Combustion Products in the Home  

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A variety of combustion processes occur in the home including smoking tobacco, cooking with gas appliances, space heating with unvented kerosene or gas heaters, heating with vented gas or fuel-oil furnaces or boilers, burning wood in fireplaces or stoves, and running cars in attached garages. These combustion processes can produce a complex mixture of gaseous and particulate pollutants that can cause illness.

This publication will discuss risks from all the combustion processes in the home except smoking. Although smoking tobacco presents the greatest health risk, it will not be covered here because the consequences have been widely publicized.

Unvented Gas Stoves

Nitrogen dioxide — produced by gas combustion — is associated with gas stoves. Studies show homes with gas stoves have concentrations of nitrogen dioxide approximately twice as high as homes with electric stoves. When the gas stoves are in use, nitrogen dioxide levels exceeding the National Ambient Air Quality Standard for nitrogen dioxide have been measured. Nitrogen dioxide levels are clearly affected by the amount the stove is used and whether the burners are properly adjusted. Burner design or the stove’s age do not appear to affect nitrogen dioxide levels in the air.

Exposure to high levels of nitrogen dioxide cause coughs, eye irritations and increased heart rate of children and some adults, according to studies. To avoid potential air-quality problems from gas ranges, use an exhaust fan when cooking on the range for prolonged periods (when canning or simmering all day, for example). Do not use an unvented gas stove for heat.

Unvented Kerosene Heaters

Unvented kerosene heaters produce a number of potentially dangerous substances including nitrogen dioxide, carbon dioxide, carbon monoxide and formaldehyde. Depending on the type of fuel being used, sulphur dioxide also can be produced.

Carbon dioxide emissions are probably the highest under normal operating conditions. In closed rooms, the level of this gas produced by kerosene heaters often exceeds safe workplace emission standards. While generally not hazardous, prolonged exposure to high levels of carbon dioxide can cause headaches, increased heart rate and dizziness.

If heaters are not maintained and operated properly, emissions of some of these compounds, particularly carbon monoxide, will increase. To prevent potential problems with hazardous emissions from unvented heaters, carefully follow the operating and maintenance instructions in the owner’s manual. Do not operate kerosene heaters in a closed room or in a bedroom while someone is sleeping. An appropriate use for a kerosene heater is to warm up a garage in which you are working or raise the temperature of a living room where people are gathered while the remainder of the house is heated to only 60 F. In many areas, operating unvented kerosene heaters in homes is illegal.

Oil and Gas-Fired Furnaces and Boilers

Usually, combustion products produced by furnaces and boilers are exhausted through the chimney and pose no threat to air quality. But vented heating equipment can present a hazard in two situations. Malfunctioning furnaces and boilers can produce dangerous levels of carbon monoxide. The danger is not as great from oil-fired appliances because the odor of other compounds produced with the carbon monoxide will alert occupants to the problem. Low-level exposure to carbon monoxide can cause disorientation and grogginess. Higher levels cause death.

The second potential problem with furnaces and boilers is “backdrafting.” Normally, the heat of combustion creates enough upward pressure to carry emissions up the chimney flue and away from the house. Backdrafting occurs when this force is not strong enough and combustion products actually spill into the house. A recent Canadian study found at least 10 percent of a randomly selected sample of Canadian homes experienced
excessive backdrafting at some time during the three-year study.

The chimney draft may be weak because the flue may be partially blocked by a collapsed liner or debris. Also, a replacement furnace may require a smaller flue opening because of its smaller output or because of the lower exhaust temperature. In relatively tight homes, drafts created by a clothes dryer, fireplace or exhaust fans may be stronger than the draft produced by the furnace and may draw combustion products down the chimney and back into the home.

If carbon monoxide is already being produced by the furnace or the boiler, backdrafting will make the problem worse. In most cases, however, the backdrafting will increase levels of nitrogen dioxide and carbon dioxide. Backdrafting also introduces large amounts of water vapor into the air. This can lead to fungi and mold growth.

Have your furnace and chimney maintained and inspected regularly to prevent carbon monoxide emissions and backdrafting. Be sure the heat exchanger is checked for cracks. The draft of the chimney should be checked while the furnace and other equipment that provide competing drafts, such as clothes dryers, are operating.

Wood Stoves and Fireplaces

The U.S. Environmental Protection Agency (EPA) has identified more than 100 chemical compounds in the exhaust of burning wood. Eighteen of the compounds have been linked to cancer and six of the compounds can kill cells in the human respiratory or digestive systems.

Studies measuring the impact of wood burning on indoor air are rare, and the results are inconsistent. Some of the products found in wood smoke are recognized health hazards, including benzo(a)pyrene, polycyclic organic matter and gases such as nitrogen dioxide and carbon monoxide.

In a recent Wisconsin study, researchers found no connection between increases in indoor air pollution and burning wood. Stoves with poor air supplies or holes in doors and stove pipes, however, produced higher levels of pollutants. Poor operating habits, such as drafting improperly or leaving the stove door open, also increase pollution levels.

Scientists know little about the effects of wood-burning appliances on human health. A Michigan study found a strong link between the presence of wood-burning appliances and respiratory problems in children. However, a similar study in Massachusetts found no such association.

Wood burning presents a greater health threat when wood composition products (plywood, for example) and trash are burned. Some of these fuels add additional toxic substances to the air and leave ash, which contains dangerous ingredients such as arsenic.

You can avoid air-quality problems from wood-burning appliances by heeding the stove installation and loading instructions.

Other Potential Combustion-Related Problems

A few simple precautions will eliminate air-quality hazards posed by most combustion equipment. There is one exception, charcoal-fueled grills used indoors. Charcoal gives off carbon monoxide routinely. Charcoal grills should not be used indoors, even with ventilation.

Deciding If You Have a Problem

While you can test for some potential harmful emissions from combustion, it is best to avoid problems by using and maintaining stoves and furnaces appropriately.

References


Wisconsin Division of State Energy. Assessment and Control of Indoor Air Pollution Resulting from Wood-Burning Appliance Use, 1986.