The underestimated risk of ethanol fireplaces

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Ethanol fireplaces create an inviting atmosphere. However, they emit a substantial amount of pollutants. Credit: Fraunhofer WKI/Manuela Lingnau

Ethanol fireplaces are becoming more and more popular. However, they are not only highly combustible – in the past, severe accents have

occurred repeatedly with decorative fireplaces. The devices also pollute the air in the rooms. This has been proven by a recent Fraunhofer study. Wood-burning ovens are also on the testing block.

Go to the DIY-market in the morning, buy the fireplace, and that evening, enjoy the cozy warmth and homey atmosphere of your new ornamental hearth. The suppliers of ethanol fireplaces are doing a brisk business with the lightweight, easy-to-install ornamental stoves with no chimney. However, caution is warranted when operating these fireplaces, because ethanol is a fuel that, together with the air, forms a highly combustible atmospheric mixture. If ethanol runs out when filling the combustion chambers and it ignites, then the entire room could go up in flames.

On top of this, these decorative items conceal another potential risk: If the manufacturers are to be believed, the devices do not discharge any harmful combustible residues into the ambient atmosphere. A study by the Fraunhofer Institute for Wood Research WKI in Braunschweig indicates the opposite. "These stoves do not feature any guided exhaust system whatsoever, so all combustible products are released directly into the environment. Those are, for example, very fine combustion particles and gaseous compounds like formaldehyde and benzene. Hardly any data exists yet about the effect of ethanol stoves on air quality of interior spaces," explains Dr. Michael Wensing, chemist at WKI. The researcher and his colleagues have examined the level and nature of the released emissions. Likewise wood-burning stoves have also been on trial.

Tests in the test chamber

The ethanol fireplaces were tested inside a stainless steel, 48 m3 test chamber. In the process, the engineers took the DIN 4734-1 standard into account, defined the technical minimum standard for ethanol fireplaces, and ventilated the test chamber according to manufacturer

instructions. Dr. Wensing's team examined four stoves and a total of eight liquid and gelatinous fuels. "In purely theoretical terms, ethanol and bioethanol completely burns up into carbon dioxide (CO2) and water. But under real conditions, things turn out differently. On a case-by-case basis, precisely how the course of that incineration runs really depends on the quality of the fuel and other factors – like the type of fuel, or the incineration temperature. As a rule, ethanol does not burn out completely. Rather, the incineration process results in CO2 – along with poisonous gases (like carbon monoxide, a respiratory toxin), organic compounds (like benzene, a carcinogen), and irritant gases (like nitrogen dioxide and formaldehyde), aswell as ultrafine combustion particles," explains Wensing. In the majority of cases, the scientists were able to measure high concentrations of pollutants, and the guideline values were frequently exceeded. For example, all devices exceeded the guideline value for indoor air quality of 0.35 mg/m3 for nitrogen dioxide; in one case, the result was considerable: 2.7 mg/m3. With respect to formaldehyde, the stoves likewise failed to fulfill the requirement of 0.1 ppm (parts per million). Here, the highest value measured equaled 0.45 ppm. One stove reached a peak concentration of released carbon dioxide equal to 6,000 ppm – placing it far above the hygienically acceptable threshold value of 1,000 ppm. The decisive factor here is also the fuel consumption rate. This means that the more ethanol which is burned within a certain period, the greater will be the amount of pollutants released. At the same time, ultrafine combustion particles were released. These have a diameter measuring 10,000 less than the thickness of a human hair – and they can penetrate deep into the human lung. "Ornamental stoves with ethanol-based firing are a source for pollutants in indoor air that are hazardous to one's health. In order to guarantee an air quality level that does not pose a risk to human health, we advise avoiding the use of these devices in the interior of apartments. The units should only be operated in large, very well-ventilated spaces, " states Wensing in summary.

The testing of wood-burning stoves – which have always been popular as an additional heat source – resulted in a quite different picture, based on the testing. In Germany, emissions from this heat source into the outside air are subject to strict regulatory mandates. The stresses placed on inhabited interior spaces – for example, from stove doors with faulty seals – had been neglected until now. For that reason, researchers from WKI studied seven stoves in situ in homes under real-life conditions. Here, the focus was placed on volatile organic compounds, fine and ultrafine particles, and combustion particles like carbon dioxide, carbon monoxide, formaldehyde and nitrogen dioxide. The finding: As long as the stove door is closed, the influence on the air quality within the interior space is negligible. Emissions enter the air of the room only when the fire wood is replenished and ignited. At that point, the researchers were able to measure a brief spike in concentrations. "During closed-door operation, no substances of any noteworthy level were released. For instance, the formaldehyde values were harmless," Wensing explains. There were a few exceptions, though: With one of the ovens, the researchers identified very high concentrations of benzene at 72 micrograms/m3. However, they attribute this rise to the consumption of the paraffinic ignition device. By comparison: When lighting up this oven with paper, the value was only 8 micrograms/m3." As long as the stove door and the ash pan are well-sealed, there is no need to fear any compromise to human health. The ventilation damper should be positioned in such a manner that the stove draws air well, and any paraffinic ignitors should be dispensed with," says Wensing.

Provided by Fraunhofer-Gesellschaft

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