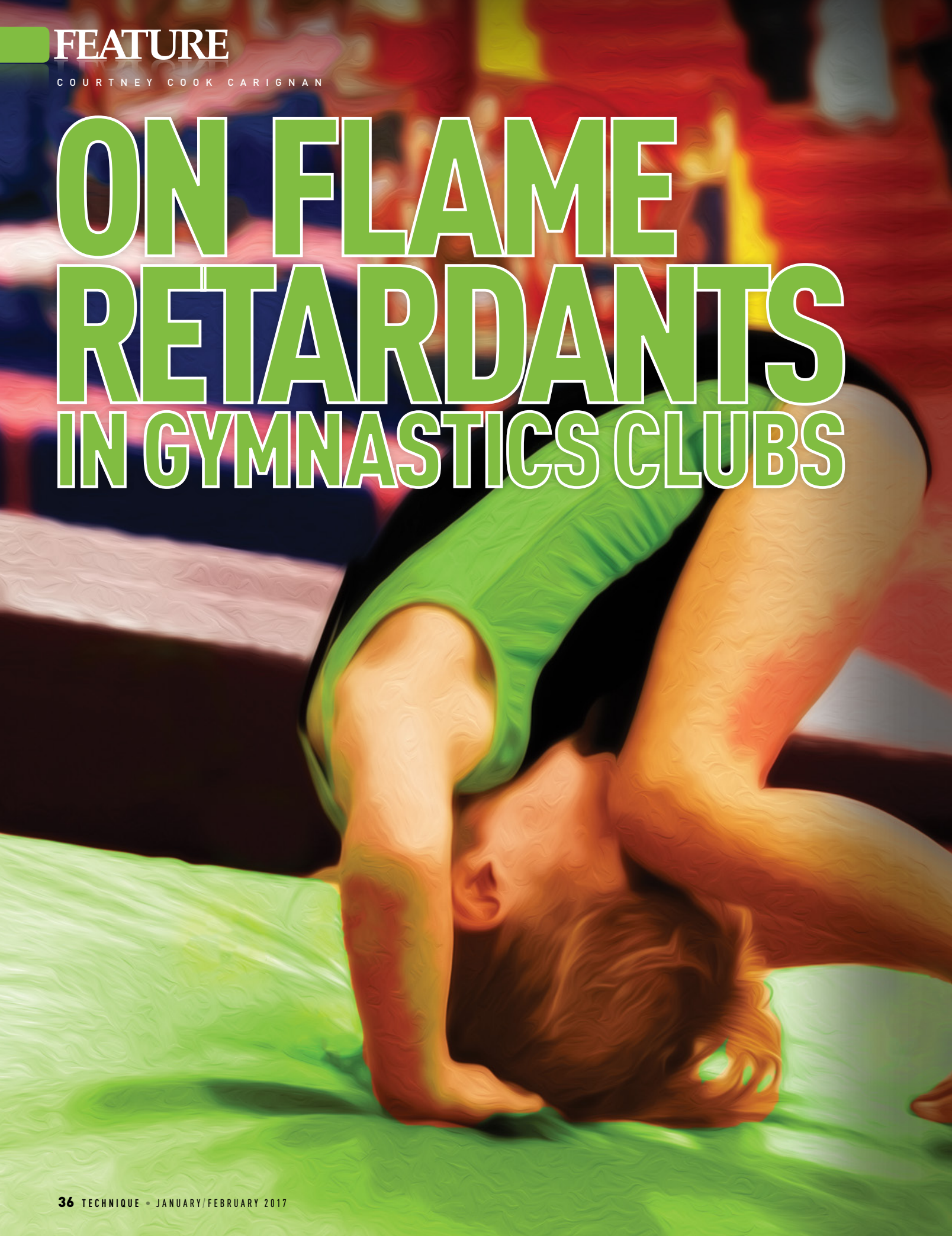
FEATURE

COURTNEY COOK CARIGNAN

ON FLAME RETARDANTS IN GYMNASTICS CLUBS



Almost a decade ago, I remember being shocked to learn that the foam equipment in my gym likely contained flame-retardant chemicals. Like many competitive gymnasts, I started the sport at a young age and by the time I was 18 had spent more than 6,000 hours in the gym. I never dreamed that chemicals like this were in my gym, or that the chemicals in foam could be harmful and get into my body.

Flame-retardant chemicals have been added to products in an effort to improve fire safety. However, we now understand that they can easily evaporate from products into the air then stick to dust and skin and enter our bodies. The main way they enter the body is when dust on the hands is accidentally ingested, but they are also inhaled and absorbed through the skin. Over a decade of research indicates that some flame retardants accumulate to high concentrations in the body, can harm the developing brain, and have been linked to cancer as well as reproductive problems. In 2010, scientists across the globe released a consensus statement documenting concerns about these chemicals and more recently the Chicago Tribune and HBO covered this issue, including new findings that flame retardants may not be as effective as advertised.

Flame retardants are used in many products including polyurethane foam (like in upholstered furniture) as well as the plastic casings of electronics. When I first began researching flame retardants in graduate school, I wondered if it they could also be used in the foam found in landing mats and the loose foam pit commonly used by gymnasts. As a former gymnast, I remembered that as the foam ages, it creates a gritty dust that gets all over the gym, especially in the loose foam pit. The dust clings to your skin and can get into the eyes and mouth. I was concerned about what this could mean for gymnasts, so I conducted a study as part of my doctoral thesis. Three years ago I graduated and published that work in *Environmental Science & Technology* reporting flame retardants in the air, dust and foam of training equipment from a gymnastics training facility at levels much higher than what we find in homes, offices or vehicles.

The flame retardants we found at high levels in the gym were the same that are typically used in foam. These included the PentaBDE mixture, which was the most commonly used flame-retardant mixture prior to 2005, when it was phased out of use. Part of the reason these findings are concerning is because PentaBDE is known to accumulate in the body where it will persist for many years. I suspected that some gymnasts and coaches could have very high levels of PentaBDE in their bodies. To address this question, I asked a team of collegiate gymnasts to provide blood samples for testing. We found that average levels of a component of the PentaBDE mixture was 4 times higher in their blood compared to the general U.S. population and similar to an occupationally exposed population of foam cutters and carpet installers. PentaBDE was present in the pit cubes from their current gym and were likely also in many of their former gyms. In a recent survey of foam from gyms across the U.S., we identified PentaBDE only in the majority of pit cubes purchased prior to 2005. Like most of the population, the gymnasts likely also contacted PentaBDE in their homes as it was a common flame retardant used in upholstered furniture until 2005.

"AS A FORMER GYMNAST, I KNOW THAT THERE ARE MANY BENEFITS TO GYMNASTICS, AND I DON'T THINK ANYONE SHOULD QUIT THE SPORT BASED ON OUR FINDINGS. HOWEVER, I DO THINK IT IS PRECAUTIOUS TO LIMIT CONTACT WITH FLAME RETARDANTS..."

Flame-retardant chemicals used to replace the PentaBDE mixture were also found at high levels in the gym and in pit cubes from our survey of foam from U.S. gyms. These include tris (1,3-dichloro-2-propyl) phosphate (TDCIPP) and the Firemaster 550® mixture which includes triphenyl phosphate (TPHP) as one component. We found evidence that these chemicals entered the gymnasts' bodies during practice, with higher levels of TPHP and TDCIPP metabolite found in urine samples collected from gymnasts after practice compared to before practice. Our results also confirmed that TDCIPP and TPHP are eliminated from the body more quickly than PentaBDE, on the order of hours. Most people contact these replacement flame retardants in the home and other indoor environments, as both are used in upholstered furniture. Although these replacements don't accumulate in the body to the extent that PentaBDE does, people can have low levels in their body for much of the day and continuous low level exposure is of concern for chemicals that are hormonally active.

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Environmental chemicals that are hormonally active are known as endocrine disruptors because they can disrupt action of the endocrine system. PentaBDE, TPHP and TDCIPP have all been shown to act on thyroid hormone and may act on the steroid hormones as well. Both human and animal studies indicate that PentaBDE can disrupt levels of thyroid hormone in the body and adversely affect neurodevelopment and reproduction. In population-based studies, women with higher levels of PentaBDE in their blood took longer to get pregnant and their children were more likely to have developmental behavioral disorders such as ADHD. Most research on TPHP and TDCIPP is experimental (lab and animal) with observational research on humans (epidemiology) just beginning. TPHP is suspected of being a developmental obesogen, which means changing how babies develop in the womb. In rodent studies, prenatal exposure to TPHP can stimulate development of fat cells and interfere with bone cell development. TDCIPP is a mutagen and listed on Proposition 65 as a chemical known by the State of California to cause cancer.

Our findings are particularly concerning for competitive gymnasts and coaches, who spend a lot of time in the gym. As a former gymnast, I know that there are many benefits to gymnastics, and I don't think anyone should quit the sport based on our findings. However, I do think it is precautious to limit contact with flame retardants and that we can find ways to maintain fire safety without the use of these chemicals. As a club owner, you can promote the health of your coaches and gymnasts by considering the following suggestions:

IMPLEMENT A HAND-WASHING POLICY FOR GYMNASTS AND COACHES AT THE END OF PRACTICE.

Accidentally ingesting dust is an important way that flame retardants enter the body, and people who wash their hands more frequently with soap and water have lower levels of flame retardants in their bodies. *Note that while hand sanitizer is effective for removing germs, it does not remove flame retardants.*

PURCHASE FLAME RETARDANT-FREE EQUIPMENT IN THE FUTURE.

We have been told that most landing mats do not contain flame retardants due to the presence of a vinyl fabric cover. However we have identified flame retardants in landing mats as well as in generic sting mats and the vault runway. Therefore, we suggest asking your supplier whether the equipment you are purchasing contains any flame-retardant chemicals.

REPLACE YOUR PIT WITH FLAME RETARDANT-FREE FOAM.

The loose foam pit appears to be the most important source of flame retardants in the gymnastics training environment. I am currently working with a fire engineer on a study of pit cubes and fire safety that will provide useful information for gyms and Fire Marshalls. That information should be available in the coming months, so stay tuned.

JOIN THE GYMNAST FLAME RETARDANT COLLABORATIVE via our website or by liking our Facebook page (**facebook.com/gymnastcollaborative**) to receive updates such as results from our flammability study, flame retardant-free suppliers, release of our fact sheet, opportunities for foam testing, and findings from future research. Please also help inform our work by taking a short survey.

Many thanks to everyone who has participated in or helped facilitate this research including my collaborating researchers at the Boston University School of Public Health, Duke University, Worcester Polytechnic Institute and Silent Spring Institute as well as funding from the National Institute of Environmental Health Sciences and the Toxics Use Reduction Institute at UMass Lowell.