Q & A: Why does the CleanCook stove fuel canister stay cool when the stove is in use?

When ethanol or methanol, or a mixture of the two alcohols, evaporates from the fuel canister into the stove's combustion chimney, the liquid fuel adsorbed onto the fiber in the canister is cooled. This cooling occurs because it takes heat to evaporate alcohol, or any liquid, from its liquid state to a gas. As alcohol evaporates, the heat leaves with the gas, cooling the liquid.

We are all familiar with what happens when we put alcohol (like rubbing alcohol, which is isopropyl alcohol) on our skin. We feel a cooling effect. The alcohol is evaporating, taking heat away with it and leaving a cold sensation on the skin. And we know from the cold feeling that evaporating alcohol gives us that it is an effective coolant.

The same thing happens when we put water on our skin, or step out of the bath. We feel cold. This is because water is evaporating and taking heat with it. For every gram of water that evaporates from our skin, 2264 joules (539 calories) of energy are being used to evaporate that gram of water. The energy is taken in the form of heat from our skin and therefore we feel cold.

This gives an important clue about how the CleanCook stove works.

An evaporating liquid, to be effective in removing heat, needs to have a high latent heat of vaporization (so that each gram evaporated removes a lot of heat) and a low boiling temperature (so that it boils easily and removes heat rapidly).

Ethanol and methanol fit this to a 'T'. Methanol actually has a lower boiling point and a higher heat of vaporization than ethanol, so adding some methanol (~10%) to ethanol keeps the fuel canister even cooler and also helps the CleanCook stove to combust even better. (This is because there is just a little more oxygen in methanol than ethanol, relative to its carbon.)

Using Liquids as a Coolant: Boiling temperature and latent heat of vaporization of some liquids

Liquid at atmospheric pressure	Boiling Temperature (C)	Approximate Latent Heat of Vaporization (joules/gram)
Ether (C2H5)2O	34.5	378 (90 calories)
Acetone (CH3COCH3)	56.2	987 (235 calories)
Methanol (CH3OH)	64.5	1008 (240 calories)
Ethanol (C2H5OH)	78.3	848 (202 calories)
Water (H2O)	100	2264 (539 calories)