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STUDY AND PERFORMANCE OF PARTIAL DISCHARGE OF MODEL FOR DIFFERENT TYPE INSULATION MATERIALS WITH CAPACITANCE VALUE

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ABSTRACT

The properties of the insulating material must be the best to avoid failure of electrical equipment. Partial discharges act as electrical sparks that occur within insulation and the high-voltage electrical system. The different types of voltage and current pulses are produced, which last for a very short time. Partial discharge is taking place in high voltage power equipment such as cables, transmission lines and transformers, etc.

1. INTRODUCTION

The first concept to review is the characteristic feature that partial discharges occur only during the first and third trimesters of each cycle. This is the initial rising positive signal and the initial rising negative signal. Indeed, during the initial upward positive signal, all capacitive components are charging until the initial partial discharge voltage is reached at each specific vacuum and partial discharges begin. When the positive wave cycle begins to decrease, the positive voltage at each vacuum decreases, as some capacitive charge remains. There must be some level of charge since the voltage across a capacitor cannot be changed instantly.

The design of the insulation must meet vital requirements such as the evaluation of the electrical stresses that the insulation can withstand, and also the behavior of said insulating medium when subjected to applied electrical stresses. The coordination of the insulation reveals the close concordance between the electrical stresses developed on the insulation and the dielectric strength of the insulating medium. Solid insulation with imperfections or voids that lead to PD can be represented by an equivalent circuit as shown in Fig. In the equivalent circuit, C_c corresponds to the capacitance of the vacuum; C_b is the capacitance of the insulation in series with C_c and C_a is the capacitance of the void-free sound part of the insulation parallel to the vacuum. When the applied voltage is increased, a critical value is reached across C_c and a discharge occurs across it. Because the gaps are filled with gas whose resistance to rupture is less than solid insulation. The condition for the capacitance model shown in Fig. Should be $C_c << C_b << C_a$.

2. RESULTS AND DISCUSSION

The capacitance value for epoxy resin ($\varepsilon_r = 3.4$) as $C_a = 5.34 \times 10^{-12}$ F, $C_b = 4.23 \times 10^{-13}$ F and $C_c = 2.88 \times 10^{-14}$F is used for simulation in MATLAB. We use the parameter used in the Simulink model after we are discovering the partial discharge value as 6 X 10^{-4} amplitude PD (V) shown in Figure 2, when applied the AC voltage source as 220 X10^3 (V) using the value of capacitance as 0.33 X10^{-6} F. After that, it is observing the partial discharge value as 1.5 X 10^{-3} amplitude PD (V) shown in Figure 3, when applied the AC voltage source as 220 X10^3 (V) using the capacitance value as 0.47 X10^{-6} F.

The capacitance value for vulcanized fibers ($\varepsilon_r = 2.5$) as $C_a = 5.13 \times 10^{-12}$ F, $C_b = 4.26 \times 10^{-13}$ F and $C_c = 2.78 \times 10^{-14}$F is used for simulation in MATLAB. We use the parameter used in the Simulink model after we are discovering the value of the partial discharge as 1.0 X 10^{-3} amplitude PD (V) shown in Figure 4, when applied the AC voltage source as 220 X10^3 (V) using the capacitance value as 0.33 X10^{-6} F. After that, it is observing the partial discharge value as 1.5 X 10^{-3} amplitude PD (V) shown in Figure.5, when applied to AC voltage source like 220 X10^3 (V) using the capacitance value as 0.47 X10^{-6} F.

The capacitance value for polyethylene ($\varepsilon_r = 2.2$) as $C_a = 4.88 \times 10^{-12}$ F, $C_b = 3.87 \times 10^{-13}$ F and $C_c = 2.81 \times 10^{-14}$F is used for simulation in the MATLAB. We use the parameter used in the Simulink model after we are discovering the partial discharge value as 3.0 X 10^{-3} amplitude PD (V) shown in Figure 6, when applied the AC voltage source as 220 X10^3 (V) using the capacitance value as 0.33 X10^{-6} F. After that, it is observing the partial discharge value as 3.0 X 10^{-3} amplitude PD (V) shown in Figure 7, when applying the AC voltage source as 220 X10^3 (V) using the capacitance value as 0.47 X10^{-6} F.

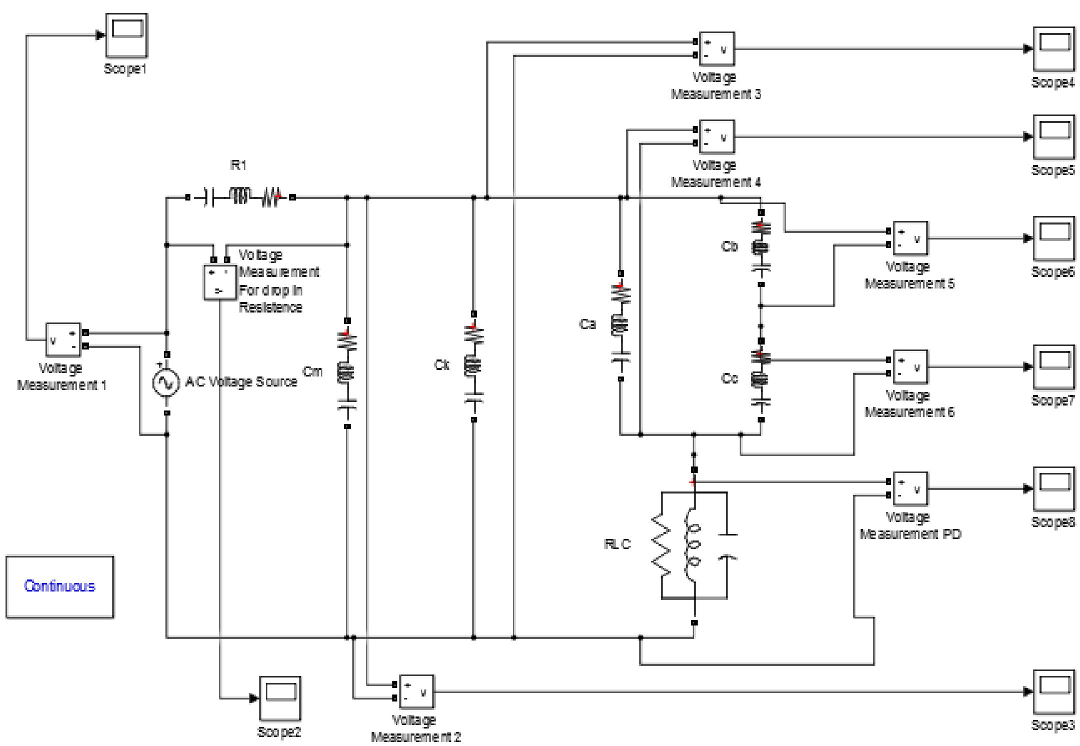

Figure 1: MATLAB Simulink model

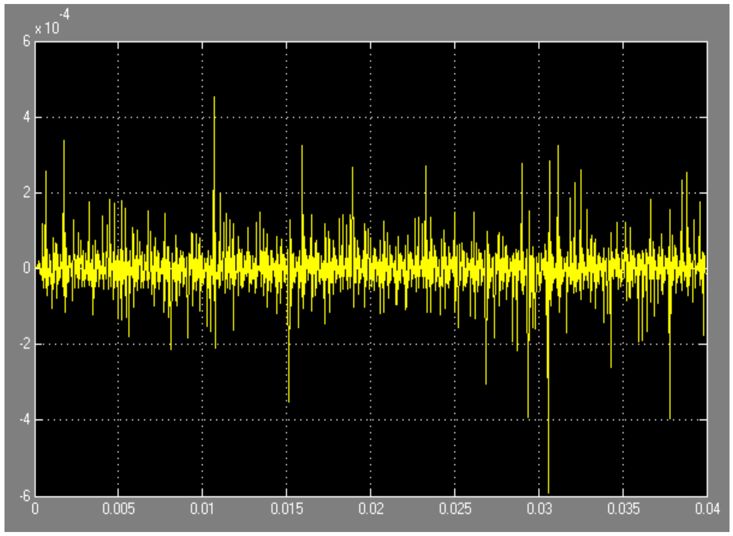

Figure 2: Value of partial discharge

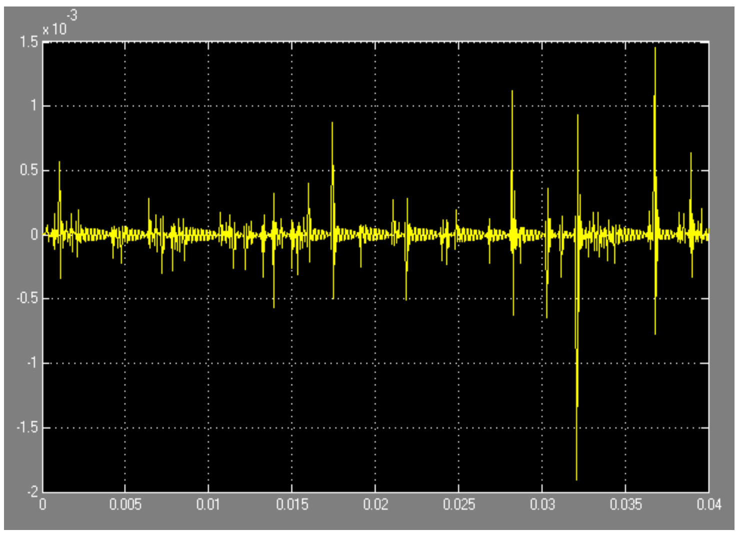

Figure 3: Value of partial discharge

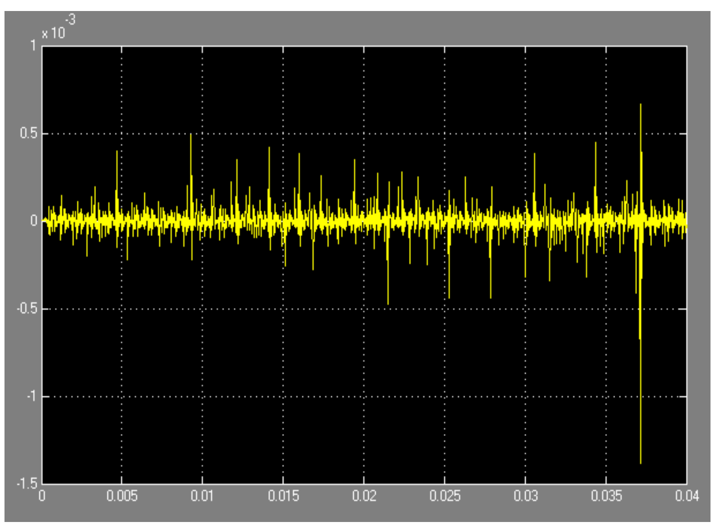

Figure 4: Value of partial discharge

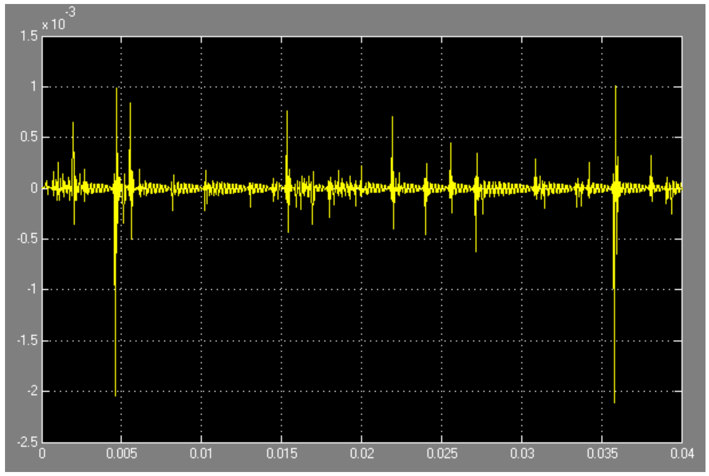

Figure 5: Value of partial discharge

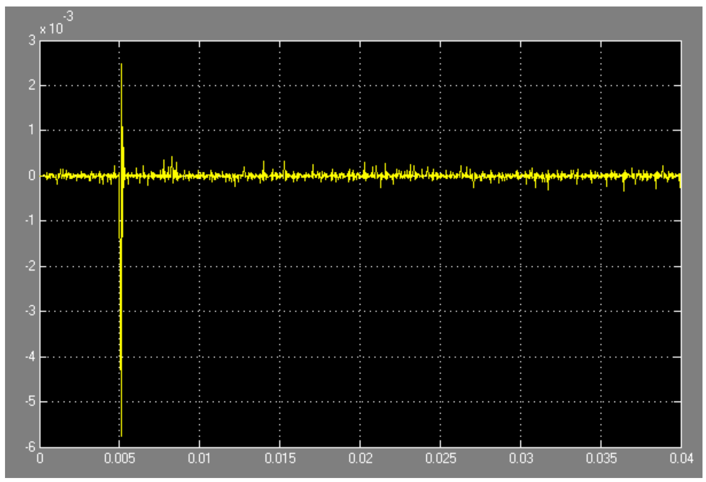

Figure 6: Value of partial discharge

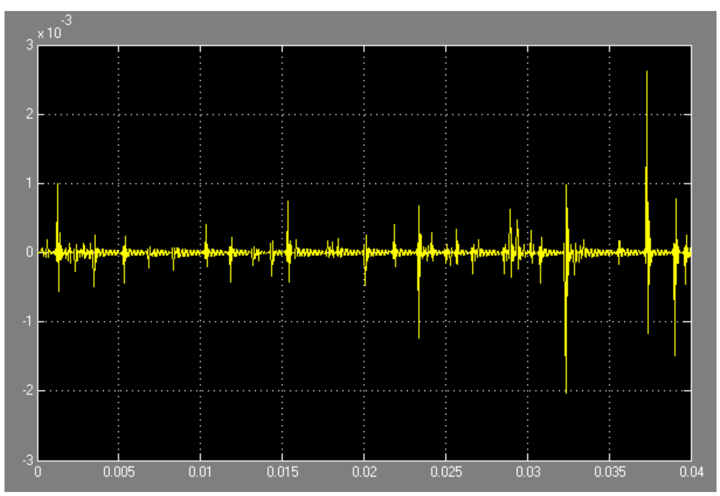

Figure 7: Value of partial discharge

3. CONCLUSION

In this work, three insulating materials are considered, such as epoxy resin (ε_r = 3.4), vulcanized fibers (ε_r = 2.5) and polyethylene (ε_r = 2.2), which have different relative permittivity (ε_r). The different types of capacitors are also used, the capacitance value values are 0.33 X10^{-6} F, 0.47 X10^{-6} F in the Simulink model, after that it is observing the different partial discharge values. The capacitance value for polyethylene (ε_r = 2.2) as $C_a = 4.88 \times 10^{-12}$ F, $C_b = 3.87 \times 10^{-13}$ F and $C_c = 2.81 \times 10^{-14}$F is used for simulation in the MATLAB. We use the parameter used in the Simulink model after we are discovering the partial discharge value as 3.0 X 10^{-3} amplitude PD (V) shown in Figure 6, when applied the AC voltage source as 220 X10^{3} (V) using the capacitance value as 0.33 X10^{-6} F. After that, it is observing the partial discharge value as 3.0 X 10^{-3} amplitude PD (V) shown in Figure 7, when applying the AC voltage source as 220 X10^{3} (V) using the capacitance value as 0.47 X10^{-6} F. Thus, the partial discharge value is stable as 3.0 X 10^{-3} amplitude PD (V) using polyethylene (ε_r = 2.2).

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CONFLICT OF INTEREST

The author have declared that no competing interests exist.

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