

Siemens Competition

Math : Science : Technology

Regional Finalist

Names: Christin Abraham and Jeffrey Hurd

High School: Pelham Memorial High School

Mentor: Dr. Seongchan Pack

Project Title: *The Immobilization of Phosphorus-Based Flame Retardants using Halloysite Nanotubes* (Chemical Engineering)

Flame retardants are widely used in industrial and household products. Toxic additive flame retardants can be released into the environment and have been linked to thyroid cancer and other disorders. In this study, an environmentally friendly method for preventing the release of flame retardants into the environment was developed. Halloysite nanotubes (HNTs) were used to immobilize flame retardants, preventing their release into the environment. HNTs are naturally forming alumino-silicate clays with a hollow tubular shape. Previous studies have shown that HNTs can be loaded with molecules, and can control the absorption and release of those molecules. Untreated and commercially treated HNTs were used to determine the most effective type of nanotube for immobilization. Four phosphorus-based flame retardants were tested. Thermogravimetric analysis, gas and liquid chromatography, and infrared and ICP emission spectroscopy were used to analyze the effects of loading flame retardant into HNTs. Treated HNTs were most effective at immobilization. They had the greatest thermal stability, absorbed the most flame retardant, and also were least chemically reactive with flame retardants. This study has very wide applications, as HNTs loaded with flame retardants can be used in huge variety of polymers and products as a safe flame retardant alternative.