Cold Climate Housing Research Center
CCHRC

June 2019

Improving Indoor Air Quality for Small Alaska Homes

Indoor air quality (IAQ) is a straightforward concept. To maintain healthy air inside a home, you need to be able to introduce fresh clean air and get rid of stale air. The most effective method is through ventilation–exchanging the inside air with outside air. While there are many options for ventilation in Alaska homes, the best ones recover heat from the exiting air to preheat incoming air. These heat-recovery systems are usually ducted to all parts of the house and have a central Heat Recovery Ventilator (HRV) that moves air and has a heat exchanger at its core.

While HRVs work great for medium or large homes, they tend to be oversized for small homes. This means they can deliver too much cold air, use excess energy, or over-dry the home, leading to systems getting shut off at the expense of indoor air quality. Solutions for these smaller homes need to be matched to the ventilation needs. A 1,500 sq. ft. house with two bedrooms needs 67 cubic feet per minute (about 67 basketballs' worth) of air exchange to maintain healthy indoor air. While some HRVs can deliver this amount of air by modulating their motors, smaller homes need even less air exchange than typical HRVs can provide.

In this study, CCHRC looked at alternative IAQ systems for homes less than 1,500 sq. ft. and evaluated them on the following metrics:

1. Can they maintain healthy indoor air quality?
2. How do operation and maintenance requirements differ from exhaust-only and HRV systems?
3. Do the systems work at cold temperatures with a high moisture load?

While we considered several types of ventilators in the study, including HRVs and exhaust-only systems, this snapshot focuses on through-wall ventilators that provide heat recovery because of the growing interest in cold climates. One of the three types of through-wall ventilators looked at in this study is pictured in Figure 1.

Through-wall ventilators with heat recovery cores have been available in the U.S. for almost 20 years. Compared to a small HRV system, they are simpler and less expensive to install because they do not require ductwork throughout the house. However, because there is no ductwork, a home may need more than one unit to provide adequate ventilation, depending on layout and occupancy. Each ventilator requires a hole in the wall and a power source; the most difficult part may be maintaining both air and vapor barrier integrity around the unit. They are also easier to retrofit into an existing house than a ducted system, depending on the wall type and thickness.

However, the units in this study did not perform well with high moisture loads at cold temperatures. In high humidity conditions, the outside hoods would freeze closed, basically eliminating all air transfer and increasing electrical use.

Figure 1. Through-wall ventilators are made up of an external hood, a fan, an internal air diffuser, and a ceramic core, pictured here. The ceramic core retains heat from the exhausting air and returns that heat into the supply air from the outside. The air flow reverses every 70 seconds in an effort to keep the core from freezing.

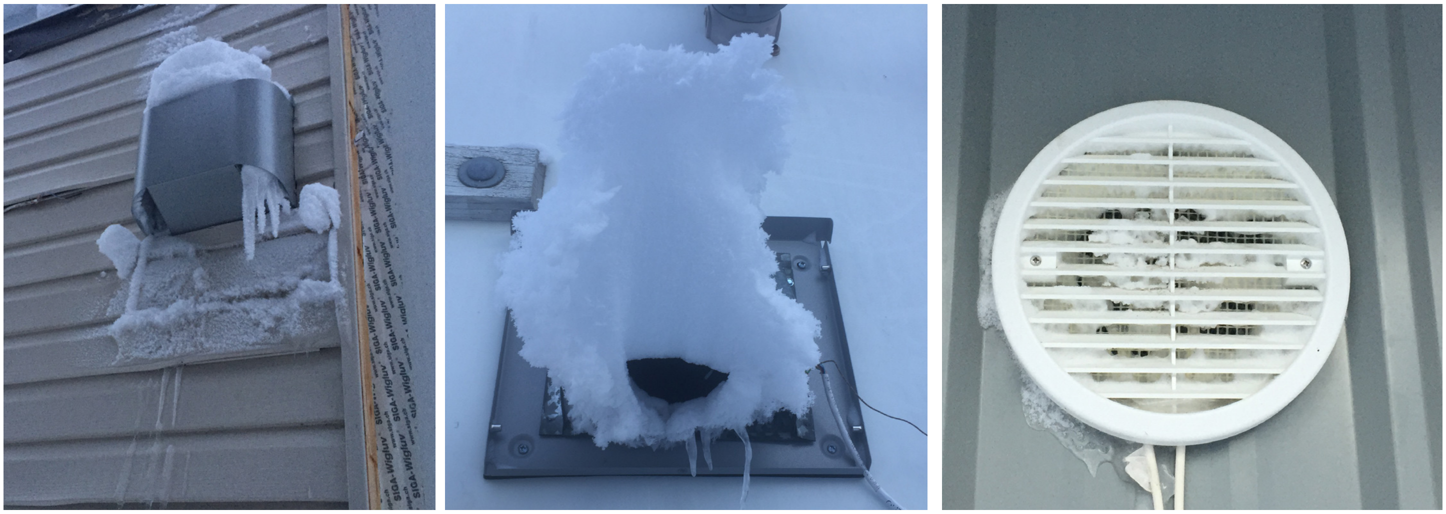

Figure 2. Exterior hoods for different through-wall units. The left hood from the Twinfresh is frozen closed. The center hood was an alternative to the factory supplied Twinfresh hood and has significant frost buildup, but there is still an open path for air. The hood on the right is from the Lunos E2 and didn't freeze closed (potentially because the house had lower relative humidity than the other test sites).

Different hood configurations may mitigate this problem. Figure 2 shows the ice buildup on three different exterior hoods.

We also looked at the efficiency in heat recovery of one type of through-wall ventilator. The Twinfresh model has two through-wall units that alternate between supply and exhaust every 70 seconds. The heat recovery efficiency was 40–50% based on outside temperatures, and the unit did not operate below -2°F due to freezing. Figure 3 shows the efficiency based on outdoor temperature.

While the Twinfresh unit was not as efficient as expected, 45% heat recovery is better than an exhaust-only system, which has no heat recovery. The outside hood design was problematic for freezing but there is the potential that a different hood may solve this problem. Longer cold weather testing on alternative hoods would help to validate this potential.

Alaska Housing Finance Corporation

This project was funded by Alaska Housing Finance Corporation

For more information please visit cchrc.org/little-ventilation-project

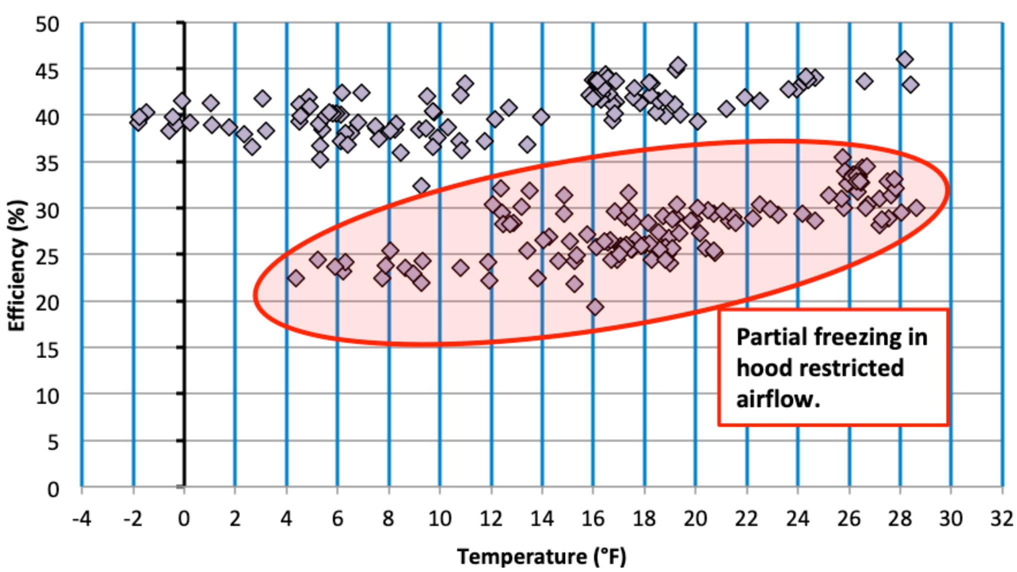

Figure 3. The efficiency of heat recovery for the Twinfresh unit relative to outdoor temperature. The efficiency dropped as the hood started to freeze and eventually froze closed.