A numerical model for the simulation of the vertical UL 94 test.

Julio Marti and Sergio Idelsohn

[*] Centre Internacional de Mètodes Numèrics en Enginyeria (CIMNE)
Universitat Politècnica de Catalunya (UPC)
Campus Norte UPC, 08034 Barcelona, Spain
e-mail: congreso@cimne.upc.edu, web page: http://www.cimne.upc.edu/

[†] Spanish Association for Numerical Methods in Engineering (SEMNI)
Edificio C1, Campus Norte UPC
Gran Capitán s/n, 08034 Barcelona, Spain
e-mail: semni@cimne.upc.edu, web page: http://www.semni.org

ABSTRACT

Polymeric materials, in particular thermoplastics, tend to melt and drip at elevated temperatures. In fire situations, these effects can lead to higher burning rates or remove the fuel and heat from the fire source. Predicting the fire behavior of these materials is usually done via a set of standardized test. The most important is the so-called “vertical UL 94 test” [1]. The numerical simulation could provide an important alternative to this costly experiment when testing new materials.

Computer modelling and simulation of this test is extremely complex involving several phenomena, such as fluid flow, heat transfer, material degradation, among other. In addition, the drastic changes in shape pose a severe challenge to traditional modelling methods.
In this paper, a new computational procedure for the modelling the fire behavior of polymers in the vertical UL 94 scenario is presented. The method models the polymer adopting the Particle Finite Element Method(PFEM) philosophy[2].The PFEM is a numerical method that uses a Finite Element mesh to discretize the physical domain and to integrate the differential governing equations. According to their density, initial acceleration and velocity, and subject to the force of gravity, the mesh nodes can move freely and can even separate from the main analysis domain, transporting their momentum and physical properties. A robust and efficient remeshing algorithm connects the nodes into a finite element mesh for solution of the state variables in the new configuration. An overview of the algorithm is given in [3].
The numerical results show that PFEM is a successful approach to model numerically the complex behaviour of polymers in the UL 94 test including the essential aspects of dripping, gasification and combustion in a qualitative as well as quantitative manner already. Nevertheless, advances regarding the determination of boundary conditions and material properties as a function of temperature are also needed to further improvement of the modelling[4].

REFERENCES

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