

Ask the 3Expert

Hans Plugge: What do rattlesnakes, barbeque and firefighters have in common?

Hans Plugge, Senior toxicologist at 3E Company, recently conducted an American Chemical Society (ACS) sponsored [AMA](#) (Ask Me Anything) on Regulatory Toxicology for the [New Reddit Journal of Science](#) website. Hans has more than 35 years of experience in regulatory toxicology and risk assessment and is a member of 3E's Chemical Review and Analysis (CRA) team. He recently developed 3E GreenScore, a new hazard screening assessment tool which assesses hazards from commercial products and complex mixtures.

The following excerpt is from the Reddit AMA session:

Q: What is the most worrying toxic material you've seen gain traction over the years? Which material is the worst for the environment, and are we doing anything about it?

A: The most toxic materials are both man-made—such as dioxins—and natural products—venomous (?) natural pesticides such as pyrethrins—but they tend to be present in minute quantities. Basically their inherent hazard independent of exposure is very high but once you take into account the amount of exposure they don't tend to pose a significant risk. One analogy: a bite from a rattlesnake has significant toxic effects but in general the probability of being bitten is extremely low especially for the usual suburbanite.

While not quite as toxic, more common chemicals are present in much higher doses or exposure levels and actually may be the biggest source of chemical risk. Flame-broiling or barbequing meat would be one controversial example especially when you burn it to a crisp. Some components of gasoline are harmful which is why using it as a cleaning agent is not recommended. If you pump your own gas in urban areas vapor recovery technology moves the vapors away from you.

The really toxic things people obsess about are generally not the ones that pose the highest risk.

Q: I'm a career firefighter paramedic with 15 years in so far. I'm in a fairly busy metro Atlanta department. We don't run a ton of fire but we do participate in training and PT in our gear every shift. Numerous studies have confirmed firefighters are diagnosed with cancer (substantially) more than the general population. (Forgive my lack of sources to cite).

This article (<https://station-pride.com/2017/03/28/the-real-cancer-in-your-gear/>) is now bringing new concerns that contributing factors may not be just the carcinogenic byproducts of fire, but from components of the gear itself.

We all take great pride in washing our gear after fires (running it through commercial extractors designed for gear), as well as swapping our hood since it hangs out over the sensitive skin right in front of your thyroid. I'm a 38 year old mom to three daughters and want to live a long time. I'm usually not terribly worried about the hazards we face but this one is really bothering me. Thanks!

A: Firefighting is an awesome job! The exposure of firefighters to toxins is not easy to evaluate as every fire is different. Generally the really hot fires completely burn substances (which is a good thing), whereas smoky fires do not, which results in combustion byproducts such as polycyclic aromatic hydrocarbons (PAHs) being formed. These are generally carcinogens and tough to remove from gear but blocked by self contained breathing apparatus (SCBA) gear. These byproducts also cause the sooty odor that often lingers (think of barbeque smoke). I quickly glanced at the study you cited and the link is not opening correctly in my browser. Sweating into your gear won't cause cancer, but may cause a (heat) rash in people who are prone to such reactions.

However, perfluorooctanoic acid (PFOA), which makes the gear waterproof, can be a problem – I'm not sure there is anything on the market that can stand the heat! PFOA is bonded to the exterior of the fabric and very little comes off, which is why it stays waterproof for an extended period. Alternatives are under development but for the extreme conditions of firefighting it may take a while to develop a suitable alternative.

Q: Do you have information regarding formaldehyde and pregnancy? We work in a Pathology Lab and use formalin fixation for the surgical specimens we process. We do not use any masks, only a cotton lab coat, nitrile gloves and a working station with air extraction. Is it safe for our pregnant workers? Thanks!

A: Formaldehyde toxicity is very controversial, especially the carcinogenicity aspect. At fairly high doses, formaldehyde causes cancer inside the noses of rats ONLY after inhalation. Feeding studies have been negative. Noses of rats contain different tissue types than humans, so the applicability to humans isn't clear. All green vegetables and fruits naturally contain formaldehyde up to concentrations of approximately 100 parts per million. Even humans naturally have formaldehyde in their cells. So concerns over low levels of formaldehyde, especially when it's not inhaled, may be overestimated. This is where risk versus hazard comes in: formaldehyde may have a relatively high hazard at concentrated/ high exposure levels, but its risk at (very) low concentrations may be minimal. I am not sure this debate will ever get settled, but people get unduly worked up over tiny amounts of formaldehyde.

Having said that, tissue preservation can result in moderate to high levels of formaldehyde (yes, smelling it is an indicator but even low levels have an odor). Working in fume hoods or other local ventilation can substantially reduce the smell. Face masks (i.e., white dust masks) don't do much – if anything – to reduce exposure.

Reproductive studies on formaldehyde have not been positive, although some may be inconclusive. Most of the mutagenicity (the effect on genes) has been negative in bacteria and such.

Skin effects do occur. Gloves, especially nitrile ones, will help. Nitrile gloves are thicker and sturdier and don't allow chemical penetration of organic solvents. Please talk to your obstetrician for the latest advice.

To learn more, please check out the rest of the interview with Hans on [reddit!](#)

Another fun story about Hans: In his spare time, Hans is a volunteer chef on the 1923 Pullman train car, Dover Harbor. There are five volunteer chefs and they makes a couple of trips each year to destinations ranging from Williamsburg, VA to New Orleans, LA. They either sell tickets on a public trip or you and seven of your best friends can charter the car for an overnight private trip (yes, the car has bedrooms). The picture above is of Hans in his chef's jacket on one of the train journeys.