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MAIN REASONS FOR TRANSFORMER ELEMENTS' MALFUNCTIONS

Power transformers are one of the most important and indispensable elements of the power supply system [4]. Their reliable operation ensures the stability of the entire electrical network and the uninterrupted delivery of electric energy to consumers. Conversely, transformer malfunctions or failures can cause power interruptions, which may lead to production stoppages, economic losses, and various technical and organizational problems [3–5]. During operation, power transformers are exposed to various internal and external factors that affect their efficiency and reduce their service life [1–4]. Therefore, timely assessment of the technical condition and improvement of the reliability of power transformers are considered urgent tasks for modern power systems.

The main faults observed in transformers include the following:

Faults in the Magnetic Core

The magnetic core is one of the main structural components of a power transformer. Due to various reasons, overheating may occur in the transformer windings. This overheating can destroy the insulation (varnish coating), causing steel sheets to stick together.

Faults in the Windings

As a result of insulation moisture or damage, the windings may overheat, leading to insulation breakdowns and mechanical deformations in the coils.

Faults in the Tank

Poorly tightened bolts or cracks in the tank can lead to oil leakage.

Faults in the Cooling System

Due to various impurities in the oil, clogging may occur in the oil circulation pipes, and the oil pump may fail [1–4].

Based on the above, research was carried out to identify the faults observed in traction transformers used in railway transport. The results of the study are shown in Figure 1**.**

According to the research results, the factors causing transformer component failures can be divided into the following main groups:

1. Internal factors;
2. External factors.

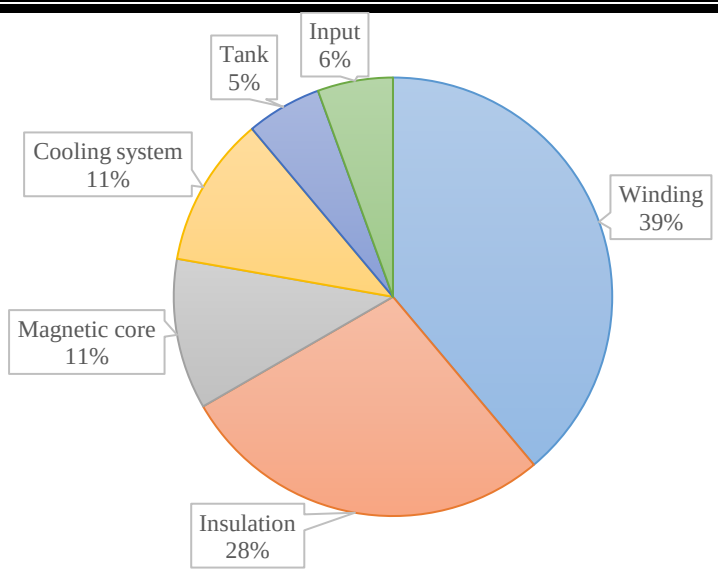

Fig.1. Fault Indicators by Transformer Components

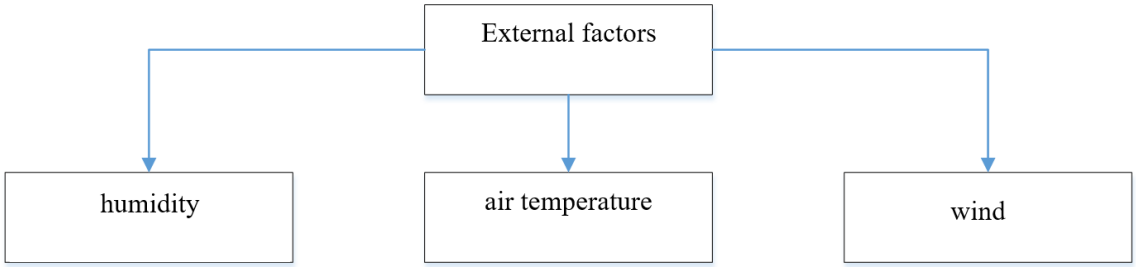

Fig. 2. External factors causing failure of transformer elements

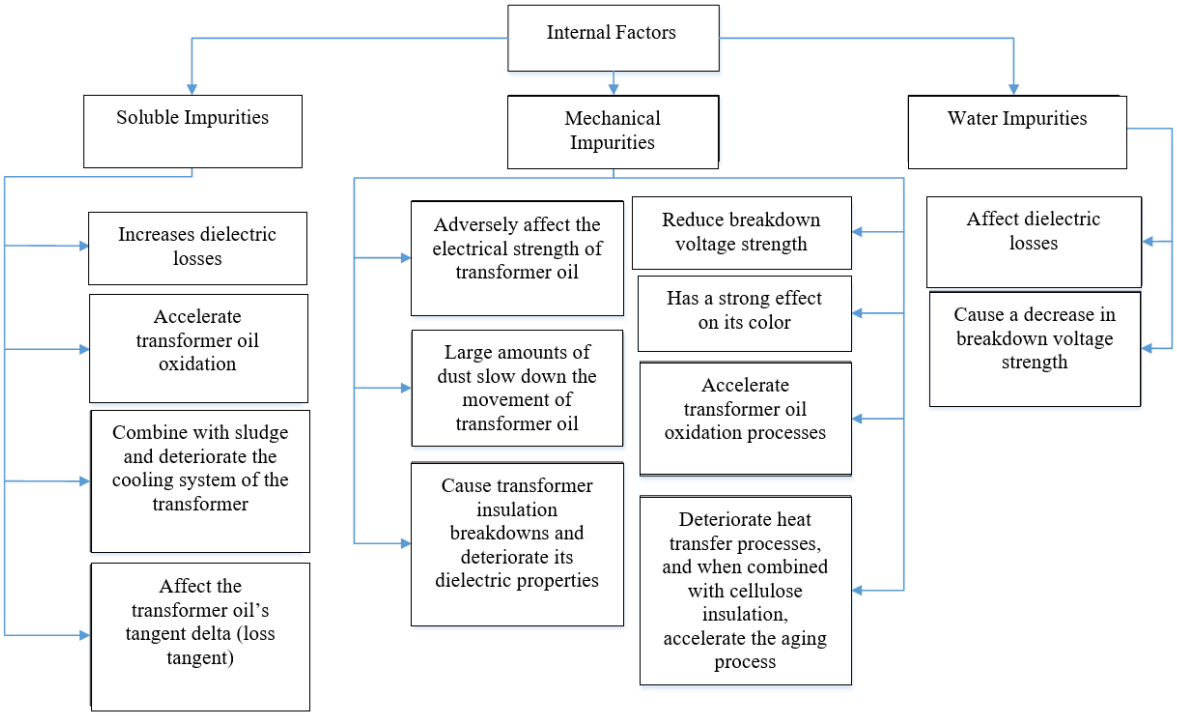

Fig. 3. Internal factors causing failures of transformer components

The wind lifts dust particles from the surrounding environment, and these lifted dust particles accumulate on the radiators of power transformers. As a result, the cooling system does not operate efficiently, which in turn leads to various types of malfunctions [2–5].

The internal factors that cause transformer components to fail can be conditionally divided into three groups: soluble impurities, mechanical impurities, and water impurities.

Based on the research results, the following conclusions were drawn: Various (external and internal) factors affect the operational characteristics of power transformers, and the overall impact of these factors on the transformers' performance is stronger than the influence of each individual factor.

References:

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