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Study on Ignition Capability of Overloaded Wire to the Wool Fabric

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Abstract

In order to check the overloaded wire's ignition capability to the wool fabric, different multiples overloaded current were selected as the main parameter, and meanwhile, the thickness of the wool fabric and the contact way were considered as well in this study. Moreover, the temperature's rising law and the ignition of the wool fabric under different ignition conditions were obtained. The result showed that the thicker the wool fabric, the more susceptible to be ignited. It also has been found that it takes shorter time to be ignited when the overloaded current is greater and the contact way is wrapping. The conclusion of this paper would provide guidance for investigation on fires related with overloaded wire and the wool fabric.

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Keywords: o*verloaded wire; wool fabric; ignition capability; temperature*

1. Introduction

In the recent years, with the continuous improvement of economic level and the updating of science and technology, an increasing number new high-power electrical appliances are used in people's daily life, which makes the electricity consumption of per person increase and causes more fire hidden dangers [1-2]. According to the statistics, the amount of electrical fire in China accounted for about 30 % of the total number of fire recently. Electrical wires can become involved in a fire in two different ways. They may be subjected to either an external heat source or internal heating. Overloaded current may transform electric energy of conductor into thermal energy. Therefore, the internal temperature rise could be due to resistance heat of the conductor caused by a current overload incident [3]. Among the numerous events of electrical wires fire, because of the big scope and long time, the electric circuit overloaded becomes one of the most dangerous causes. The copper wires may come into contact with the fabric items in different laying modes. Previous researchers mainly focused on the fire prevention of overloaded wire, microscopic characteristics of the wire and the mechanism of fire [4-6]. However, little attention was paid on its ignition capability [7-8]. Whether overloaded wire can ignite the items, and what these items' characteristic appearances are after the ignition are very important for fire investigation. This article selected the wool fabric as burned material and simulated the situation that the overloaded wire ignited the wool fabric under different conditions. The ignition temperature, its morphology characteristics, as well as the ignition condition of overloaded wire to the wool fabric were obtained through the experiment to study. The conclusions can offer help for preventing the fire caused by the wool fabric.

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2. Experiment

2.1. Materials and equipment

Material: BV copper wire (cross-section of 2.5 mm^2), wool fabric (20 cm×20 cm), film, several pieces of board

Equipment: Fire traces comprehensive test-bed, TES-313 point thermometer, stopwatch, wire stripping pliers, video capture device

2.2. Experimental procedure

The copper wire was cut into around 30 cm long, the insulation skin of the wire was off by 4 cm from both ends. At one end, the wire was fixed on the fire traces comprehensive test-bed; at the other end, the wire was clamped by the electric welding machine. Sticking the point thermometer with tape on the wool fabric closely, we can monitor the temperature in experiments. In this experiment, the rated current of the BV copper wire at 30 ℃ is 30 A. The temperature and state of the material were obtained by passing through different multiples overloaded currents (2 *Ie*,3 *Ie*,4 *Ie*). With the increasing of distance from the wire to wool fabric (0 cm, 1 cm) and varying of thickness, the materials were placed in wrapping and unfolding modes. All the experiment process was recorded by the video capture device. A simple diagram of the experimental set-up is shown in Fig.1.

Each experiment will not terminate until it reaches the equilibrium time, unless a naked flame has occurred, in which case the test is terminated at that time. Here, the equilibrium temperature means the temperature obtained by the thermometer in the process of temperature rising when the temperature changing rate (the value of temperature change in one unit of time) comes nearly to zero.

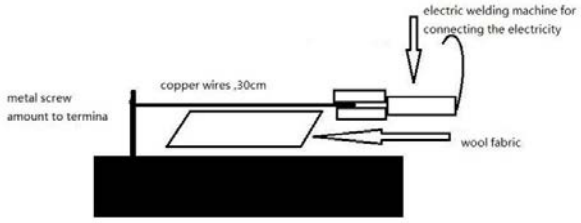

Figure.1. Outline of the experimental set-up with the sample

3. Results and discussion

3.1. Ignition capability of overloaded wire to the wool fabric under different overload current

Table1. Ignition results of the wool fabric under different overload current

Overloaded current	Maximum temperature/℃	Time to reach the highest temperature/s	Ignition condition
60A	174	660	Some wool fabric burned black.
90A	358	120	Wool fabric wrapped tightly on the outside of the conductor. Stiff touching. Wool fabric has serious carbonation without naked flame.
120A	410	44	Flame. Some became ashing after experiment.