

Studies on environmentally friendly flame retardants for cellulose-based materials

Phytic acid is a naturally occurring compound found in the foods we eat, e.g. in nuts and cereals. It is the most important storage of phosphorus in plants, and phytic acid contains 28% phosphorus. Phosphorous compounds have proven to be effective flame retardants for cellulose-based materials such as wood and cotton, so phytic acid has the potential to be a non-toxic and environmentally friendly alternative to the flame retardants used today, which in many cases are hazardous to the environment and health. By mixing phytic acid with various common metal ions which are important nutrients for the body, the flame retarding properties can be modified.

Aim

In this project, chemical theories and analytical methods are used to systematically describe and evaluate the flame retarding properties of different phytic acid-based compounds at the molecular level. The materials studied are cotton and wood. The pure phytic acid compounds are studied as reference materials.

Methods

- Simple combustion tests.
- Thermogravimetric and calorimetric methods.
- Nuclear magnetic resonance in solid phase for carbon and phosphorus.
- Water solubility and moisture control.
- Small-scale samples are studied after heating to different temperatures.

Resultat

Phytic acid and its compounds with various metal ions have a flame retarding effect. The effectiveness of the flame retardant varies when different metal ions are added.

The different analytical methods provide supplementary information that can be combined into a description of the thermal degradation process at the molecular level and link it to macroscopic fire properties. Method development is useful for further studies also on more complex systems.

The mechanism is low-temperature charring, which leads to less combustible degradation products, polymerization of phosphate groups, and barrier formation that prevents contact between volatile substances and oxygen. An intumescent effect can also be seen. In addition to the final report, the results are also published in undergraduate theses and a scientific article. The results are of interest to the scientific community as well as to companies and organizations working for a fire-safe and sustainable living environment.

RESEARCH TEAM



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