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Compounding of flame retarded materials for the wire and cable industry

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Abstract: Flame retardant compounds are costly materials that must be consistent in performance and reproducible in behaviour. The cable maker requires a compound that is readily extrudable and meets requirements on cable. This paper reviews the role of the compounding operation and its importance for well dispersed, highly performing flame retardant compounds.

Keywords: Compounding, flame retardant, dispersion

1. Introduction

The use of flame retarded compounds in wire and cable applications continues to grow at a regular and steady pace. These products can be based on a number of polymers and a diverse and varied range of formulations. The flame retarded wire and cable compound will typically call for a blend of characteristics, the most important of which are: FR properties, mechanical and electrical properties. Unfortunately these properties tend to be competitive rather than complementary and therefore present the formulator with an interesting challenge.

Development of a flame retardant compound requires formulating skill in order to address and meet these competing property requirements. However, between formulating and conversion onto cable lies the extremely important step of mixing and compounding.

Compounding of flame retardant insulation and jacket formulations can require the addition and homogenisation of a large number of additives, some at high and even extremely high filler levels. Without accurate addition and efficient mixing the product can easily fail in one or more of its performance properties. The wire and cable industry needs both versatile and continuous processes for optimum dispersion and reproducible performance of flame retardant materials. For overall compound properties and ease of cable extrusion the compounding step can provide the key to success.

Résumé: Les produits retardateurs de flamme sont des produits onéreux qui doivent avoir des performances constantes et des comportements reproductibles. Le fabricant du câble requiert un produit qui soit à la fois facilement extrudable et qui satisfasse aux spécifications du câble. Cette présentation passe en revue le rôle de l'opération de compoundage ainsi que son importance pour des mélanges retardateurs de flamme bien homogènes et hautement performants.

Mots clés: Produits ignifuges, compoundage, dispersion

2. Background

The majority of polymers used in the cable industry will by themselves burn. It is therefore necessary to incorporate flame retardants in order to impart the required degree of protection. A number of routes are available each depending on a different chemistry and mode of action. They are summarised in Table 1.

Table 1. Flame retardant types and mode of action

Type	Mode of action
Halogens Including halogen/antimony synergies	Radical scavenger
Metal hydroxides	Quenching
N containing P containing (polyphosphates) Elemental P	Intumescence
Nanofiller	Char forming and reduced heat release

However a competing performance matrix exists, Fig 1, that makes the life of the development chemist extremely challenging (1-5). By adding high levels of filler to the polymer, most of the other desired features, mechanical, physical and electrical properties of the compound will suffer.