42nd International SAMPE Symposium
May 4-8, 1997

NANOCOMPOSITES: A REVOLUTIONARY NEW FLAME RETARDANT APPROACH

Jeffrey W. Gilman*, Takashi Kashiwagi
National Institute of Standards and Technology
Gaithersburg, MD

Joseph D. Lichtenhan
Phillips Laboratory
Edwards Air Force Base, CA

ABSTRACT

To evaluate the feasibility of controlling polymer flammability via a nanocomposite approach, we have examined the flammability properties of nylon-6 clay nanocomposites. The fire retardant (FR) properties of this new class of materials, organic - inorganic nanocomposites, are reported. The Cone calorimeter data show that the peak heat release rate (HRR), the most important parameter for predicting fire hazard, is reduced by 63 % in a nylon-6 clay-nanocomposite containing a clay mass fraction of only 5 %. Not only is this a very efficient FR system but it does not have the usual drawbacks associated with other FR additives. That is, the physical properties are not degraded by the additive (clay), instead they are greatly improved. Furthermore, this system does not increase the carbon monoxide or soot produced during the combustion, as many commercial fire retardants do. The nanocomposite structure appears to enhance the performance of the char through reinforcement of the char layer. Indeed, transmission electron microscopy (TEM) of a section of the combustion char from the nylon-6 clay-nanocomposite (5 %) shows a multilayered silicate structure. This layer may act as an insulator and a mass transport barrier slowing the escape of the volatile products generated as the nylon-6 decomposes.

KEY WORDS: Nanocomposite, Flammability, Clay.

1. INTRODUCTION

In the pursuit of improved approaches to fire retarding polymers a wide variety of concerns must be addressed, in addition to the flammability issues. For commodity polymers the low cost of these materials requires that the fire retardant (FR) approach also be of low cost. This limits the solutions to the problem primarily to additive type approaches. These additives