# Prediction of Insulation Resistance of Mining Electrical Equipment as a Method of Increasing its Safe Operation

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**ABSTRACT**

Ensuring the safe operation of electrical equipment in networks with isolated neutral during underground mining of coal mines achieved by the use of protection devices against leakage currents in underground power supply systems. Leakage protection devices (relays) monitor the insulation resistance of the mine electrical networks and initiate a fairly quick disconnection of the power receivers or part of the network from the voltage source when a person touches one phase, an electric network element or an electrical installation case, if this happened due to mechanical damage or a decrease in the resistance level isolation below the critical (set) value. The value of the insulation resistance of the elements of the electrical network changes during operation depending on the operating modes of the mechanisms (vibration, load), environmental parameters (temperature, humidity, aggressive fumes, coal dust). The approach of the value of insulation resistance to the value specified by the condition for the safety of maintenance personnel occurs at different speeds, and with a rapid change in insulation resistance, the operation of the protective device can occur with delay and go beyond the limits stipulated by the regulations. In this case, the touch of a person to an element that is energized leads to increased danger to him. It is possible to increase the safety of work and the efficiency of the operation of mining equipment by using a system for monitoring and predicting insulation resistance. This will allow us to timely identify the network section where there is a tendency to damage the insulation and restore the insulation resistance of the network during the scheduled repair, before an emergency occurs, which will reduce the likelihood of an electrical hazard and reduce the damage from a decrease in coal production [1]. The solution to the problem of timely detection of insulation defects can be done by continuously diagnosing the state of electrical equipment wiht intelligent nodes with the ability to predict its change [2]. Existing methods for measuring insulation resistance have a fairly high accuracy in determining the location of a defect, but they require stopping the electrical equipment and lead to loss of productivity of the production line.

In this work, the problem of monitoring and predicting the insulation resistance of equipment $R_{iz}$, which is determined in modern protective shutdown devices by the measured values of the operating current and source voltage, is solved [3]. It is proposed to solve the forecasting of insulation resistance of equipment using digital technologies based on the use of artificial intelligence, in particular neural networks.

The diagnosed parameter is the value of the ohmic insulation resistance of the electrical equipment of mining machines. The solution of the problem with the help of a neural network consisted of 4 stages. 1). Formation of training source data. For this is it necessary to obtain statistical data on the measurement of the value of the function $R_{iz}(t_1)$, $R_{iz}(t_2)$,… $R_{iz}(t_n)$ , from the moment the registration of the insulation resistance


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values ($t_0$) begins until the last known insulation resistance value ($t_n$) is registered. In order to take into account external factors that additionally affect the change in insulation resistance, it is proposed to add statistics of relative humidity% and outdoor temperature data in addition. Next, the set of input data should be divided into training, test and control samples in a percentage ratio of 70/30/30. 2). Choosing the type and architecture of a neural network. A direct distribution neural network with two hidden layers, a non-linear sigmoidal activation function, was chosen. The input training signal of the neural network consists of three components: the actual value of the insulation resistance, ambient temperature, air humidity, the output parameter is the predicted value of the insulation resistance of electrical equipment. 3). Rationing of source data 4). The choice of neural network learning algorithm with checking its errors.

In fig. results of its verification on a test sample. The analysis of the obtained graphs indicates the acceptability of the result, the forecasting accuracy is 95%.

Thus, the proposed forecasting will establish the limit value of the insulation resistance $R_{iz}$, at which the electrical equipment should be decommissioned. Knowing this value, it is possible to determine the likelihood of an emergency condition of isolation and the time of maintenance with replacement or repair.

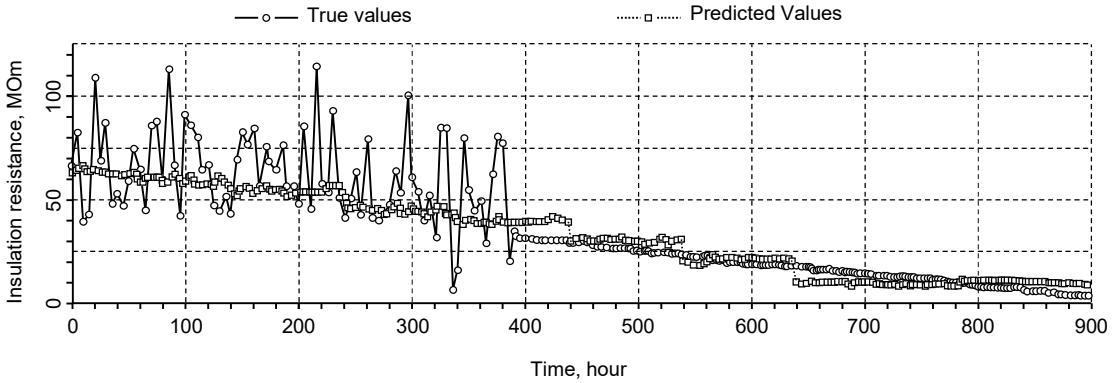


Fig. The result of predicting changes in insulation resistance

**Conclusions**. Thus, the following is obtained:

1. A method has been developed for monitoring and predicting the insulation resistance of underground networks and electrical equipment of mining machines using digital technologies based on artificial neural networks, which allows, based on the actual trend of resistance changes, to evaluate with sufficient accuracy for a given period, the achievement of critical value by insulation resistance

2. The use of the method of monitoring and predicting insulation resistance allows to increase the electrical safety of mining equipment operation by eliminating the risk of electric shock to personnel in case of failure to provide leakage protection by the safety device, as well as to increase the efficiency of mining equipment by reducing damage from sudden outages underground mining machines during their normal operation.

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