Exploring the Presence of Chemicals in Juvenile Car Seats

Cornell Center for Materials Research

The Chicco Sustainable Parenting Initiative is our commitment to act responsibly, respecting people and the environment, with an outlook to future generations. As part of this initiative, we developed the ClearTex® line of car seats that meet federal flammability standards without the addition of fire-retardant chemicals. With this development, we wanted independent, accredited, third-party validation to ensure that chemicals of high concern, like fire retardants and stain- or water-repellents, were not present in our line of ClearTex car seats. Chicco partnered with the Cornell Center for Materials Research (CCMR) to identify chemicals in juvenile car seats.

The team at CCMR used advanced research-grade analytical techniques to identify the presence of chlorine, bromine, phosphorous, and fluorine on each component of our ClearTex® car seats. Chlorine, bromine, and phosphorous are commonly used in flame retardant treatments. Fluorine is the basis for many stain- and water-repellent treatments, like PFAS. Fourier Transformation Infrared Spectroscopy (FTIR) was used to identify the fiber type. Scanning Electron Microscope (SEM) and Electron Dispersive X-Ray Spectroscopy (EDX) were used to image and identify chemicals on the surface of materials. X-ray photoelectron spectroscopy (XPS) was used to build the structure of the compound found on the surface.

Through this laboratory analysis, ClearTex materials - including fabrics, foams, and labels - were found to have no additional chemicals present, including fire retardant and water- or stain-repellent chemicals. This work made use of the Cornell Center for Materials Research Shared Facilities which are supported through the NSF MRSEC program (DMR-1719875).

Fire Retardants in Car Seats

All juvenile car seats must meet a federal flammability standard. FMVSS 302, Federal Motor Vehicle Safety Standard for the Flammability of Interior Materials, is the same standard that is used for vehicle car seats. FMVSS 302 tests all materials within the car seat including fabrics, foams, labels, linings and fills for a maximum burn rate. The standard was developed for vehicle seats in 1971 and implemented in the juvenile industry in 1981.

Historically, this standard was met through the application of fire-retardant treatment to materials. These fire-retardant treatments are made from three main

chemicals: chlorine, bromine, and phosphorous. In recent years, car seat manufacturers have developed solutions to eliminate these chemical treatments from car seats through material innovations.

These material innovations include both polyester fabrics and wool fabrics. The polyester fabrics use a tighter, more dense construction that reduces the amount of oxygen supplied to the flame, therefore reducing the burn rate. The wool fabrics use merino wool fibers that have a naturally high fire resistance, creating a naturally fire-resistant fabric.

Per- and polyfluorinated Substances

Per- and polyfluorinated substances are fluorine-based compounds. Commonly known as PFOAS, PFOS, or PFAS, these compounds are typically found in stain- and water-repellent treatments. Dubbed 'forever chemicals,' fluorinated compounds create strong electron bonds which means they will not break down over time. Some manufacturers apply stain- or water-repellent treatments to their products, including some car seats. Other manufacturers avoid the use of these treatments and, instead, make the fabric covers on their products easy to remove for machine washing.

Regulatory Testing

All car seats materials must be tested against federal chemical regulations to ensure safety for children. These regulations include Washington State Chemicals of High Concern to Children, Maine Chemicals of High Concern to Children, Oregon State Toxic-Free Kids Act , Vermont State Chemicals of High Concern to Children and California Proposition 65. The regulated chemicals have been identified as being high concern to children. For a substance to be on this list, there must be research done to prove the impact, which may take years.

These regulatory tests are performed by internationally recognized third party labs, such as Intertek and SGS. This testing uses a combination of Liquid Chromatography and Mass Spectroscopy. These methods work in a two-part system. First, the chemical compounds are separated from the material through Liquid Chromatography. Then, the chemical compounds are identified from the molecular weight in Mass Spectroscopy. Some of the chemicals identified during this testing include formaldehyde, vinyl chloride, BPA, BPS and PFOAs. For the full list of chemicals tested for by each state, please visit their websites from the above links.

Cornell Center for Materials Research Project

The goal of Chicco partnering with Cornell Center for Materials Research was to identify the presence of any chemicals on the surface of our ClearTex® materials. Instead of identifying already known compounds like the regulatory testing, these test methods would identify elements of concern, specifically, bromine, chlorine, phosphorous, and fluorine.

These elements would be identified using the Scanning Electron Microscope (SEM) equipped with Electron Dispersive X-Ray Spectroscopy (EDX). After the element was identified, X-ray Photoelectron Spectroscopy (XPS) would be used to build the structure of the compound found. These test methods were used because of the sensitivity of the machines and the ability to map out the surface of the material.

Material Identification

To begin, the chemical composition of the material was determined. This was done through the use of Fourier Transformation Infrared Spectroscopy (FTIR). FTIR spectra are like the fingerprint of a material. FTIR uses infrared light to identify chemical bonds. Each chemical bond has a specific energy that corresponds to a peak value. Using these peak values, the spectra can be compared to an existing database of materials to identify the material. Using FTIR, the fabrics on ClearTex® were identified to be polyester.

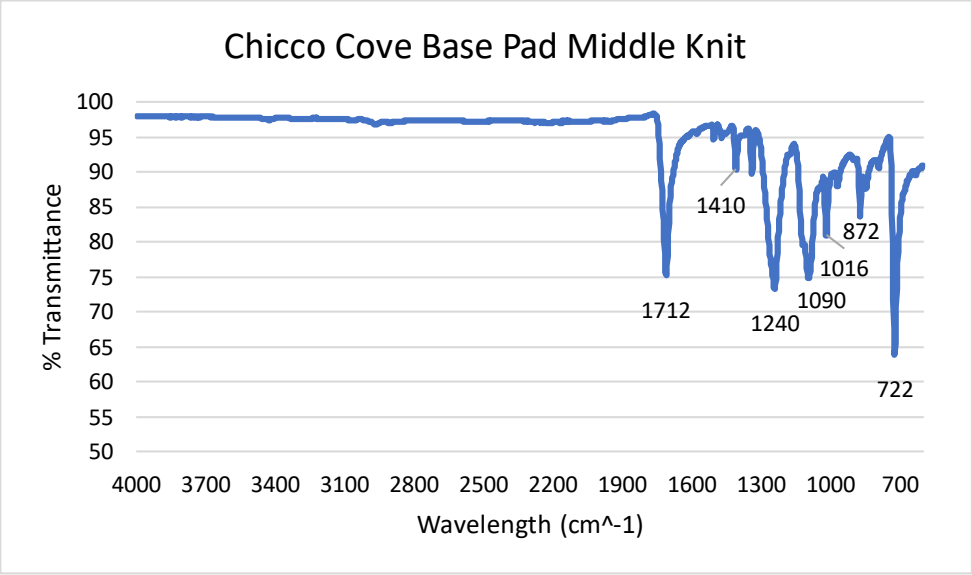

Figure 1 - ClearTex FTIR Spectrum

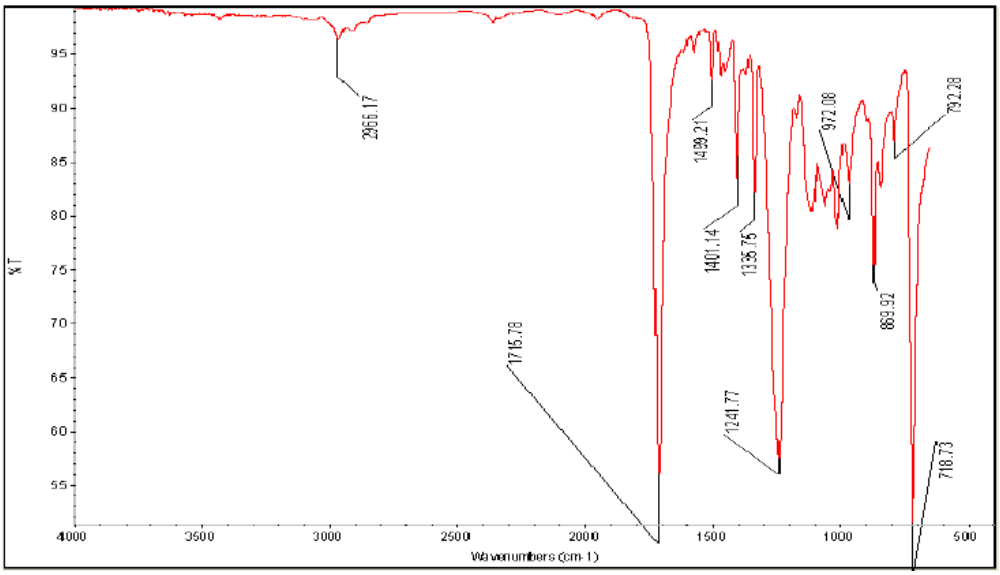

Figure 2 - Polyester FTIR Spectrum

Surface Imaging

After identification, the surface of the material was analyzed for the presence of elements with the Scanning Electron Microscope (SEM). SEM uses a beam of electrons to create an image of the surface of material. The electrons in the beam interact with the atoms in the sample and produce signals that create the image of the material. Below is an SEM image of the Chicco ClearTex knit.

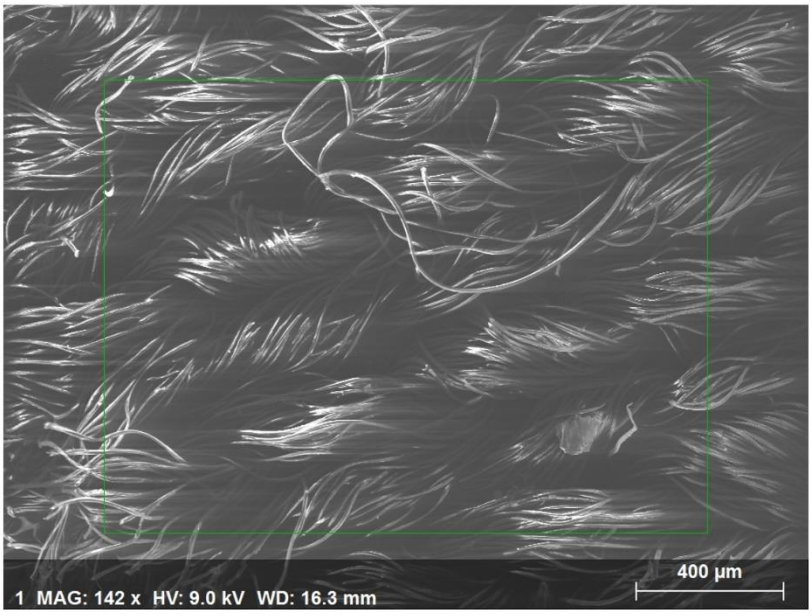

Figure 3 - SEM Image of Chicco ClearTex Knit

Electron Dispersive X-Ray Spectroscopy (EDX) is used in combination with the SEM to create a map of elements on the surface of the material. The EDX will pinpoint the exact location that an element is found on the surface. The EDX produces a layered image that includes multiple elements and individual images.

Figure 4 - Layered EDX Image

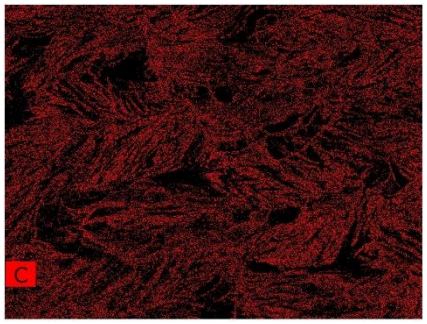

Figure 5 - Carbon EDX Image

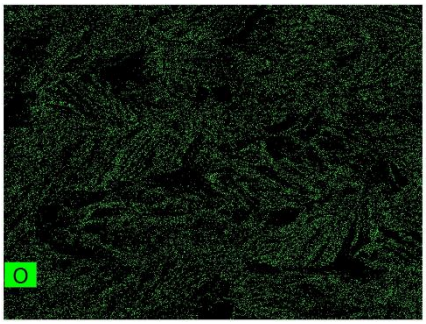

Figure 6 - Oxygen EDX Image

Figure 7 – Bromine EDX Image

Figure 8 - Phosphorus EDX Image

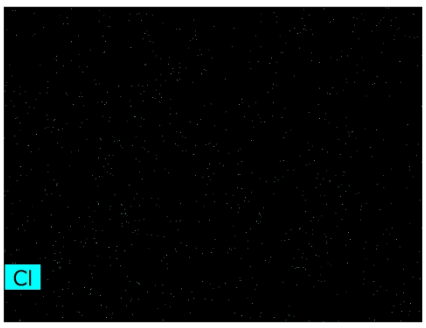

Figure 9 - Chlorine EDX Image

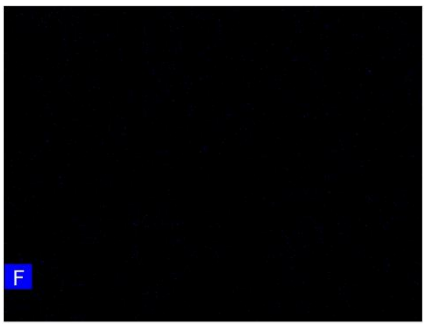

Figure 10 – Fluorine EDX Image

The EDX images here show that the only chemicals on the surface of this material are carbon and oxygen. There is no presence of the four chemicals of concern – bromine, chlorine, phosphorous, and fluorine.

Findings

The above analysis was performed three times for every material in the ClearTex® car seat including fabrics, nonwovens, foam, fills, and labels. Through this project, ClearTex® materials including fabrics, foams, and labels, were found to have no additional chemicals, including fire retardant and water- or stain-repellent chemicals.