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### Study on low-smoke low-halogen and flame retardant PVC sheath composite

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**Abstract:** The effects of  $\text{Al}(\text{OH})_3$  and epoxy Soybean oil on smoke density, mechanical and physical properties, discharge of HCl, and heat stability of PVC sheath materials are studied in this paper. The experimental results indicate that  $\text{Al}(\text{OH})_3$

and epoxy Soybean oil with proper content can decrease the discharge of HCl and the smoke of the material system.

**Keywords:** Low-halogen, Low-smoke, PVC sheath composite

## 1. Introduction

Usually, traditional flame-retardant cables adopt PVC to be sheath material, but PVC can discharge a vast amount of poisonous corrosive halogen hydrogen gas and smoke, which is greatly harmful to the environment and human's body. Therefore, the discharge of HCl and smoke must be decreased during the combustion of PVC. In this article,  $\text{Al}(\text{OH})_3$  and different kinds of plasticizer are studied to figure out how they influence on smoke density, mechanical and physical properties, discharge of HCl and heat stability in PVC sheath material. Experiments show that adding  $\text{Al}(\text{OH})_3$  and plasticizer at a proper ratio can decrease the discharge of HCl and smoke. A PVC sheath composite with good synthetically performance, whose smoke density is 233 and content of HCl is 8.24, is found in this paper. Considering the abundant resource and low-price of PVC, this product has higher economic and social benefit in our country.

## 2. Experimental

### 2.1 Material:

The materials used for preparing samples are polyvinyl chloride (PVC) S-1300, Dioctyl Phthalate (DOP), assist plasticizer (epoxy Soybean oil), aluminum hydroxide ( $\text{Al}(\text{OH})_3$ ), and composite heat stabilizer made by authors, respectively.

### 2.2 Preparation of samples:

All kinds of materials at a content ratio were mixed, then put in a double roll plasticator and plasticated at

150°C for 15 minutes. Then a slice of the plasticated material was pressed in a mould on plate vulcanizer at 165°C for 5-10 minutes and cooled under pressure. According to demand of measurement, the different thickness of the samples was pressed.

### 2.3 Measurement:

The specific optical density was measured in NBS smoke chamber on the basis of ASTM E662. The discharge of HCl was measured by Inning charge of tube type oven on the basis of state standard GB17650.1. The tensile strength of samples was measured on a tensile test machine of model INSTRON-TSK at a tensile speed of 250 mm/min.

## 3. Results and Discussion

### 3.1 Effects of $\text{Al}(\text{OH})_3$ on smoke density and discharge of HCl.

$\text{Al}(\text{OH})_3$  is a main component for producing the low-smoke and non-halogen material at present, due to its efficiency of flame-retardant and smoke suppression function. While  $\text{CaCO}_3$  in low-smoke low-halogen PVC sheath material can absorb the HCl as well as decrease the smoke-releasing amount. In this article, we try to put  $\text{Al}(\text{OH})_3$  instead of  $\text{CaCO}_3$  in the formulation of low-smoke low-halogen material to gain the same flame and smoke retardant effect.

When the PVC containing 20~30phr  $\text{Al}(\text{OH})_3$ , the small discharge of HCl and smoke in the composite are shown in table I. This is caused by that heating will decompose  $\text{Al}(\text{OH})_3$  to be  $\text{Al}_2\text{O}_3$  and  $\text{H}_2\text{O}$ . The endothermic reaction of  $\text{Al}(\text{OH})_3$  may decrease the temperature and the water steam may dilute the