Possible Mechanism for Increasing the Fire Resistance of a Polymer Coating Filled with Diatomaceous Biosilica

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Polymer coatings are widely used in various fields of technology to protect the substrate from the negative effects of the atmosphere. Usually, coatings perform several functions, in particular thermal and fire protection. It was recently shown [1] that introduction of diatomaceous biosilica to the silicone polymer significantly improves the heat resistance of the protective film. According to our data, it also increases the fire resistance of the coating.

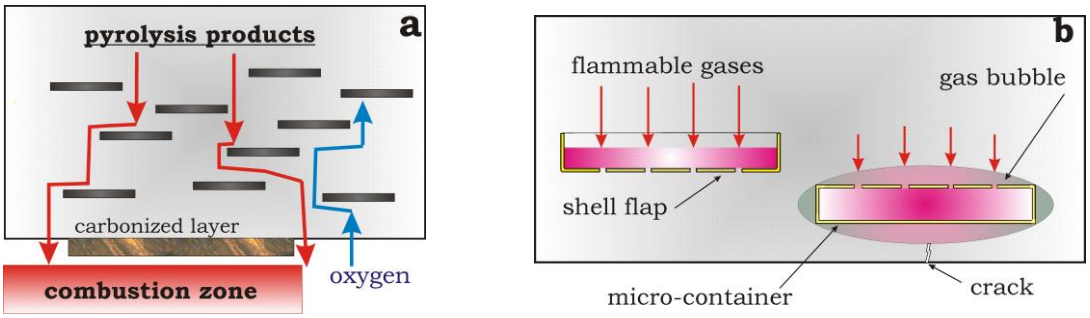

Fig. 1. Scheme of the barrier (a) and the proposed mechanism (b) of flame retardation

A known barrier mechanism for increasing the fire resistance of polymers is characteristic of fillers in the form of plates or scales. Flakes of the filler prevent the oxygen diffusion into polymer and hinder the transport of gaseous products of pyrolysis, see scheme in fig. 1a. Particles of diatomic biosilica (shells of algae) are micro-containers with a diameter of ~ 4 μm. Individual shell flaps, which are similar in shape to a Petri dish, are perforated with an ordered system of pores 150-200 nm in diameter. The filler serves as a natural sink for combustible decomposition products, as shown in Fig. 1b. If the average distance between the particles is less than the thickness of the sample, then the primary sink for combustible gases will be not the film surface, but the filler particles, which play the role of a flame retardant.

1. E. Olewnik-Kruszkowska, W. Brzozowska, A. Adamczyk, M Gierszewska, I Wojtczak and M. Sprynskyy. Energies **13** (2020), 5828.