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## **ОБЛЕДЕНЕНИЕ КОНТАКТНОЙ СЕТИ ЖЕЛЕЗНЫХ ДОРОГ (ВОЗДУШНЫХ ПРОВОДОВ): АНАЛИЗ ОПЫТА РОССИЙСКИХ И ЗАРУБЕЖНЫХ УЧЕНЫХ**

*Аннотация.* В статье рассматривается проблема обледенения контактной сети железных дорог. Автор анализирует российский и китайский опыт, представляет традиционные методы, используемые в России (механические, химические, электрические), и описывает китайский эксперимент в этой области. Новое оборудование было установлено на Ростовском отделении Северо-Кавказской железной дороги. Это позволяет получать необходимые данные об окружающей среде и изменениях веса контактной подвески, а также иметь инструменты для предотвращения обрыва контактного провода.

**Ключевые слова:** железнодорожная контактная сеть, обледенение, оборудование, механическое, электрическое, обрыв контактного провода, Северо-Кавказская железная дорога.

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## **ICING OF THE RAILWAY CONTACT NETWORK (OVERHEAD WIRES): RUSSIAN AND FOREIGN SCIENTISTS EXPERIENCE ANALYSIS**

***Annotation.** The paper deals with the problem of railway contact network icing. The author analyses Russian and Chinese experience, presents the traditional methods using in Russia (mechanical, chemical, electrical) and describes the Chinese experiment in this field. The new equipment was installed on the Rostov branch of the North Caucasus railway. It allows to obtain the necessary environmental data and changes in the weight of the contact suspension and to have tools to prevent breakage of the contact wire.*

***Key words:** railway contact network, icing, equipment, mechanical, electrical, breakage of the contact wire, the North Caucasus railway.*

**Introduction.** The problem of the contact network icing is relevant for many countries, especially with a harsh humid climate. Ice on the contact network can lead to big problems: increased wire tension, deformation of the middle anchor clip, the appearance of an electric arc that can burn the contact wire and the pantograph trains, electrical breakdown of insulation, breakage of the contact wire, and most importantly - to the destruction of structures and large economic costs for repairs. This problem is studied by many Russian and foreign scientists: M. A. Trubitsin[1], Liu Heyun [6], T. W. Brakel , J. P. F. Charpin, T. G. Myers[4], Belyev[5] and many others.

This topic is being developed at the Department of "Automated power supply systems" at Power engineering Faculty of Rostov State Transport University.

### **The purpose, Concept, Material.**

The purpose of our research is to study an important problem - icing of the contact network of railway on the base of Russian and Chinese experience.

Icing is the process of forming ice on the surfaces of various objects and buildings at low temperatures and high humidity. However, there are not so many works devoted to the study of icing contact wires of railways, but this issue is becoming more relevant every day due to the development of high-speed traffic.

### **Literature Review.**

There are various methods for removing ice [1, 2, 3]:

1. Mechanical;
2. Chemical;
3. Electrical.

1.1 Mechanical removal of ice is performed promptly by repair personnel and electric locomotives with a vibrating pantograph, which provides knocking down ice from the wires. These methods are inconvenient because of manual activity and time for this activity. It leads to disruption of the normal operation of the railway section due to the need for equipment and personnel.

1.2 Under the chemical method special de-icing agents are used, waterproof and antifreeze lubricants to prevent icing if other methods of removing ice are not possible.

1.3 The electrical method is the method when removing ice is carried out by heating the wires with an electric current, which prevents the formation of ice. It should be noted that the scientists of the Rostov State Transport University emphasize that there are still no effective and universal ways and methods of dealing with ice deposits on contact wires in the world [1].

Chinese scientists conducted an experiment on icing and melting on contact wires. The entire experiment was conducted in an artificial environment chamber.

Using a special tube with a solution, the desired temperature was maintained during the experiment. In the plexiglass section, three wires with the same dimensions were placed: one real CTS120 contact wire, and the other two cylindrical ones. In this experiment, the influence of wind speed, temperature, and liquid water content on the process of icing and melting of ice was studied. After conducting the experiment, the main conclusions were made:

1) wind speed has a significant effect on icing, and the higher the wind speed, the greater the ice density will be;

2) air temperature increasing leads to an increase of the density of ice, but it reduces its thickness [6].

**Discussion.** Analysis of the literature, theoretical and practical experience have demonstrated the difference in methods and ways of icing removing. If the Russian authors emphasize the lack of a universal method and continue to search for solutions to the problem depending on the type of contact network (AC / DC), the Chinese scientists offer bench experimental models. But both Russian and Chinese Scientists stress such factors as: wind speed, thickness and density of ice cover, kind of contact net (AC or DC), type of climate conditions, railway infrastructure (tunnels or open air).

**Results.** On one of the main sections of the Rostov branch of the North Caucasus railway, a set of equipment was installed (in the area where there was an intensive wind impact), which allows to obtain the necessary environmental data and changes in the weight of the contact suspension [1]. These tools help to protect wires from breakage.

As mentioned above, icing of wires is a very serious problem. Large resources are allocated to fix the problem if the contact network is damaged. Therefore the main task at the moment is to analyze all methods and identify a new more effective way to eliminate icing taking into account all the climatic features of definite country's regions.

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