

Periodic Graphics

A collaboration between C&EN and Andy Brunning, author of the popular graphics blog *Compound Interest*

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To see more of Brunning's work, go to compoundchem.com. To see all of C&EN's Periodic Graphics, visit cenm.ag/periodicgraphics.

The chemistry of cast-iron cookware

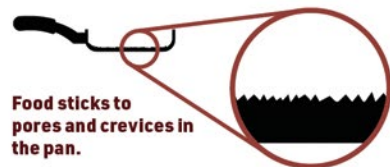


Cooks used cast-iron pans for centuries before modern nonstick pans turned up on the scene. Here we look at what makes cast-iron pans nonstick and the chemistry behind seasoning pans.



Why does food stick to pans?

Food sticks to pans because chemical bonds form between the food and the pan surface. These bonds occur because heat induces intermolecular van der Waals forces between food molecules and the pan materials or causes covalent bonds to form between the two.



Food sticks to pores and crevices in the pan.

Foods high in protein are particularly susceptible to sticking to pans because the proteins form complexes with metal atoms in cookware.

Cast-iron cookware

Cast-iron pans are made from an alloy of iron, carbon, and silicon. These pans owe their nonstick properties to the seasoning process.

Cast-iron seasoning



Step 1

Wash and thoroughly dry the cast-iron pan.



Step 2

Apply a thin layer of oil to the pan. Wipe off any excess oil.



Step 3

Place the pan in an oven at 230 °C (450 °F) and bake for 30 min, then let the pan cool inside the oven.



Step 4

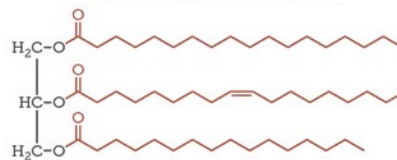
Repeat steps 2 and 3 several times for thorough seasoning.

The thin layer of oil polymerizes in the high temperature. The polymerized oil layer stops food from sticking by making the surface of the pan smoother and repelling water, preventing contact between the iron and water-rich foods.

The science of pan seasoning

Triglycerides in oil contain fatty acids, which have long hydrocarbon chains. At the high temperature used for pan seasoning, the hydrocarbon chains break down. The carbon-carbon double bonds in the chains polymerize to form large and complex polymer molecules that stick to the pores and crevices in the pan.

Example oil triglyceride



Glycerol

Fatty acids

Oils high in unsaturated fats, such as canola oil, contain more carbon-carbon double bonds and polymerize more easily.

Increasing unsaturated fats



Lard Olive oil Sunflower oil Canola oil

Washing cast-iron pans with dish soap doesn't damage the polymerized seasoning.

