Abstract: The properties of rubber (Chloroprene Rubber) can be improved by adding nanomaterials for the special effects expressed on the nanoparticles. This paper focuses on the mechanical, sulfuration and dielectric properties of the rubber by adding three kinds of nanoparticles (nano-Al₂O₃, nano-SiO₂ and nano-ZnO). The tests show that the properties of the base rubber change dissimilarly according to adding different kind or content of the nanoparticles. In conclusion, the tear strength and plasticity of the rubber are increased by adding the three kinds of nanoparticles. The sulfuration property of the rubber with nano-ZnO is not the same to that of the rubbers with other two nanoparticles. The deterioration of dielectric properties has not been found. In some nanoparticles content, $p_o$ of the composites are improved clearly and tanδ get reduced.

Keyword: nanomaterials, cable, mechanical property, dielectric property

1. Introduction

The particles of the dimension between 1 nm and 100 nm have special properties, which are neither the same as the microcosmic scale nor as the macroscopical scale (atom or molecule dimension), because of their surface effect, small dimension effect, and quantum dimension effect and macroscopic quantum tunneling effect [1]. These kinds of particles are on the mesoscope state. When the dimension of any materials reduces to the mesoscope scale, they will behave special optical, electrical, mechanical and thermal properties. After particles of such dimension are compounded with macroscopical materials, the new composites will also behave many special performances [2-4]. The former study shows that when proper nano-SiO₂ particles are put into epoxy resin, the composite will be improved both at mechanical intensity and ductility without deterioration of electrical performances [3]. The common insulating and jacket rubber of the rubber cables is not perfect at flexural strength and impact strength, which directly influence the life of the cable. Through the method of compounding nanoparticles with rubber to improve the mechanical performances of it, we can increase the life of rubber cable.

2. Raw Materials and Sample Preparation

2.1 Main Materials and Recipe

Chloroprene Rubber, Type CR322; Nano-SiO₂ (Particle diameter is 10nm, radio surface area is 640±50m²/g); Nano-ZnO (Particle diameter is 20nm, ratio of surface area is 50m²/g); Nano-Al₂O₃ (Particle diameter is 15±5nm, ratio of surface area is 130±10m²/g).

The sulfuration recipe of rubber: In every 100 chloroprene rubber, add 9 sulfuration (5 ZnO, 4 MgO, particle dimension is in micron level), 2.8 accelerator, 11 soft agent, 2.5 anti-aging agent, 25 SiO₂.

2.2 Preparation Method

The common methods for the preparation of composite with nanoparticles and rubber are as follow:

1. Direct Mixture Method: Before mix the raw rubber, compound the nanoparticles with other agents directly and mix them evenly. Then put them into the rubber step by step, make the nanoparticles dispersive in the