Exercises on High Voltage Engineering

Yuanxiang Zhou

**Supplementary Exercise 1:** Between the electrodes of parallel plate capacitors, there are two layers of dielectric with the dielectric interfaces parallel to the electrodes. The electrical properties of the two layers of dielectric are as shown in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dielectric | Thickness (mm) | *ε*r | tan*δ* (50 Hz) | *ρ* (Ω·cm) |
| 1 | 5 | 2 | 5×10-4 | 1016 |
| 2 | 3 | 6 | 3×10-3 | 1016 |

Assuming a 50 Hz voltage (rms) of 10 kV is applied between the electrodes, please calculate:

1. The electric field strength in each layer;
2. The capacitance per square centimeter of electrode area for the capacitor (*ε*0 =0.8854×1013 F/cm);
3. The dielectric loss per unit volume in each layer, W/cm3.

(If a DC voltage of 10 kV is applied between the electrodes, calculate after reaching a stable state)

1. The electric field strength in each layer;
2. The dielectric loss per unit volume in each layer, W/cm3;
3. The charge density accumulated on the interface, C/cm2;
4. The time constant for discharge when the capacitor is short-circuited.

**Supplementary Exercise 2:** If the multi-layer dielectric insulation is considered as two capacitors in series (*C*1=0.1 μF, *C*2=0.2 μF) and in parallel with two resistors (*R*1=10 MΩ, *R*2=20 MΩ), connected to a DC power supply of 3 kV. When the switch is closed, the voltage distributes inversely proportional to capacitance. After stabilization, the voltage distributes inversely proportional to conductance. How much charge will accumulate on the dielectric interface during the process?

**Supplementary Exercise 3:** Tsinghua University has a 500 kV/500 kVA test transformer with a protection resistance *R* of 50 kΩ. What is the maximum capacitance of the test sample that can be connected under the rated test voltage?