceed this level, the air is considered “unhealthy”. But there are other considerations when evaluating the implications of the numbers. Frequency is one big factor. How often is this air standard exceeded? Some information on frequencies is included in Vermont’s OWB modeling report. The frequency of exceeding the particulate standard varies with the distance from the modeled hypothetical OWB and the topographical scenario among other variables.

Averaging time is another major factor when evaluating health impacts. Vermont’s OWB modeling looks at impacts averaged over 24 hour periods, the same averaging time used to set the federal 35 $\mu g/m^3$ standard. Some studies, however, indicate that exposures to 35 $\mu g/m^3$ or greater particulate levels for shorter time periods have significant health impacts. The question of health impacts versus averaging times is a topic of discussion among air pollution regulators, researchers and health experts.

“Background” levels of particulate may also be considered when evaluating modeling results. Although modeling may show particulate impacts caused by emissions from a particular OWB by itself, those impacts are in addition to the levels of particulate already in the air we breathe. Rural “background levels” of particulate in Vermont may be around 10 $\mu g/m^3$. Thus, a modeled impact of only 25$\mu g/m^3$ (24 hour average) from an OWB would put the air particulate levels at the standard of 35 $\mu g/m^3$. As the modeling report indicates, on those days that modeling predicts high OWB impact levels, particulate levels from all sources may be accumulating due to weather conditions making matters that much worse. Related to this issue, is the impact of multiple sources. The Vermont OWB modeling exercise considers emissions from a single OWB only. Having multiple OWBs in a location could significantly alter the particulate levels in an area.

To summarize, the results of general modeling exercises should be interpreted with caution. Modeling provides very useful information regarding theoretical impacts of OWB emissions but any application of the results should consider influencing factors such as background levels, frequency of high pollutant levels, averaging times, multiple source impacts and topographical effects.