

## ANALYSIS OF THE INFLUENCE OF MOISTURE ON TRANSFORMER COILS

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### ABSTRACT

Analysis of the effect of moisture on the transformer windings, drying of transformer windings, drying standard, winding methods, requirements for post-drying transformer, purpose of transformer drying, technical means, the main factors affecting the drying effect of the transformer given.

**Keywords:** single-phase network, transformer, three-phase winding, drying, voltage, resistance, standard, humidity, breakdown voltage.

The purpose of drying the transformer is to remove moisture from the insulating oil of the transformer, increase the resistance of its insulation and increase its tensile strength. Transformers with a voltage higher than 3 kV are oily and must be cleaned of moisture. The transformer body is mainly made of iron, and the magnetic core is made of flat steel. After the body, i.e., the transformer tank and its coils are ready, before adding the transformer oil, it must go through the drying process to remove the moisture and gas in the insulation material, so that the water content of the product can control the quality. It is necessary to ensure sufficient insulation strength and operation of the transformer. In high-voltage transformers, the moisture content of the insulating material should be around 0.5%.

Transformer insulation drying standard and drying treatment

#### **Drying Standard:**

1.1 There is no moisture in the insulating oil of the transformer. The breakdown voltage of the oil is not lower than 75% of the factory data; 1.2 The insulation resistance is not less than 70% of the factory data; The media loss angle touch is not greater than 130% of the factory data.

2. The transformer should be cleaned of moisture in the following cases: wrapping or insulating the place during the preparation of coils; During the repair or installation of the housing, the air tank time exceeds the specified time; The transformer winding is wet by measuring the insulation resistance and absorption coefficient.

### Common methods for drying a transformer

1. Induction heating method. The body is placed in the original oil pan, and the coil is wound around the outside of the oil pan to allow the flow to pass through, and the dirty flow of the pan skin is heated to dry. At this time, the wall temperature should not exceed  $115^{\circ}\text{C} \sim 120^{\circ}\text{C}$ , and the body temperature should not exceed  $90^{\circ}\text{C}$ .  $95^{\circ}\text{C}$ . The number of turns of the coil should be as small as possible or the current should be as small as possible so that it is convenient to wind the coil. Usually, the current is 150A, and the cross-sectional area of the wire can be 35-50mm<sup>2</sup>. Several asbestos strips can be placed on the wall of the tank, and the wires are wrapped around the asbestos strips. The power required for induction heating is determined by the type of transformer and drying conditions.

2. Hot air drying method. Place the transformer in a drying room and dry it with hot air. The drying room can be combined with wall panels according to the size of the transformer tank. Wall panels are covered with asbestos panels or other canvas or asbestos linen impregnated with a fireproofing solution. The drying room should be as small as possible, and the distance between the wall plate and the transformer should not exceed 200mm. It can be heated with an electric oven or steam. The electric power consumed when using an electric oven is calculated as follows: the volume of hot air in the drying room Q, according to the volume of the drying room, use  $Q = 15 \text{ m}^3$  every minute. When drying, the inlet hot air should increase gradually and the maximum temperature should not exceed  $95^{\circ}\text{C}$ . To eliminate fire and dust, a filter or metal grill should be installed at the hot air inlet. The hot air should not be blown directly on the body, it should be blown evenly from the lower part of the body to different parts, so that the moisture is released through the ventilation holes in the box.

3. Vacuum drying method. In this drying method, air is used as a heat carrier. Under atmospheric pressure, the transformer housing or coils are gradually heated to about  $105^{\circ}\text{C}$ , and then vacuum treatment begins. Due to slow heat transfer, uneven heating inside and outside (internal cooling and external heating), high-voltage large-power transformers are often heated for more than 100 hours due to the thickness of the insulation layer.

4. Vapor phase vacuum drying method. This drying method uses special paraffin vapor as a heat carrier. The kerosene vapors introduced into the vacuum tank are compressed in the transformer housing, releasing a lot of heat energy and thereby drying out the winding. Since the thermal energy of kerosene vapor is large (heat of gasification of coal is  $306 \times 10^3 \text{ j / kg}$ ), the transformer body is thoroughly dried and heated, uniformly, with high efficiency. damage to the insulating material is also minimal. However, due to its complex structure and high cost, it is currently limited to drying large transformer windings of 110 kV and above.

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