

CHANGES IN FLAME RETARDANCY - THE DEVELOPMENT OF FLAME-RETARDANT, HALOGEN-FREE ADHESIVE TAPES

Introduction: Double-sided adhesive tapes are equal to viscous adhesives or mechanical connections in many ways. Consequently, pressure-sensitive tapes are becoming more and more important economically due to their easy application during assembly and the fast further processing of the joining partners. The flexible combination of carrier materials and the applied pressure-sensitive adhesive can also meet the mechanical requirements of a wide range of applications. For the areas of construction and transport, however, flame retardancy plays an additional role, since the normative and legal fire protection requirements must be fulfilled for approval. This is problematic in that the pressure-sensitive adhesives and carrier materials used are highly flammable polymers consisting mainly of aliphatic hydrocarbons. The technology required in order to still obtain approval, is therefore the use of various flame retardants. The halogens chlorine and bromine together with antimony trioxide as a synergist have repeatedly proven to be particularly suitable. However, these substances have all been criticised for their toxicological properties and poor recyclability and are therefore increasingly being substituted.

Problem definition: The flame retardancy of pressure sensitive adhesives is generally relatively difficult to achieve. In contrast to reactive adhesives, pressure sensitive adhesives for better fire protection cannot be formulated with common flame retardants or fillers without negatively affecting the balanced and required viscoelastic properties. Flame retardants, such as aluminum trihydrate (ATH), would have to be added in considerable quantities, which would greatly impair the mechanical and adhesive properties. As a consequence, halogen-containing flame retardants were largely resorted to in the past. In the event of fire, these act directly in the gas phase and lead to incomplete combustion, but also to high smoke generation and the formation of toxic gases. This limits the possible applications. Since the pressure sensitive adhesive usually only makes up a small proportion of the pressure sensitive adhesive tape, the flame retardancy of the backing material must also be taken into account in order to meet the fire protection requirements. This must also be compatible with the adhesive, since in the event of fire, despite the respective flame-retardant design, the two components can interact and thus lead to undesired fire behaviour of the resulting pressure-sensitive adhesive tape as a whole.

Implementation with VITO: Recycling management and sustainability are no passing fancy for VITO as a processor of renewable raw materials. For example, we have already been able to realise the Cradle to Cradle (C2C) certified sealing adhesive tape Vitolen 111 FR-B on behalf of a customer, with which both the "Silver" certification level has been achieved and through which halogenated flame retardants can also be avoided. In the course of the project, the use of phosphorous-containing additives in pressure-sensitive adhesives was also evaluated as a promising alternative. In the event of fire, these form a phosphate-based barrier layer on the polymer matrix and cause less smoke development [1, 2]. Optimally, the mechanical and adhesive properties are not strongly influenced, since these additives for fire protection only need to be added in very small amounts to the pressure sensitive adhesive. Appropriately modified adhesives were tested in combination with suitable carrier materials, and the two adhesive films Vitocoll 132A07FR and Vitocoll 132R13FR were successfully realised in this way. As a medium-sized company, VITO is also participating in the AiF research project "Simplified methods for estimating the fire behaviour of pressure-sensitive adhesive tapes and pressure-sensitive adhesive joints (Klebeb(r)and)" and is contributing its accumulated experience.

Conclusion: The halogen-free design of flame-retardant pressure-sensitive adhesive tapes can be realized by using phosphorous-containing flame retardants. Even demanding applications with increased fire protection requirements for safety-relevant bondings in construction and transport can be realized with these modified pressure sensitive tapes.

Bibliography:

- [1] M.M. Velencoso, A. Battig, J.C. Markwart, B. Schartel, F.R. Wurm, *Angew. Chem. Int. Ed.* 57 (2018) 10450-10467, Molecular Firefighting – How Modern Phosphorus Chemistry Can Help Solve the Flame Retardancy Task
- [2] B. Schartel, *Materials* 3 (2010) 4710-4745, Phosphorus-based Flame Retardancy Mechanisms – Old Hat or a Starting Point for Future Development?