

Fakulti: <b>FAKULTI KEJURUTERAAN ELEKTRIK</b>	
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**SEE 4722**

**FAKULTI KEJURUTERAAN ELEKTRIK  
UNIVERSITI TEKNOLOGI MALAYSIA  
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**INSTITUT VOLTAN DAN ARUS TINGGI (IVAT)  
PROBLEM (Experiment 14)**

**Effect of Ageing Time on Surface Discharge Characteristics of  
Polymeric Materials under AC Voltage**

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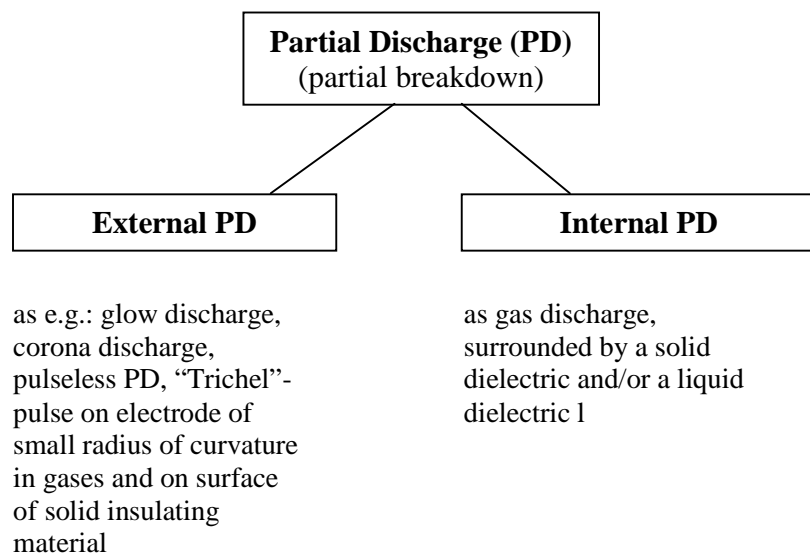
## Introduction

### a. Terminology

The most common cause of insulation failure is the presence of discharges either within the voids in the insulation or over the surface of the insulation. The probability of failure will be greatly reduced if such discharges could be eliminated at the normal working voltage. Then, failure can occur as a result of thermal or electrochemical deterioration of the insulation.

In high voltage terminology, one differentiates between a “complete” and an “incomplete” breakdown of the insulation stressed by voltage application. During “complete” breakdown, the insulation collapses, resulting in “partial discharges”. The still healthy portion of the insulation can withstand the voltage stress. Since such breakdown occurs, as a rule, in a gaseous dielectric, it is referred to as **partial discharge (PD)** based on the terminology of “gas discharges”.

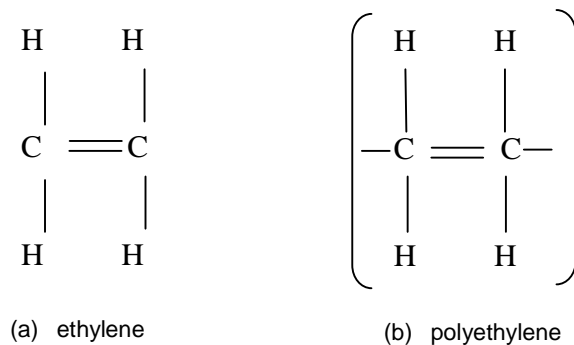
Partial discharges occurring in gases around electrodes of small radius of curvature and those on the surface of solid insulating materials are known as **external partial discharges**. On the other hand, one speaks of **internal partial discharges** if gas discharges occur as *partial breakdown* in solid or liquid insulating materials. **Fig. 1** is a compilation of all the concepts from the view point that partial breakdown serves as a common indicator of external as well as internal partial discharges.



**Figure 1** Terminology

### b. Polymeric Material

Polymers consist of long-chain macromolecules with repeating *monomer* (or *mer*) units, an idea first proposed by the Nobel laureate Hermann Staudinger in 1920 and which laid the foundation for systematic polymer synthesis. A polymer is usually named by putting the prefix 'poly-' in front of the name of the monomer from which it is derived. For example the monomer *ethylene* is the repeated monomer in *polyethylene*.



**Figure 2** Chemical structure of polyethylene

Polymer can be classified into three groups, namely thermo plastics molding compound (acrylic, nylon, polypropylene, etc), thermosetting molding compound (epoxy, polyester, etc), and extrusion compound (polyethylene, PVC, silicone rubber, etc).

### c. Ageing Time

Partial discharges which occur in dielectric materials for certain time can lead a completely breakdown of the dielectric if appropriate actions not be taken. So that, partial discharge monitoring system is important activities in electrical power system.

Therefore, ageing time is one of essential parameter which influences the electrical properties of dielectrics.

### Problem Statement

Polymeric materials are widely used as insulator in electrical power apparatuses due to having good electrical, economical and mechanical properties. However, because of an organic substance, polymeric material relatively easy affected by environmental condition, such as,

temperature, humidity, chemical and radiations. Partial discharge is one of the source will affect the performance of polymeric materials.

Students are required to investigate the *effect of ageing time* on surface discharge characteristics of different type of polymeric materials under AC voltage.

### **Trigger**

Partial discharge (PD) characteristic parameter can be grouped as follows:

- parameters of the individual PD current pulse (waveform and charge)
- parameters of the train of PD current pulse (PD current and PD pulse repetition rate)
- parameter of the train of PD current pulses together with temporally assigned instantaneous value of high voltage (PD energy and PD power)

PD which occur in certain time will lead to completely breakdown of dielectrics if appropriate action not be taken.

1. What is the relation of ageing time to deterioration of polymeric materials?
2. How to conduct the experimental observation in laboratory if we would like to investigate the effect of ageing time on surface discharge characteristics on polymeric materials (experimental setup, experimental scenario, etc)?
3. What parameters have to be investigated to observe of ageing time effect on surface discharge characteristics on polymeric materials?
4. What is the relation of surface morphology investigation to deterioration of polymeric materials?