Assessment of technical state of power transformers based on dissolved gas chromatographic analysis in oil

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Abstract .The work is devoted to the study of a power transformer based on chromatographic analysis of dissolved gases in oil. Data were obtained on dissolved gases (hydrogen, methane, ethane, methylene, acetylene) of power oil transformers of various brands with operation for more than 30 years. Particular attention is paid to the graphical presentation of the results of chromatographic analysis of the oil. As a result, the probable expected defects of power transformers were determined. Studies have shown that power transformers need immediate repair based on their assessment. Timely repair of power oil transformers allows increasing their durability and reliability of power supply to consumers.

1. Introduction

In the electric power industry, the method of dissolved gas chromatographic analysis (DGChA) in transformer oil has become extremely widespread due to a number of advantages [1-2]:
- ability to run on running equipment, which determines its availability [3];
- implementation by one specialist in a short time, which leads to a low cost [4];
- applicability to any oil-filled transformer equipment and high-voltage inputs, making it universal [5];
- ability to detect a wide range of defects in the equipment, which is why DGChA takes a leading place in complex diagnostics [6].

In the oil of a normally operating transformer, the gases that are released from the cellulose insulation and oil during their natural aging are dissolved [7-9]. As shown by experiments on models, the main gas release occurs from electrical cardboard and paper as a result of exposure to elevated temperature, oxygen and moisture [10-14]. Timely assessment of the technical condition of power oil transformers based on chromatographic analysis of dissolved gases in oil is an urgent task of the power industry.

2. Materials and methods

Data were obtained on dissolved gases (hydrogen, methane, ethane, methylene, acetylenes) of power oil transformers of various brands with operation for more than 30 years. General information about power oil transformers is given in Table 1.

Table 1. General information about the investigated power oil transformers

No.	Electrical device	Type	Power, kVA	Voltage, V	Year of operation	Oil volume, t
1	Transformer	TDTN	63000	110	1984 y	30
2		TDTN	16000	110	1984 y	26
3		ATDTSTN	200000	220	1979 y	76
4		ATDTSTN	200000	220	1990 y	59

The methodology in [15-17] was used for the study, which is the current normative document regulating the diagnosis based on DGChA. The essence of the study is to determine possible defects in the operated power oil transformers.

3. Results and Discussions

Based on the methodology [15-17], the results were obtained for each power transformer on figures 1-4. According to the results obtained on the action of gases for the power core, possible defects were detected. The results of assessment of technical state of power transformers based on dissolved gas chromatographic analysis in oil are given in Table 2.

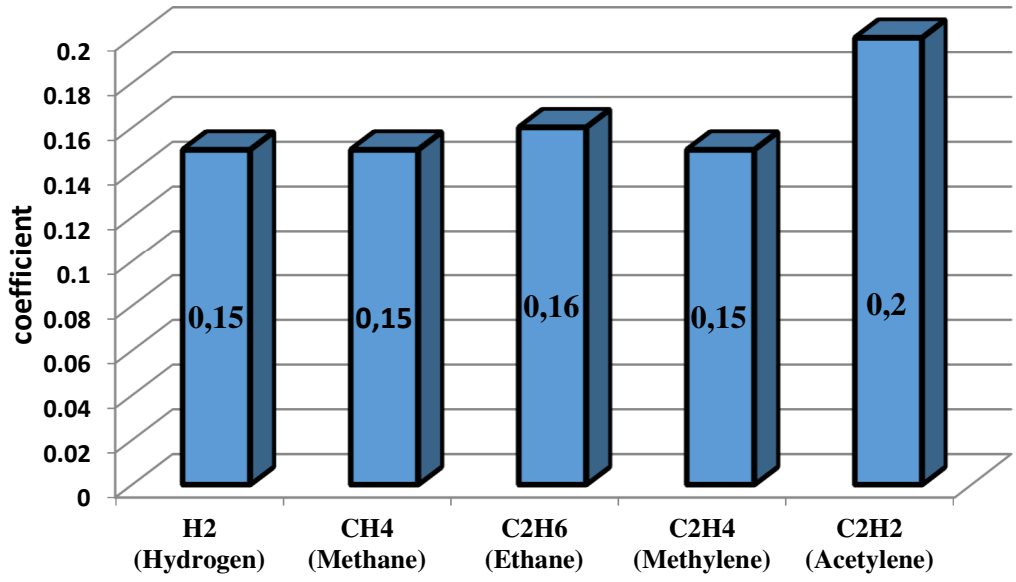

Figure 1. Determination of the fault by the ratio of key gases for a power transformer of the TDTN brand N1

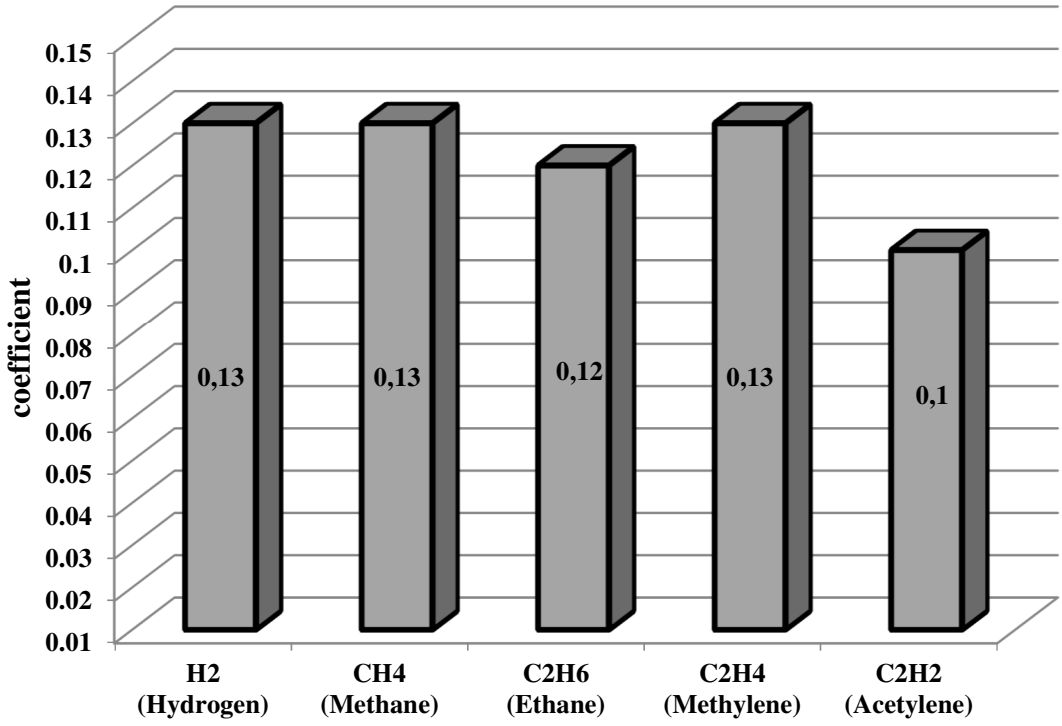

Figure 2. Determination of the fault by the ratio of key gases for a power transformer of the TDTN brand N2

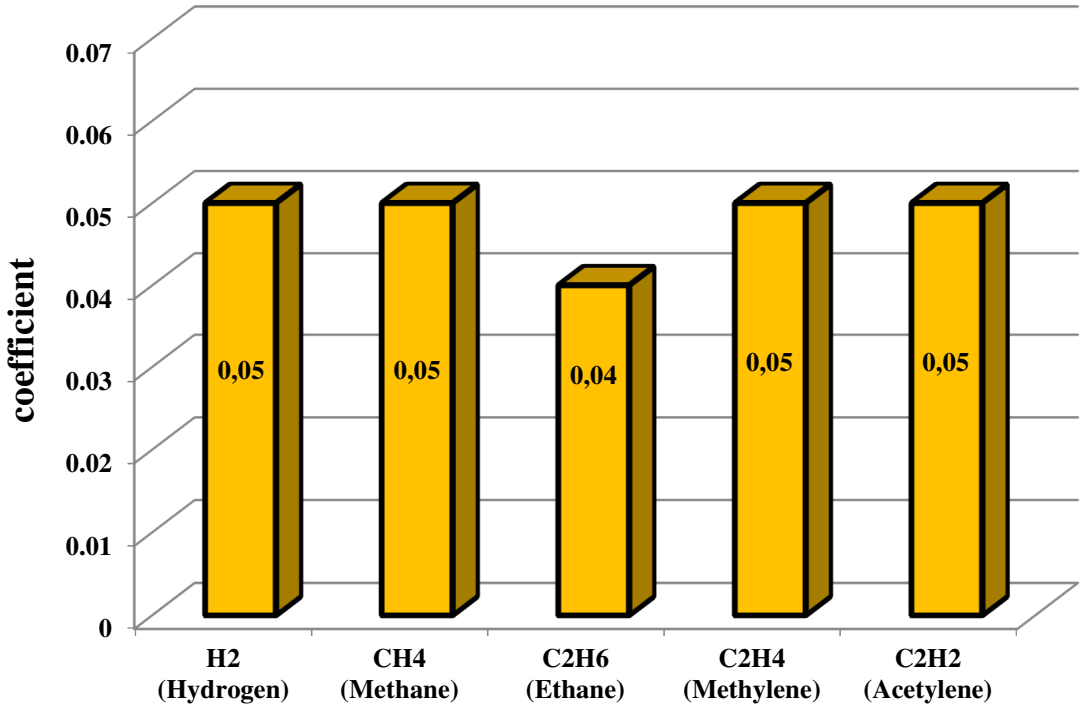

Figure 3. Determination of the fault by the ratio of key gases for a power transformer of the ATDTSTN brand N1

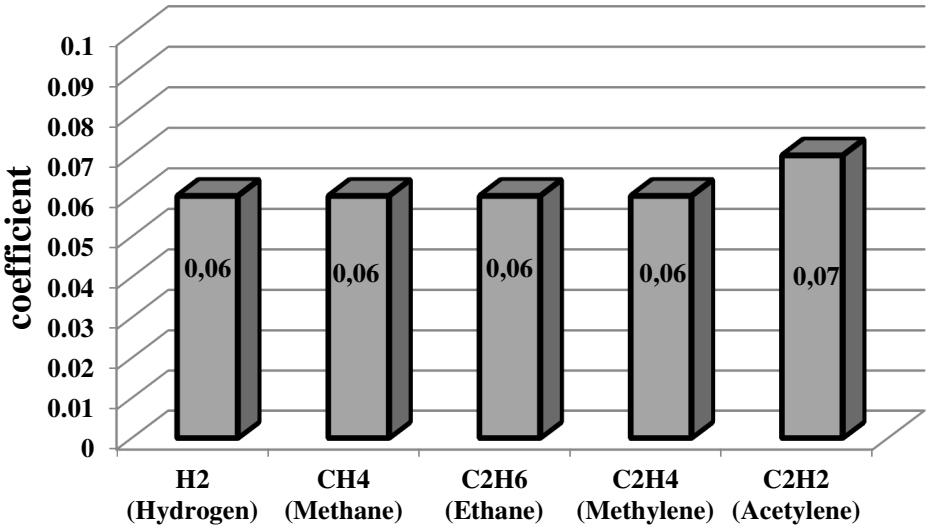

Figure 4. Determination of the fault by the ratio of key gases for a power transformer of the ATDTSTN brand N2

Table 2. The results of assessment of the technical state of power transformers based on dissolved gas chromatographic analysis in oil

No.	Electric equipment	Expected defects
1.	TDTN brand transformer N1	Discharges in gas-filled cavities formed due to incomplete impregnation or insulation humidity.
2.	TDTN brand transformer N2	Continuous sparking in the oil between compounds of different potentials or floating potential. Oil breakdown between solid materials.
3.	Autotransformer of the ATDTSTN brand N1	Arc discharges; sparking, oil breakdown between windings or coils or between coils to ground.
4.	Autotransformer of the ATDTSTN brand N2	Arc discharges; sparking, oil breakdown between windings or coils or between coils to ground.

4. Conclusion

Studies have shown that power transformers need immediate repair based on their assessment. Timely repair of power oil transformers allows increasing their durability and reliability of power supply to consumers.

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