User Manual

Python program and its interface for transformer oil analysis based on IEEE Standard C57.106-2015

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1. Program Interface

The GUI python program was developed for transformer oil analysis based on IEEE Standard C57.106-2015. The main purpose is to get several parameters of transformer oil, check its current state condition and give the recommendations, when it is needed. The condition assessment uses suggested limits for continued use of in-service mineral oil (Table 3 of the Standard). The program can evaluate the condition of transformers in different voltage classes. The voltage classes are divided into three main groups:

- under 69 kV;
- between 69 and 230 kV;
- above 230 kV.

When the program has launched, an user can see the initial frame, which is shown in the Fig.1, for receiving input data, where empty entries are commented.

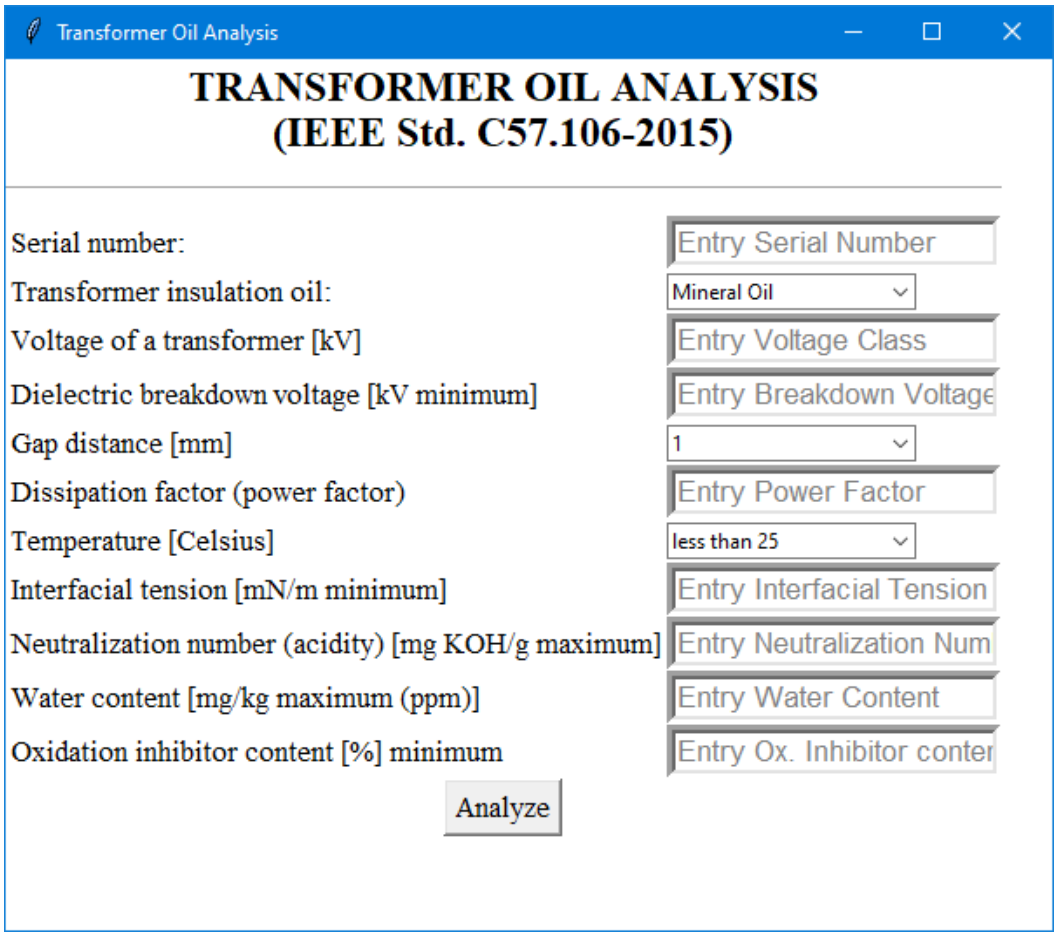

Fig.1. The initial frame for input data

Some of the inputs require clarification, namely:

Serial number. It is the serial number of the transformer to be tested. The entry can accept both symbols and numbers as input data. It serves as a distinction between one transformer and another.

Transformer Insulation Oil. It is an insulating oil type of the transformer. The goal of the project was to test a mineral oil of transformers, so, currently, only "Mineral Oil" can be selected as an input. If another parameter is selected, then an information window gives the warning message in the Fig.2.

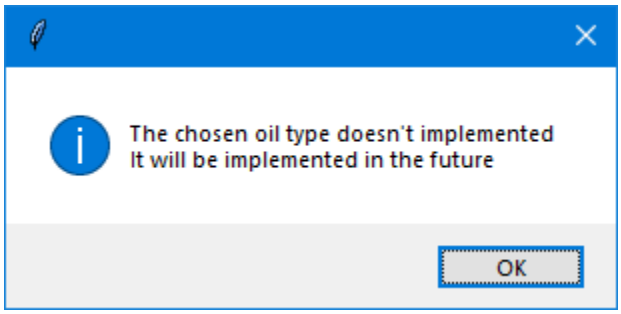

Fig.2. Warning message about insulating oil type.

Voltage of a transformer. It is an operating voltage of the transformer. The voltage value is entered in kilovolts. Besides, the window takes values in rational numbers, so, for example, values of 0.4 kV or 0.220 kV are also accepted.

Gap distance. According to the method of measuring the breakdown voltage of the dielectric of insulating liquids, the standard implies the use of spherically-shaped electrodes. The "Gap distance" is the distance between the electrodes. The user can choose between “1” or “2” cell or type their numbers. For the mineral oil type, only these numbers are available. The gap distance beyond 1 or 2 mm can be used for other insulating oil types beyond this course project.

Temperature. It is the measured temperature of the insulating oil of the transformer at the time of the test. It can be remained with the choice “more than 25” or “less than 25”. Also, the user can type their number on it.

All the input parameters, except for the serial number, must be entered using numbers. Both integers and floats are accepted. In the case of using inappropriate values (for example, letters or signs), an information window appears with the message in the Fig.3.

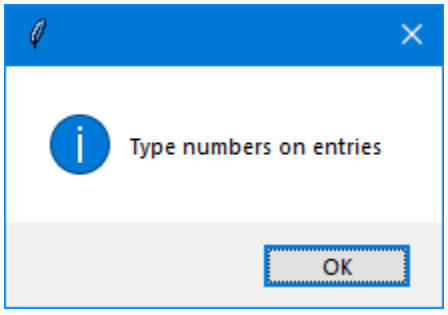

Fig.3. Warning message about wrong entry.

2. Test runs

According to the IEEE Standard C57.106-2015, after each parameter is checked, there are 3 possible outcomes of the recommendations. Each recommendation case is checked below.

The program can be tested with the parameters typed in the Fig.4.

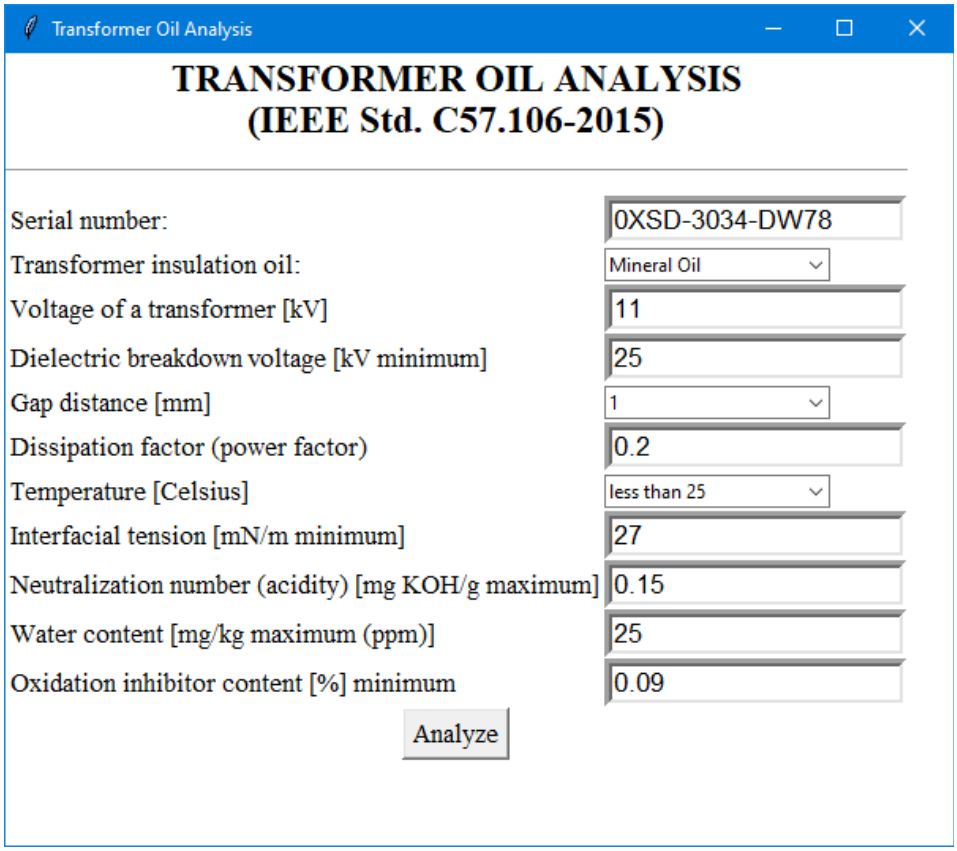

Fig.4. The program interface with the input parameters from test 1.

The program's operation for the Fig. 4 is shown in the Fig.5, where time and general information are presented, each parameter is checked and a recommendation is given. If a parameter is within a limit, then it is marked with a green color. If it is out of the limit, then it is marked with a red color. If a recommendation is positive, then it is marked with green. If a recommendation is negative, it is marked with red. The Fig.5 demonstrates that all parameters are within the limits and gives the first recommendation outcome after classifying the mineral oil with the class 1. Thus, they are marked with the green color.

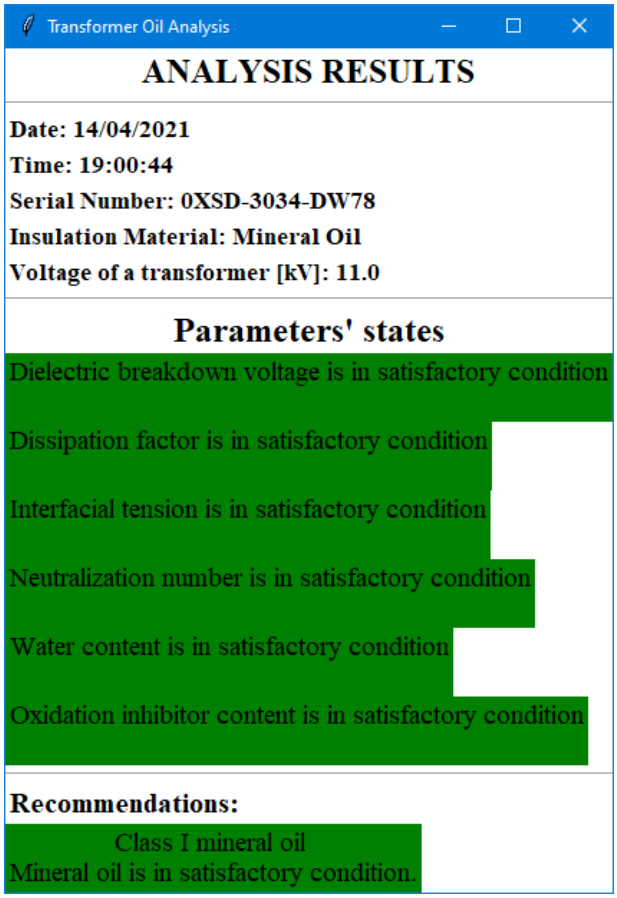

Fig.5. The result of the Fig.4.

If the dielectric breakdown voltage is decreased to 20kV as revealed in the Fig.6, then the program classifies the mineral oil with the class 2 and gives the second possible recommendation outcome, which is presented in the Fig.7. The dielectric breakdown voltage is out of the preferred range, so it is marked with red. The importance of this recommendation is, also, marked with the green color.

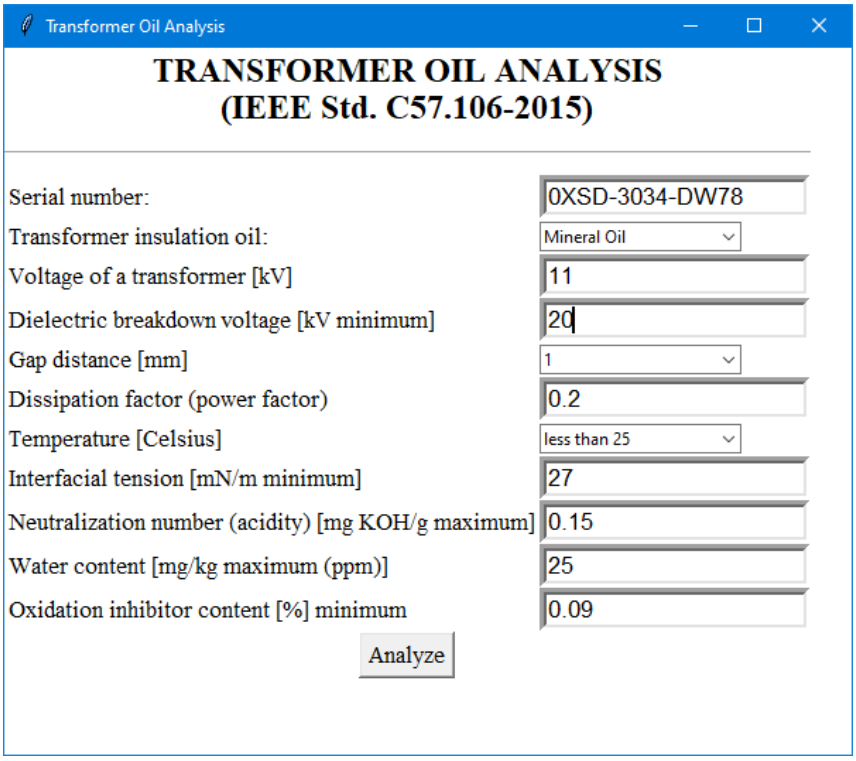

Fig.6. The modified dielectric breakdown voltage from the Fig.4.

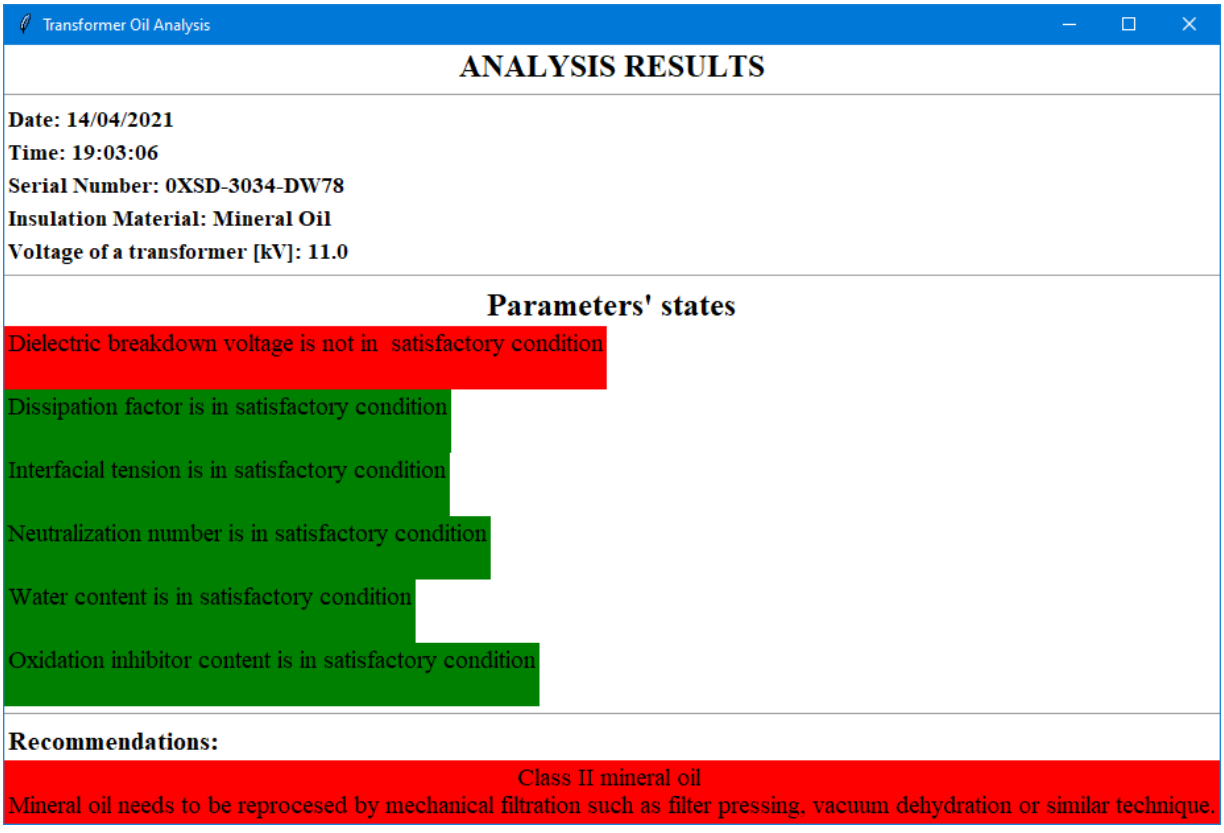

Fig.7. The result of the Fig.6.

When the dissipation factor from the Fig.6 is increased from 0.2 to 0.6 in the Fig.8, the third outcome highlights the violation of the constraint and importance of the recommendation for the class 3 mineral oil with the red color. They are presented in the Fig.9.

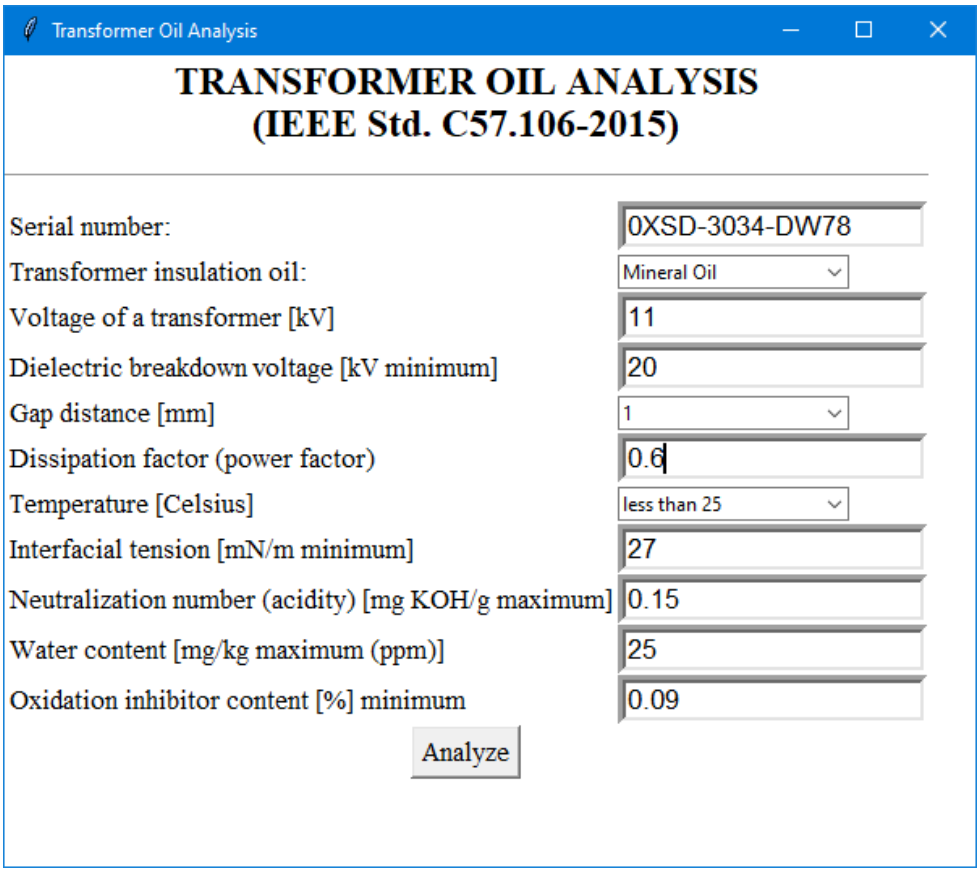

Fig.8. The modified dissipation factor from the Fig.6.

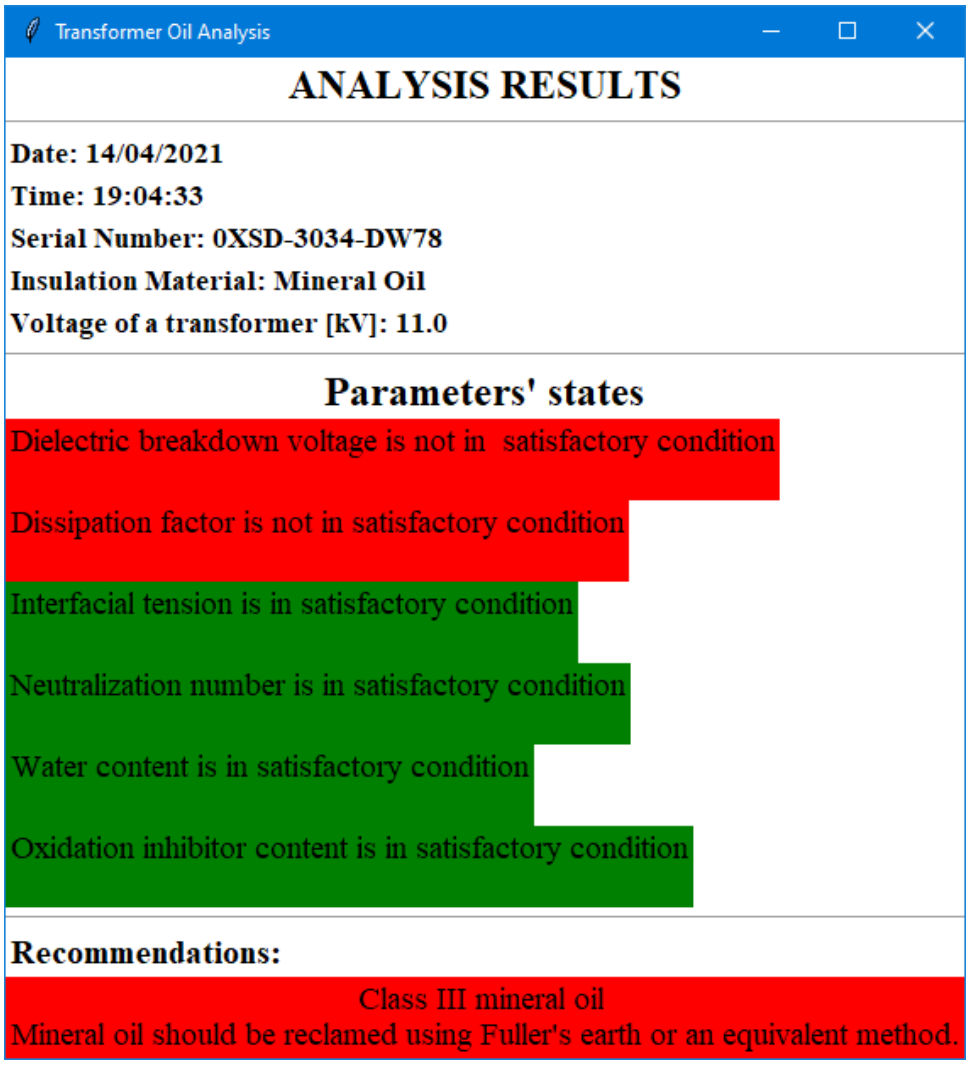

Fig.9. The result of the Fig.8.