

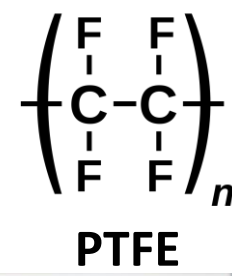
It Just Won't Stick! – Investigating Non-Stick Properties Of Cast-Iron Seasoning

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Concerns Regarding Teflon Cookware

Background

- Teflon is a brand name for the compound PTFE.
- Many chemicals (i.e., PFAS) used in its production are hazardous to human health and environment.
- Chemical dumps by large producers have caused a wide-ranging spread of these chemicals. In fact, 98% of Americans have measurable amounts in their blood.



Alternative? Cast-Iron Seasoning!

What is «Seasoning»?

The process of seasoning a cast-iron pan forms a protective layer on its surface, preventing it from rusting and giving it non-stick properties:

- The bare pan is coated with fat.
- It is heated up beyond the fat's smoking point.
- The first two steps are then repeated multiple times.

Vision

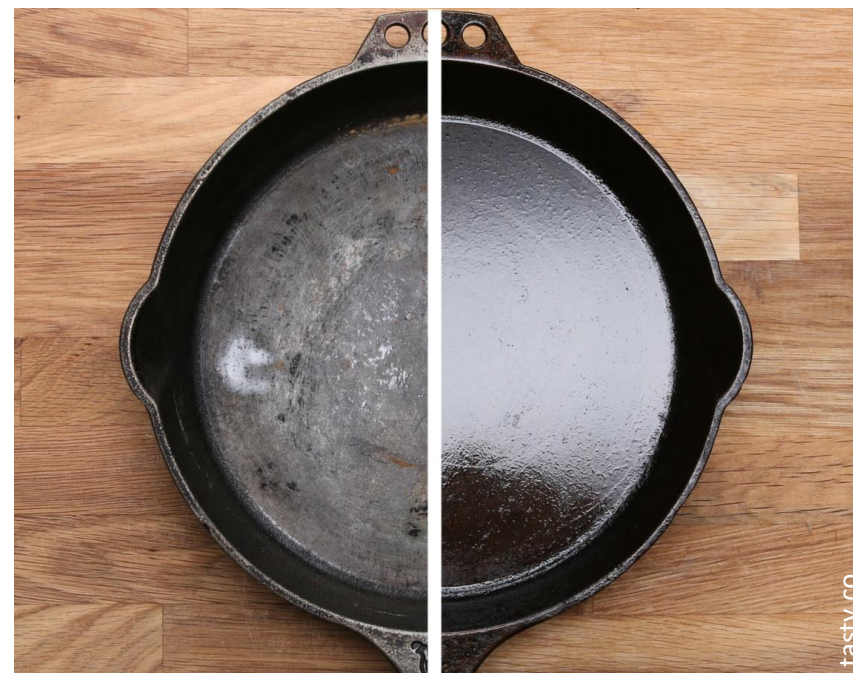
Optimize cast-iron seasoning to obtain a better alternative for Teflon

- What is the optimal heating temperature?
- What number of cycles is ideal?
- What type of reagent (fat) achieves best results?
- How much reagent should be used?

Mechanism Of Seasoning Process

Mechanism

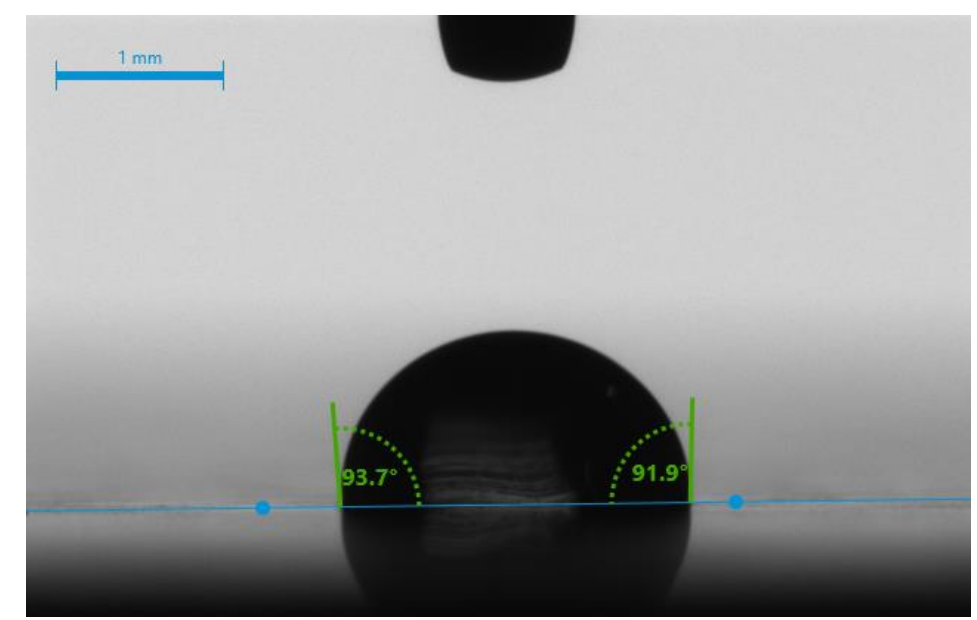
- Through heating and fat application, a black oxide layer (Fe_3O_4) is formed.
- Evaporation of fat causes changes in oxygen partial pressure at the surface and breaks this oxide layer into nanoballs.
- Obtained nanostructure increases hydrophobicity.



Measuring Non-Stick Property Of Surfaces

Determining level of adhesion

- Hydrophobicity (water repelling property) used to determine «non-stickiness»
- Measured by determining the degree of wetting through the contact angle



Methodology

Sample Preparation

- All samples were heated up to 450°C at 5°C/min, then incubated for 15 min.
- Different types and amounts of reagents were used to investigate effect thereof on hydrophobicity.
- Samples were treated with different numbers of treatment cycles to optimize the seasoning

Surface imaging

SEM imaging was used to investigate the topology of the cast-iron samples

Measuring Roughness

Surface roughness of the samples was measured using a laser scanning microscopy.

Angle Measurement

Contact angles were measured using a drop shape analyzer.



Untreated sample

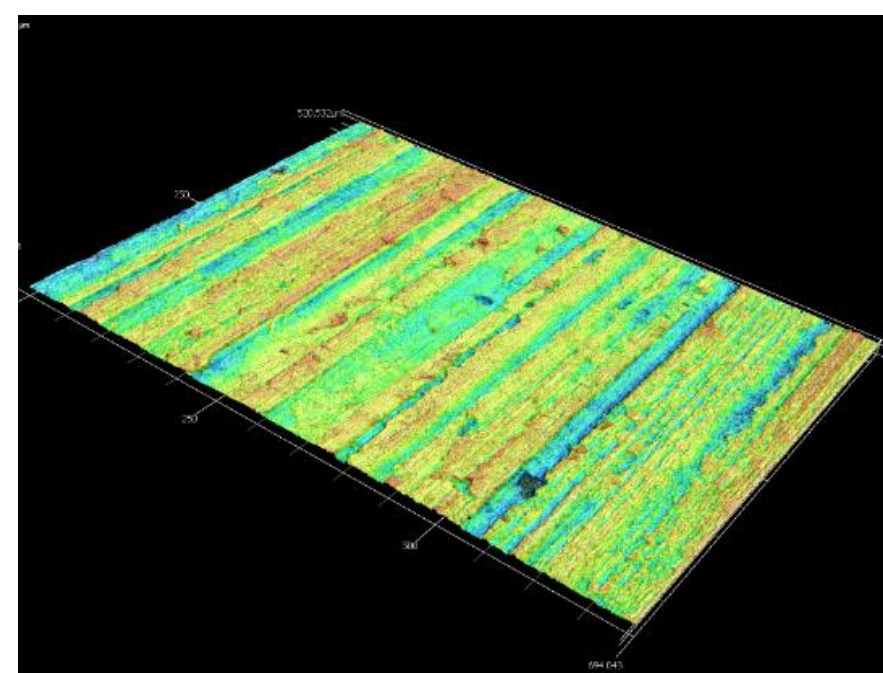
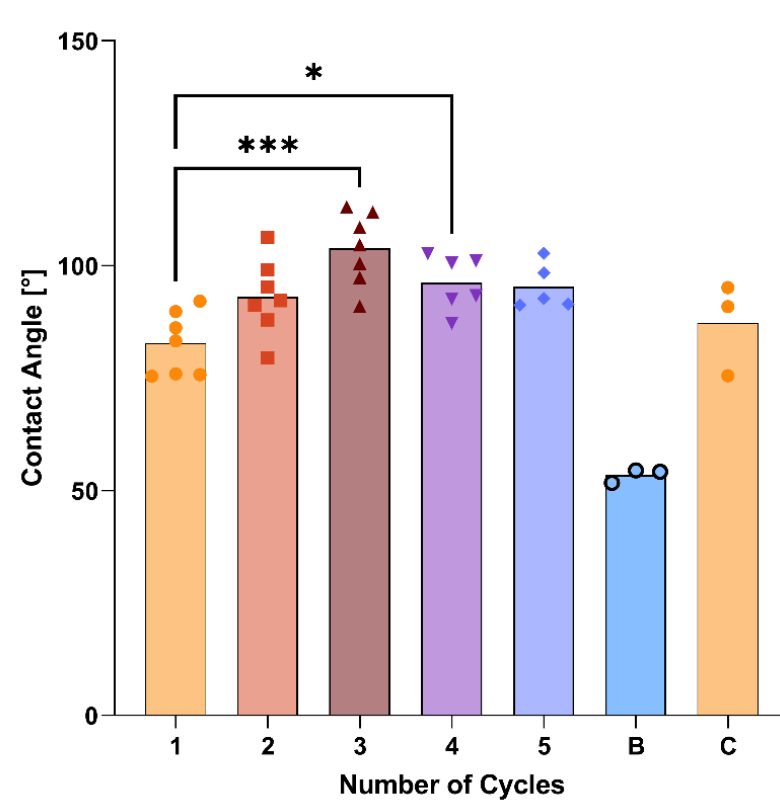


Treated sample



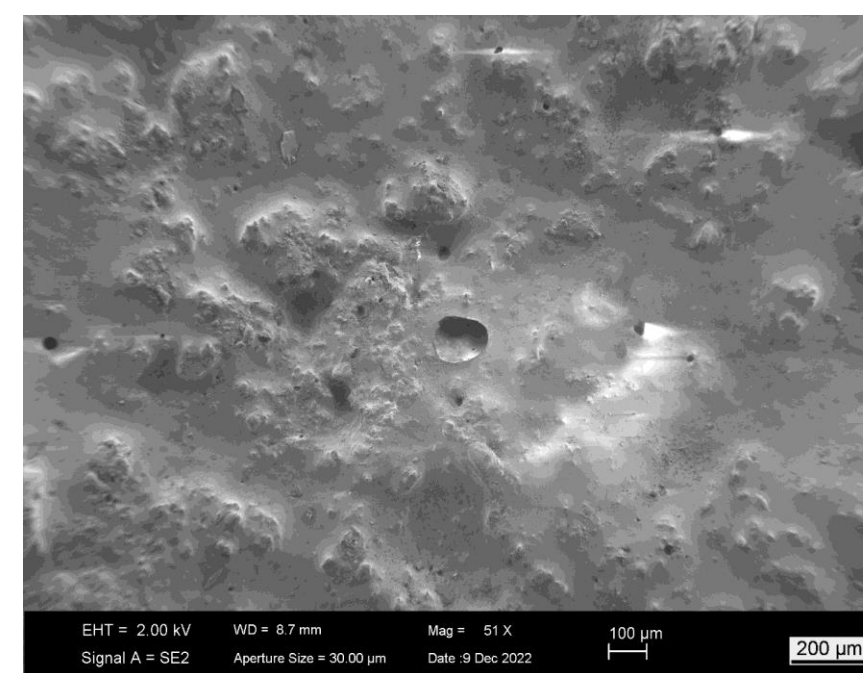
Embedded samples used for material analysis

Investigation of Parameters for the Optimization of Contact Angles



Surface Roughness

Large differences in levels of surface roughness were observed between the treated samples and controls.



Surface morphology

Characteristic surface structures of treated samples and commercially available cast-iron griddle surface were obtained using an SEM.

Contact angles

Lamb tallow at 450°C for three 100 min. cycles proved most effective, producing significantly larger contact angles than controls.

Conclusions

- Experiments yielded samples exhibiting significantly higher hydrophobicity compared to controls.
- Insight was gained into topological features of cast-iron seasoning.
- New parameters interesting for future studies were recognized

Outlook

- Investigate effect of initial surface roughness of on contact angles.
- Increase sample size and measurements per sample.
- Explore solutions for inhomogeneity of seasoning

References

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