THE ANTI-ICY EFFECT ON INSULATORS BASING ON THE HYDROPHOBICITY AND HEATING EFFECT OF SEMICONDUCTIVE RTV COATING

Li Yan[1], Sun Zhenting[2], Jia Zhidong[2], Zhao Yuming[1] and Li Xiaolin [1]
1.Technology Research Centre, China Southern Power Grid Co., Ltd., Guangzhou, China
2.Laboratory of Advanced Technology of Electrical Engineering and Energy, Graduate School at Shenzhen Tsinghua University, Shenzhen, China

Abstract: This paper mainly studied the relations between low temperature and HTV and RTV. Meanwhile in this paper we came up with a new method to prevent ice forming on the insulators.

1. INTRODUCTION

There are many factors that can influence the hydrophbicity of HTV and RTV. In this paper we show a method under the conditions of laboratory which got rid of the other factors in order to show the relations between low temperature and hydrophobicity. We also came up with an manner to prevent the ice forming. Coat the insulator with the semiconductive RTV to increase the leak current of the insulator surface appropriately. Combine the heat of the current and the hydrophobicity of RTV will make effect on anti-icing of the insulator.

2. RESULTS AND DISCUSSION

Some HTV pieces and glass pieces coated RTV were chosen as samples. The pieces were put into the set box after they had migrated fully. Then dropped a water-drop and took photos of the pieces every 12 or 24 hours and then measured the hydrophobic angle of the water- drop with a special soft.

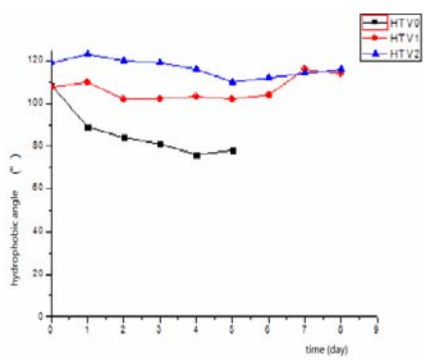

Figure 1: the hydrophobicity of HTV at -18℃

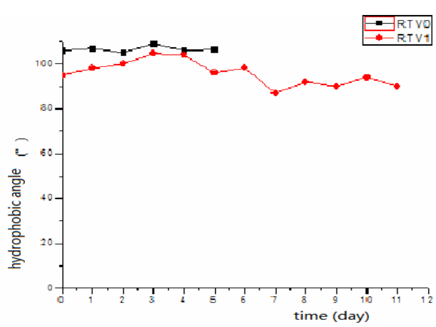

Figure 4: the hydrophobicity of RTV at -18℃

We can see that the hydrophobic angle of HTV and RTV pieces both declined slightly at low temperature. The former dropped more. But there were no sign showed that the hydrophobicity would lose absolutely even at -18℃.

The string of insulators in Figure 3 were coated with semiconductive RTV. It was put into the freezing room whose temperature was about -7℃. The water sparied was 0℃ which was the same with the natural freezing rain.

Figure 3: the shape of the water-drop on the surface of the insulator

we can see the shape of the water-drop, which illustrated that it surface still had well hydrophobiciy. And there was no ice on the insulator. It says that this method is effect.

3. CONCLUSION

Only in cold condition and there are no other nature factors, the hydrophobicity of HTV and RTV can maintain very well even at very low temperature. Thus we cannot say that low temperature will cause the loss of the hydrophobicity.

Because of well hydrophobicity, semiconductive RTV can be used on anti-icing of the insulator. Meanwhile due to the leak current, the temperature of the insulator surface can maintain above 0℃. One hand it can prevent the ice forming, the other it can also raise the hydrophobicity to make the water-drop backfall easy.

4. REFERENCES

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Li Yan, Zhao Yuming, Li Xiaolin
Technology Research Centre
China Southern Power Grid Co., Ltd., Guangzhou, China

Sun Zhenting, Jia Zhidong
Laboratory of Advanced Technology of Electrical Engineering and Energy
Graduate School at Shenzhen Tsinghua University
Shenzhen, China

ABSTRACT

The hydrophobicity of silicone rubber has been used in anti-icing, but the result is not good. In this paper we do some research on the mechanism of ice covering under laboratory conditions. This paper explores the hydrophobicity nature of HTV (high temperature vulcanized silicone rubber) and RTV (room temperature vulcanized silicone rubber) in the low temperature excluding many interference factors in the nature. Finding that in low temperature silicone rubber can still maintain good hydrophobicity, rather than losing it. The reason why insulator ice flash occurs is the icing connection between insulators. Basing on the research above , this paper puts forward a fundamentally anti-icing method, which uses an appropriate semiconductive coating to control the leakage current of insulator surface, so that the temperature of insulator surface in freezing rain can still maintain at zero ℃ or above, and thus prevent or minimize icing covered in the surface in order to achieve good results Ice Flashover.

Keywords*：*Silicone Rubber*； *Low Temperature*； *Hydrophobicity*；*anti-icing*；*Leakage Current

I. INTRODUCTION

Though many facts and research have shown that under low temperature condition the hydrophobicity of HTV insulator will decline or even disappear absolutely, we cannot simply conclude that low temperature is right the cause. Because all these experiments are carried under the natural conditions, so there are many other factors that can influence the results. In this paper we show a method under the conditions of laboratory which gets rid of the other factors in order to show the relations between low temperature and hydrophobicity.

The hydrophobicity of RTV has been used to prevent icing, but the result is not very good. Basing on the hydrophbicity experiments above we come up with an manner to prevent the ice forming. That is coat the insulator with the semiconductive RTV to increase the leak current of the insulator surface appropriately. Combine the heat of the current and the hydrophobicity of RTV will make effect on anti-icing of the insulator.

II. EXPERIMENT ON THE HYDROPHOBICITY OF HTV AND RTV UNDER LOW TEMPERATURE

The experiments were carried in a box whose temperature and humidity was constant to avoid the influence of other factors. The humidity was set at 30％. Because 0℃ is freezing point, the temperature was set at 0℃. At the same time, some samples were experimented at -18℃ to make to results more persuasive.

Some HTV pieces and glass pieces coated RTV were chosen as samples, whose sizes were all 10cm×10cm. These pieces were coated with contaminant some of which contained salt and diatomite and some salt and kaolin. The pieces were put into the set box after they had migrated fully. Then dropped a water-drop and took photos of the pieces every 12 or 24 hours and then measured the hydrophobic angle of the water- drop with a special soft. Every piece were measured 9 different points one time to acquire the average value.

A. Experiment on HTV

The temperature was set at -18℃. The surface of HTV0 was clean. HTV1 was coated with contaminant contained diatomite and 0.2mg/cm2 Nacl.HTV2 was the same with HTV1, but it had more diatomite. The results are shown in Figure 1.

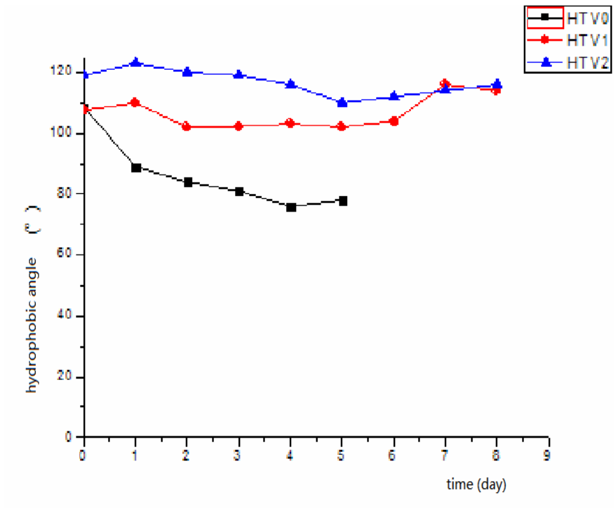

Figure 1： the hydrophobicity of HTV at -18℃

B. Experiment on RTV

The experiments on RTV were carried under different conditions. The piece shown in Figure 2 was coated with contaminant contained diatomite and 0.2mg/cm2 Nacl at 0℃.

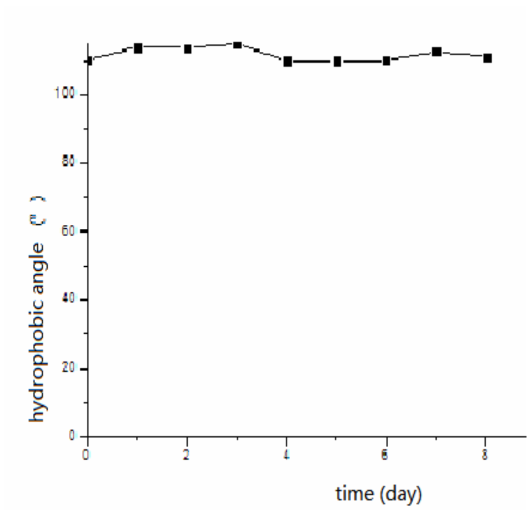

Figure 2： the hydrophobicity of RTV at 0℃

The piece shown in Figure 3 was coated with contaminant contained diatomite and 0.2mg/cm2 Nacl at -18℃.

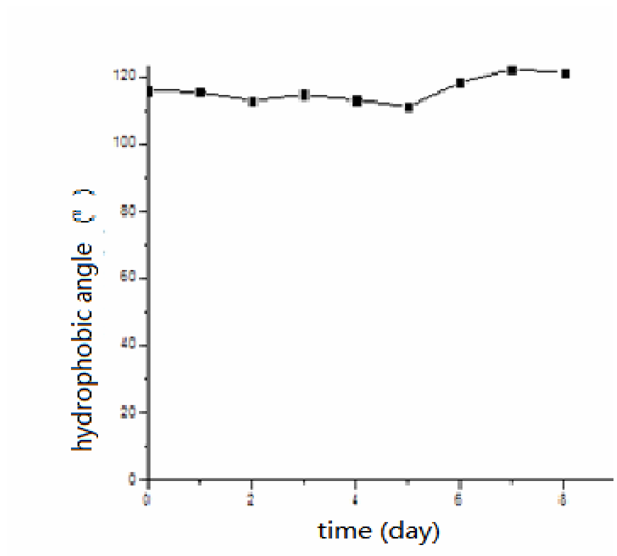

Figure 3： the hydrophobicity of RTV at -18℃

The two pieces shown in Figure 4 were at -18℃. RTV0 was clean, and RTV1 was coated with contaminant contained 0.2mg/cm2 Nacl and kaolin.

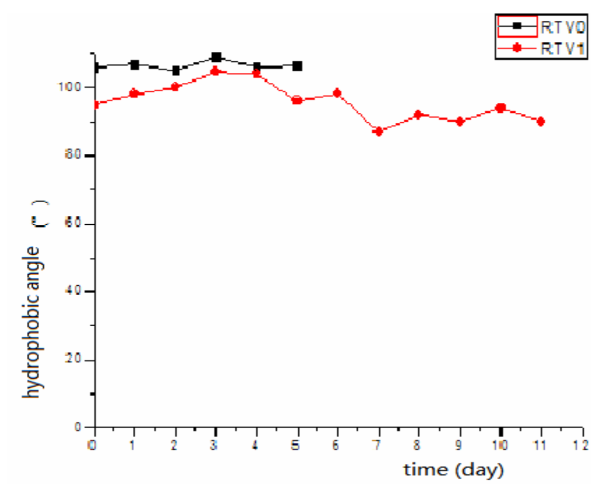

Figure 4： the hydrophobicity of RTV at -18℃

C. Discussion on the influence of the low temperature

From the figures shown above, we can see that the hydrophobic angle of HTV and RTV pieces both declined slightly at low temperature. The former dropped more. But there were no sign showed that the hydrophobicity would lose absolutely even at -18℃. To the contrary, some pieces recover the hydrophobicity after some time. And from Figure 4 we also can get that even coated with kaolin which is hydrophilic the RTV piece was still hydrophobic.

So we can conclude that the hydrophobicity of HTV and RTV will not lose at low temperature condition. It might drop slightly in some range at most. RTV is better than HTV when come to the hydrophobicity. So it may contribute to the anti-icing of the insulator.

III. RESEARCH ON THE ANTI-ICING OF INSULATOR BASING ON THE SEMICONDUCTIVEIVE RTV

Because of high hydrophobicity especial in cold condition, RTV could be used to prevent the ice forming on the surface of the insulator. At the same time add some conductive material into the common RTV to make it semiconductive. So there will be some leak current across the surface of the insulator, which can enhance the temperature to maintain its well hydrophobicity. This is the first way of the experiment like the figure shown below.

A. The first way

The string of insulators in Figure 5 were coated with semiconductive RTV. It was put into the freezing room whose temperature was about -7℃. The water sparied was 0 ℃ which was the same with the natural freezing rain.

Figure 5： the result after freezing 3 hours

We can see that there was no ice on the insulators 3 hours later. It is say that this way can prevent the ice forming indeed. But some apparent discharging trace can be seen under the insulator piece which could cause flashover if on line. At the same time it would increase the wastage. To solve this problem we find a second way.

B. The second way

The upper surface of the insulator was coated with common RTV which was not conductive and the underneath coated with the semiconductive RTV. Thus when had no rain the surface of the insulator had no leak current. When the upper surface was covered with ice there would be leak current which was the same with the first way.

Figure 6： the result after freezing 2 hours

There was only some small ice column at the edge and no ice on the upper saface shown like Figure 7 below.

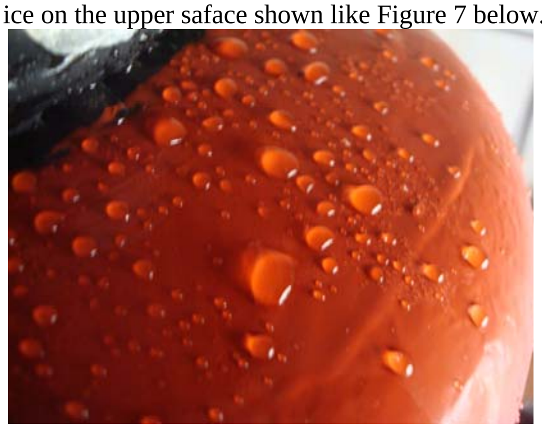

Figure 7 ： the shape of the water-drop on the surface of the insulator

From figure 7 we can see the shape of the water-drop, which illustrated that it surface still had well hydrophobiciy.

C. Discussion on this anti-icing method

The experiments prove that RTV can maintain well hydrophobicity in cold condition. So it can prevent the ice forming because of the hydrophobicity and the heat effect. If combine the common RTV and the semiconductive RTV we can both cut down the loss and get a not bad anti-icing effect. But the key problem is to find a proper leak current to make it more practical.

IV. CONCLUSIONS

The following conclusions are derived from the former study and experiments.

The statement that low temperature will cause the loss of the hydrophobicity of HTV and RTV is not exact. If in lab condition the hydrophobicity can maintain very well even at very low temperature. Thus only in cold condition the hydrophobicity will not lose.

Because of well hydrophobicity, semiconductive RTV can be used on anti-icing of the insulator. Meanwhile due to the leak current, the temperature of the insulator surface can maintain above 0℃. One hand it can prevent the ice forming, the other it can also raise the hydrophobicity to make the water-drop backfall easy. To reduce the wastage, combine the common RTV and semiconductive RTV will get better effect.

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