

Formula and preparation of special rubber sheath material for Rolling Stock Cables

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ABSTRACT

Rolling stock cables are widely used in bus, locomotive, subway, city track, high-speed railway and D-train, etc. to provide power, control, signal and communication. Due to the special working condition for railway vehicles, Rolling stock cables are required to be small, light, low-temperature resistant, oil resistant, abrasion resistant, water resistant, acid and base resistant, chemical resistant, soft, halogen free, flame retardant, low release of smoke, low toxicity of smoke, etc. The sheath material has been the development bottleneck for Rolling stock cables, especially softer rubber sheath materials. The research object of this article is 'EM104' from the Euro-standard 'EN50264-2008'. In this article, different formula systems are designed, and the torque rheometer made by Barbender from Germany are used to study rubber processing and performance characteristics. Sheath material that fully meets the standard requirements is produced by adjusting and optimizing the formula. Using fully automatic adjuvant feeding and mixer system, the rubber is mixed and molded. Then the power cable is fabricated on the equipment made by Maillefer from Finland. The power cable is tested by the testing center and its performance fully meets the standard requirement. In addition, this article also studies EVM Compound Rubber System with different contents of VA, and the synergistic flame retardant effect of aluminum hydroxide-magnesium hydroxide mixture. Therefore, the optimal ratio of base rubber and the optimal dosage of flame retardant are determined. Based on the research, when the ratio of VA is 70:20:10; meanwhile the ratio of the flame retardant is 100:60:18, the oil resistance, flame retardance and low-temperature resistance reach the optimum.

KEYWORDS

Railway Cable; EM104; Formula System for Rubber; VA Content; Synergistic Flame Retardance

INTRODUCTION

Rolling stock cables are widely used in fields such as bus, locomotive, subway, city track, high-speed railway and D-train. Usually Rolling stock cables use LSZH (Low Smoke Zero Halogen) material to satisfy their special working environment.[1-3] Sheath material in EM104 from Euro-standard EN505264-2008 is the key material for research

and development among all materials from the standard. To develop this material, the following key technologies need to be solved.

- The balance between oil resistance and low-temperature resistance. Environmental requirements from EM104 are very exacting, and they ask for high oil resistance (mineral oil, fuel oil) and relatively high low-temperature resistance at the same time. To achieve a balance between oil resistance and low-temperature resistance using EVM rubber with different VA contents is the difficult point for developing this mixed rubber.
- Halogen free and flame retardant materials are required to prevent fire and pass the toxicity index test according to the standard. This can only be achieved by the addition of large amount of inorganic flame retardants, which, however, will significantly reduce the mechanical performance of the material. Therefore, achieving the balance between mechanical performance and flame retardant performance becomes the key point for formula development.
- The balance between flame retardance and low-temperature resistance. After the base material is chosen, the only way to further improve the low-temperature resistance of the material is to add cold-resistant plasticizer, which, however, has negative effects on the flame-retardant performance of the material. To find this equilibrium point is another key point for this formula.

To solve the problems mentioned above, this section studies the selection of the base material for rubber, blending, selection of fire retardants, synergistic effect study and the selection of plasticizer, etc. Through research, the best ratio is found to meet all the performance requirements for sheath material in EM104 for EN50264-2008.