Periodic graphics

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

More online

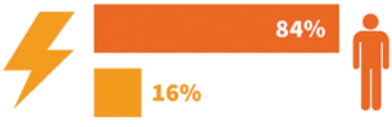
To see more of Brunning's work, go to **compoundchem.com.** To see all of C&EN's Periodic Graphics, visit **cenm.ag/periodicgraphics.**

THE CHEMISTRY OF WILDFIRES

From Jan. 1 to Dec. 22, 2017, there were 66,131 wildfires in the U.S. In this graphic, we look at wildfire combustion, the compounds produced, and the effects those molecules can have on health.

WILDFIRE COMBUSTION

Lightning strikes can spark wildfires. But between 1992 and 2013, people—either accidentally or deliberately—started 84% of wildfires in the contiguous U.S.



The principal combustible components of vegetation that fuel wildfires are cellulose and hemicelluloses (50–65%), lignin (15–35%), and other organic compounds not part of the cellular structure (0.2–15%).

WILDFIRE STAGES

1. **<400 K** — Polysaccharides and functional groups decompose.
2. **>450 K** — The polymer structure of wood breaks down.
3. **1,400 K** — Flaming combustion produces highly oxidized gases.
4. **800 K to 1,000 K** — Smoldering combustion takes over once most volatiles are released from fuel.

FLAMING VERSUS SMOLDERING

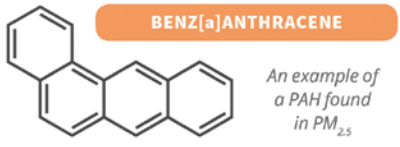
FLAMING	SMOLDERING
Combustion of volatile compounds released from fuel	Flameless, low temperature form of combustion.
PRODUCTS	**PRODUCTS**
Carbon dioxide Nitrogen oxides Sulfur dioxide Particulates Water vapor	Amines Ammonia Carbon monoxide Methane Organics

Compared with flaming combustion, smoldering converts fuel to more toxic compounds, but it occurs more slowly.

HEALTH & ENVIRONMENT

Wildfire smoke consists mainly of particulate matter, carbon monoxide, volatile organic compounds, nitrogen oxides, and other trace gases.

People can inhale particles smaller than 2.5 μm ($PM_{2.5}$) deep into their lungs, aggravating asthma and decreasing lung function. $PM_{2.5}$ also causes haze.



Exposure to polycyclic aromatic hydrocarbons (PAHs) increases risk of cancer and cardiovascular disease. The compounds also persist in the environment.

Gases emitted during wildfires can undergo reactions that create ozone. Tropospheric ozone is a major component of smog and also causes respiratory problems.

PERIODIC GRAPHICS