



IAQ RADIO+

Show Number: 749 BLOG

Delphine Farmer, PhD
Colorado State University
Wildfires; What the Science Says So Far

Good day and welcome to the IAQ Radio+ episode 749 BLOG. This week we welcomed Dr. Delphine Farmer from Colorado State University to discuss the current science on wildfires. Dr. Farmer and her team started looking closely at this topic after the Marshall Fires three years ago, when a wind-driven wildfire raced through two communities just outside Boulder, Colorado.

Dr. Farmer discussed the interdisciplinary approach to addressing wildfire issues, the differences between indoor and outdoor air chemistry, and the effectiveness of air purifiers and surface cleaning in reducing wildfire smoke exposure. She also discussed an experiment conducted in a test house to understand the behavior of wildfire smoke indoors and the health effects of wildfire smoke.

Delphine Farmer, PhD is a Professor in the Department of Chemistry at Colorado State University. Her research focuses on understanding the air we breathe both indoors and out, and how the chemistry of air impacts human health, ecosystems, and even climate. Her recent work has focused on wildfire smoke, starting with aircraft projects flying in large wildfire plumes, and more recently looking at how smoke interacts with building surfaces.

Nuggets mined from today's episode:

Dr. Farmer, welcome back to IAQ Radio+, it's been almost 4 years since you last joined us on the show. <https://www.iaqradio.com/delphine-farmer-phd-colorado-state-university-indoor-vs-outdoor-air-chemistry-cooking-cleaning-and-covid/>

Dr. Farmer began her career as an atmospheric scientist studying outdoor emissions, air pollution and their chemical interaction with the air we breathe. More recently she studies Wildfires as a major source of air pollution and what comprises Wildfire Smoke and how Wildfire Smoke is transported. She has flown through wildfire smoke plumes in aircraft laden with scientific equipment. Her research work at indoor HomeChem provided background knowledge which helped her provide

guidance to friends whose homes were impacted by the Marshall Wildfire. When researching wildfire cleanup, she found abundant advice, little of which was grounded in science.

Delphine discussed the interdisciplinary approach to addressing wildfire issues at Colorado State University, involving people from various departments. She mentioned her collaboration with colleagues at the University of Colorado Boulder and the Front Range expertise in this area.

Big smoke plumes from Canadian Wildfires impacted New York City. She studies the chemistry of sunlight driving outdoor chemical reactions. The indoor chemistry after wildfires is different because indoor spaces have high surface areas, low sunlight, low ventilation rates, preexisting background particles and chemicals.

Wildfire Smoke and Indoor Air Quality

Delphine discussed the differences between indoor and outdoor air chemistry, particularly in the context of wildfire smoke. Delphine, a professor at Colorado State University, shared her background in atmospheric chemistry and her recent research on wildfire smoke. She explained how the chemistry of air impacts human health, ecosystems, and climate, and how her research has shifted from focusing on outdoor air quality to understanding the effects of wildfire smoke indoors. Delphine highlighted the differences between indoor and outdoor air, such as the high surface area, low light levels, and absence of wind movement indoors. She also mentioned her ongoing research at NIST, where they are studying the effects of wildfire smoke on indoor air quality. The hosts commented about the surprising results from her studies, particularly regarding the use of air purification equipment and cleaning methods.

Wildfire Smoke Experiment and Ventilation

In the meeting, Delphine discussed an experiment conducted in a test house to understand the behavior of wildfire smoke indoors. The experiment involved adding a small amount of smoke into the house and observing the changes in particle and gas levels over time. The results showed that while particle levels returned to normal within a few hours, gas levels, particularly volatile organic compounds (VOCs), remained elevated for days or even weeks. This indicated that surfaces in the house acted as a reservoir for these smoke-associated gases, which could

permeate back into the air over time. The team also discussed the ventilation system of the house and the methods used to introduce smoke into the house. The experiments performed in the NIST*, test house in Maryland involved smoke generated by a cocktail smoker and pine wood chips as fuel was introduced into the test home and monitored by sophisticated scientific instruments.

National Institute of Standards and Technology. [*Nist.gov] During periods when smoke was introduced into the home, particle counts and VOC levels increased dramatically. While particle counts normalized rapidly, VOC counts remained high. The experiments found that particles and gases attached to surfaces. Particulate and gas levels increased with each introduction of smoke. It was noted that VOC never dropped to pre-test levels. VOCs were found to diffuse and permeate surfaces and create VOC reservoirs. The VOC reservoirs slowly emitted VOCs into the air. The NIST test home was built to study energy efficiency. As such, the house was tight and ventilated with a controlled ventilation system. Smoke was circulated throughout the home with strategically placed box fans. To create aged smoke, smoke was introduced into a Teflon® holding chamber outside and exposed to ozone. The experiments did not generate much ash, a known marker for wildfires. Persistent VOC sources were found to remain in the home for days, weeks and possibly years?

Air Purifiers vs Surface Cleaning

Delphine discussed the effectiveness of air purifiers and surface cleaning in reducing wildfire smoke exposure. She explained that air purifiers are ineffective for volatile organic compounds (VOCs) and only address the air, not the persistent source of smoke inside a home. Air cleaners with filters treated with activated carbon were not significantly effective in reducing VOC levels. Surface cleaning, on the other hand, was found to be highly effective in removing the source of smoke. Delphine recommended thorough cleaning of all surfaces, including hidden ones, and washing fabrics to remove the smoke source. She also emphasized the importance of wearing an N95 mask while cleaning to reduce exposure to particulate matter.

Wildfire Smoke Health and Cleaning

In the meeting, Delphine and the hosts discussed the health effects of wildfire smoke and the importance of cleaning homes exposed to it. Delphine emphasized the need for caution and the use of appropriate personal protective equipment (PPE) when returning to homes affected by wildfire smoke. She also highlighted the

importance of evidence-based cleaning methods and the potential risks of unnecessary sampling and testing. The hosts expressed concern about the potential for misinformation, fear mongering and the need for clear guidance on cleaning and remediation. Both agreed on the importance of sharing accurate information with homeowners and the need for a balanced approach to addressing the issue.

Assorted additional comments from Dr. Farmer:

- Cleaning is empowering and not necessarily hard. Clean as many surfaces as possible. Use soapy solutions and vigorous agitation. Don't forget to consider hidden surfaces (e.g. attic, HVAC system)
- There is no existing norm or baseline for levels of potential fire related contaminate in homes.
- Chemical sampling analysis data is hard to interpret.
- Sampling can be expensive.
- Sampling may not change much.
- Wildfire events from one place cannot be translated into events from other places.
- Urban wildfire interface is significantly different than wildfires in forest areas.
- There is a need for uncomplicated evidence-based solutions,
- Cannot downplay the efficacy of simple surface cleaning.
- The place for testing is when/where truly needed.
- Active ongoing air monitoring before the 2025 Los Angeles Wildfires shows huge spikes in lead and chlorine levels.
- Importance of appropriate PPE
- Don't clean while a massive event is ongoing outdoors!
- Immobilization of smoke residues and gases during cleaning isn't strong.
- Fire related particulates are known to exacerbate/cause respiratory problems and neuro problems, and be a danger to young, old and immune suppressed.
- The hazards of particulate matter are well known, its hard to tie health effects to gases.

Resources:

<https://www.redcross.org/get-help/how-to-prepare-for-emergencies/types-of-emergencies/fire/cleaning-up-after-fire.html>

https://www.fema.gov/sites/default/files/documents/fema_marshall-fire-mat-homeowners-guide-risk-reduction-remediation-residential-smoke-damage.pdf

<https://www.pdx.edu/news/targeted-household-cleaning-can-reduce-toxic-chemicals-post-wildfire-research-shows>

<https://theconversation.com/wildfire-smoke-leaves-harmful-gases-in-floors-and-walls-air-purifiers-arent-enough-new-study-shows-but-you-can-clean-it-up-214060>

<https://www.dailycamera.com/2025/01/05/opinion-colleen-e-reid-wildfire-smokes-health-risks-can-linger-in-homes-that-escape-burning/>

<https://www.utoronto.ca/news/study-fort-mcmurray-homes-after-wildfires-should-give-residents-peace-mind-u-t-researchers>

Z-Man Signing Off

Trivia Question:

What term is used to refer to a type of fire that rapidly spreads through the upper canopy of trees, often propelled by wind?

Answer: Crown Fire

Sorry, there was no correct answer to today's trivia question.