

**1****Study of the aging effect of different types of Automatic Transmission Fluid refrigerant oils on various magnet wire**

This study aims to determine the influence of engine oil composition on the aging and fracture rates of magnetic wire. The research is of applied character with expressed significance for the company and will be used to understand the compatibility of Automatic transmission fluid oil with different insulation coatings.

**Scientific benefits**

Scientific benefits: Understanding the effect of the chemical composition of Automatic transmission fluid refrigerant oils on the degradation rate of polymer insulation coatings. Providing practical recommendations for optimizing the compatibility between polymer insulation coatings and Automatic transmission fluid refrigerant oils. Expanding the existing literature database.

**It is possible to publish a scientific article based on the results of the work done.**

**Plan of work**

1. Selection of 4-6 different Automatic transmission fluid oils for motor refrigeration, selection, and preparation of wire samples for the study;
2. Loading samples into an oil tester, testing for 1000 or 2000 hours;
3. Learning basic wire testing techniques;
4. independent testing of the wire after oil tester, analyzing the obtained properties;
5. Chemical analysis of oil before and after testing;
6. Chemical analysis of copper surface after aging;
7. Drawing a conclusion based on the work done.

**2****Comparative study of the influence of testing mode and sample preparation on the result of Partial Discharge Inception Voltage analysis**

The study aims to investigate the partial discharge in polymer insulation, considering the type of specimens and their preparation: depending on the wire cleaning, both for double specimen and single specimen. Additionally, the study will examine the influence of the test program mode on the obtained Partial Discharge Inception Voltage values. In the course of the work, an array of data influencing the test results will be obtained and recommendations for the most accurate testing will be formed. and recommendations for improving testing accuracy will be developed.

**Scientific benefits**

Complementing the literature base on the impact of testing methodology on analysis results. Developing recommendations for the optimal Partial Discharge Inception Voltage testing mode.

**A paper will be published based on the results of this study.**

**Plan of work**

1. Training in the methods of testing on the Partial Discharge Inception Voltage tester and the principles of equipment operation;
2. Preparation and creation of samples;
3. Study the effect of sample type on Partial Discharge Inception Voltage result: single and double wire samples;
4. Study the effect of ambient humidity on Partial Discharge Inception Voltage results;
5. Studying the effect of wire cleaning on the Partial Discharge Inception Voltage result: comparison of results for cleaned and non-cleaned wire;
6. Considering different testing modes within the study of one type of wire, searching for the most significant factors.

### 3 Gas permeability study of polymer coated wire

The study aims to perform a gas permeability study on PEEK or PFA coated wire. The study involves testing the wire for gas permeability (for CO<sub>2</sub>, O<sub>2</sub>) and developing an optimal method for determining the gas permeability of such coatings.

#### Scientific benefits

Developing a methodology for determining the gas permeability suitable for polymer wire insulation.

**The data obtained will be used for technical documentation within the company. If a meaningful method for determining gas permeability is developed that differs from the literature data, a patent may be co-written.**

#### Plan of work

1. Familiarization with the mechanism of operation of the DryCycle machine;
2. Carrying out physicochemical analyses to determine gas permeability for polymer coatings. Investigation of the effect of PEEK crystallization on permeability;
3. Make a table of factors affecting the gas permeability of films: temperature, degree of crystallinity, etc;
4. Development of a method for determining the gas permeability of polymer coating.

### 4 Study of the effect of temperature on dielectric properties of coating of wires with different types of insulation

The study aims to investigate changes in dielectric parameters as a function of temperature. The study is carried out for wires with polymer insulation such as PEEK and PFA. Partial Discharge Inception Voltage, Breakdown Voltage, and additional methods can be used as investigated parameters. The research intends to study the temperature dependencies in the range of 25 to 240° C and plot the dielectric property curves based on wire temperature. If time permits, the experiment can be extended to include ambient humidity as an additional parameter.

#### Scientific benefits

Discovering valuable data on the relationship between temperature and dielectric properties of polymer wire coatings, contributing to a comprehensive understanding of their performance in diverse conditions.

**On the basis of the obtained data, it is possible to publish an article.**

#### Plan of work

1. Study of the principles of operation of Partial Discharge Inception Voltage, Breakdown Voltage devices;
2. Analysis of literature data;
3. Carrying out experiments for samples on Breakdown Voltage equipment;
4. Conducting experiments for samples on Partial Discharge Inception Voltage equipment;
5. Construction of dependencies for the obtained data on temperature.

## 5 Tribological properties and wettability of different types of wire

The study aims to investigate various tribological parameters, such as the coefficient of friction, abrasion, smoothness, and wettability, of PEEK and PFA-coated wire. These characteristics will be examined based on different wire manufacturing conditions to determine the influence of various manufacturing parameters on the wire's tribological properties.

### Scientific benefits

Finding the correlation between polymer application parameters and its tribological properties.

### Plan of work

1. Familiarization with the DryCycle operating principles;
2. Determination of the coefficient of friction for the selected samples;
3. Determination of the abrasion of the polymer coating of the wire;
4. Determination of the wettability angle of the polymer coating for the selected samples;
5. Compilation of the obtained data and analysis. Drawing of graphs of dependences of tribological characteristics on wire production parameters.

**Tau Group** is a technology company at the core of energy transition, decarbonization of energy and electrification of transport. Its patented technologies reconcile the necessity of sustainable, resource-minimizing manufacturing with the power, reliability and performance that electrification requires to enable smaller, greener, longer-lasting and more powerful motors, transformers and generators. Tau focuses on carbon-conscious protective coatings for high-performance and standard copper and steel wires.

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