The Analysis Partial Discharge detector by Examination for Solve-problem

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Abstract: This academic article is process from the analysis of partial discharge by using the tool to measure the partial discharge which is import from oversea that has several brand name of manufacturer. Most of the measurement of partial discharge, it would be measure the wave in the cycle or oval form. This signal wave measurement is called Elite Signal by using the measurement result to analyze. Most of the wave measurement could not classified the action and clarify the character of partial discharge that how it is happen. The cause of problem that the measurement of partial discharge which has analyzes the cause or the character that causes the high electric voltage. From the particular analyze about Elite signal wave form, it would be able to identify that the character of High Voltage Field in the Corona style that had happen, it is cause of which kind of Electric Field. And the Electric Field Value is the result from whatever. The result of measurement is not identifying the type of Electric Field. It's just told about the amount of partial discharge that each has the amount over the standard or not. So that the result it still could be able to analyze the cause of Electric Field in the details which is in the form of Elite signal wave that could measure in the graph. From this academic article has take the reason and example of graph analyze measurement in difference form to solve the real problem.

Keyword: Partial discharge ,Electric Field , Corona Discharge

1. Primary of being a Partial Discharge Theory

Partial Discharge is discharge that is defect break down. Power which would create the discharge is not enough in changing insulator to be inducing the electricity for the whole electron that is the reason in calling Partial Discharge. The reason is the electron induce one side or both side which would be the solid, liquid and gas is still the defect induce. Kreuger is described "Partial Discharge is the discharge that the electricity are not connected between electros."

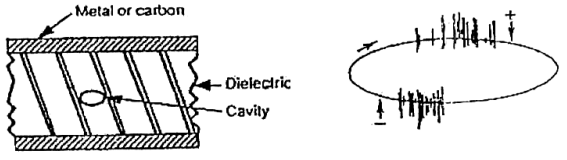
Partial Discharge will occur in the induce system which is not smooth or induce that is incoherent or have other mixtures. That would make the some part of induce of electricity field stress is higher than critical electricity field stress but not effect to completely breakdown just only some part. That could be occurred both in alternating current electricity field and direct current electricity field. Under the alternating current electricity field, the discharge would occur repeatedly in every cycle of voltage. In general, it would occur while the voltage is more push from zero to peak so that partial discharge could be divided into 3 types:

(1) Corona Discharge – It is occur from the inconsistent in the electricity field. Induce would sharp or sharp-edged in the air or gas that have a normal voltage when there are critical electricity field stress.

(2) Surface Discharge – It is occur between the surface of electricity induce and the surface of heat insulation. It would happen when capacity on the surface is high and voltage has fastest changing so that this type discharge would occur with the direct current and impulse voltage only. Example of surface discharge occurs such as at the end of cable in the area that takes off induce.

(3) Internal Discharge – It is could occur both in the solid and liquid material that have air bubble inside. Induce that have Contaminants would cause for gas that would happen after the first breakdown. Induce that have air bubble or Contaminants inside, it would cause of discharge. So that it would be reason for the shortage of expire date for using induce. To separate the type of partial discharge in cable could be separate as following:

1.1 Discharge that occur from the cavity in the dielectric, this cavity might face with the solid insulator cause of the producing process such as molding, to casting this type of discharge would occur before voltage peak. And it would stop the discharge while the voltage peak. Both positive and negative recycle of the sine voltage. The position of discharge is show by oscilloscope that shape in the perpendicular in the oval picture. It is show the result of partial discharge. The size of discharge is up to the size and amount of the air bubble. This type of discharge has the effect from voltage and it would have a short period. It can be said that while the voltage and more time, the size of partial discharge would not much different. From the test which start at withstand and the appoint time period (≅ 10 minutes)

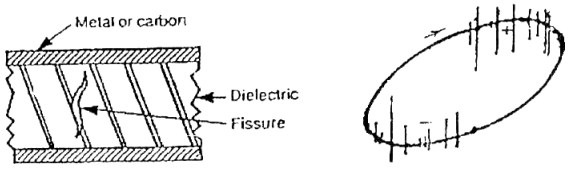


a) Air bubble that occur in dielectric

b) the PD position on the oval time base

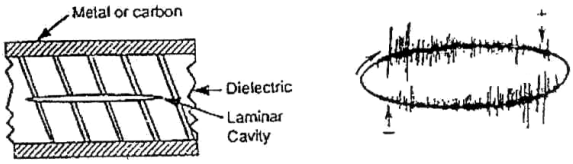
Figure 1 Partial Discharge that occur from the air bubble

1.2 Discharge that occur from fissure in the dielectric. This type of discharge most found in dielectric that has more elastic such as thermoplastic. Cracks that occur would have the same direction with the electricity field. In general reason, it would cause of dirty inside the dielectric and bubble or air cavity around the area and mixtures together. This would often happen in the cable which has been use for a while. This type of discharge will occur in between the voltage peak. It would happen first and then the voltage peak would be less. Both of positive and negative cycle of the sine wave voltage. The amount of partial discharge is not only up to the voltage and period of time. It is up to the side of fissure too. If the fissure is big, the side of discharge would be more, but while the high voltage in the period ≈30 minutes, the size of discharge would be reduce.



A1) Fissure in dielectric A2)Air bubble that occur in dielectric

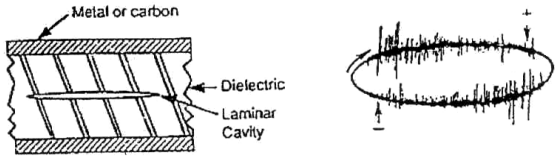
Figure 1 Partial Discharge that occur from the air bubble



B1) PD position on the time base that occur from fissure B2) the PD position on the oval time base

Figure 2 Partial Discharge that occur from fissure

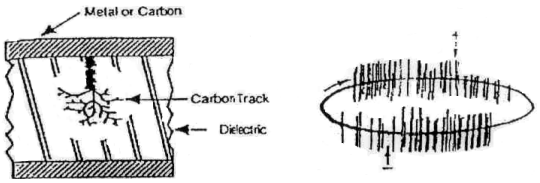
1.3 Discharge that occur from resin and contaminants in the dielectric. Most of resin and contaminants is cause of the producing process. Resin will mean to resin that use for produce insulator that has burn and remain on the producing process such as semi conductor which is burn or fiber. Contaminants mean the outside contaminants such as dust, dirt and resin that would be in the dielectric. This type of discharge is including the rough and blame of dielectric too. Discharge would occur between the voltage peak as same as the second type but it would slightly happen after the voltage peak to the less which would more discharge. Discharge will occur both positive and negative cycle of the sine voltage. Before voltage peak of the discharge it would less than the voltage peak.



a) Contaminants in dielectric b) PD position on the oval base

Figure 3 Showing of partial discharge that occurs from the resin and contaminants

1.4 Discharge that occurs from expands of carbon track. This type of discharge will occur in organic that have carbon and the components that use to produce insulator such as cross-linked polyethylene and several kind of polymer. In general, it would occur from the dielectric have too much electric field stress that cause of the treeing crack in the dielectric. This type of discharge would occur at the low voltage until high voltage, especially before it would be peak. The size of discharge would be more. Both positive and negative of sine wave voltage. The size of discharge would up to the size of carbon track. In general, the discharge would occur in every voltage except voltage at zero or no discharge. The size of discharge would be big and almost equal in every voltage. Voltage and period of time is effect to the expansion of crack and size of discharge. Too high voltage, it would effect to the size of discharge increasing rapidly. The size of discharge would not stable. Repeat testing, would expand the size of carbon track.



a) Carbon track in dielectric b) PD position on the oval base

Figure 4 Showing partial discharge which occur from carbon track expansion

2. Showing of the good result of Partial discharge

PD measurement could be measure from the high frequency to be micro – volte (V) picocoulomb (pC) but we would only know the size of PD. The method that is famous for showing the PD measurement is the result that shows on oscilloscope monitor. That could be show in 2 models; first the pulse of PD will show on the time base on ellipse that has significant show on the positive peak, negative peak and zero position of the test voltage. According to figure 6.7 a, b or show in the pulse wave. PD would show on the sine wave time base that have a good result which is correct measurement and observe the right position. Showing on the time base on ellipse has

a good point that we can analyze that where is the PD is from.

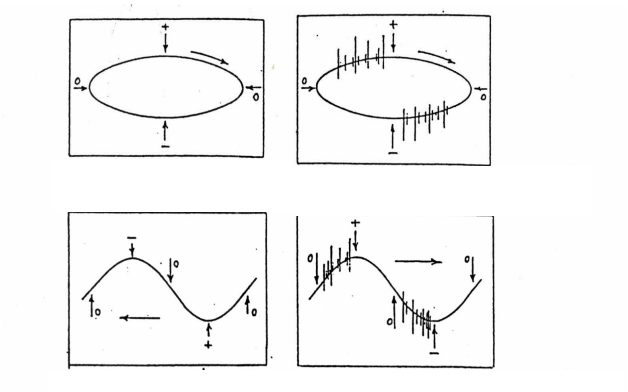


Figure 5 PD show on the time base on ellipse result

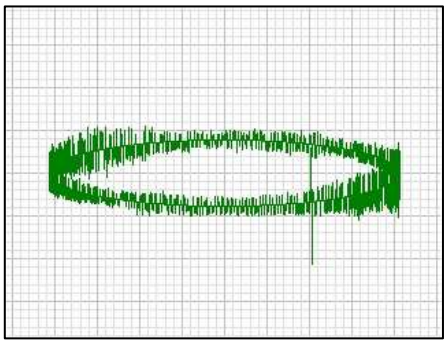
3. Example of Test Result that analyze from the partial discharge inspector from the high voltage cable XLPE

Insulator using in the test that connecting to the high voltage cable by adapt from using gas insulator 2 types. One is normal air insulator and gas insulator SF_6 by the test in the high voltage cable XLPE in 3 sizes as follow 240, 185, 150 sq.mm. It would have following result:

Example of Test Result in high voltage cable XLPE size 240 sq.mm.

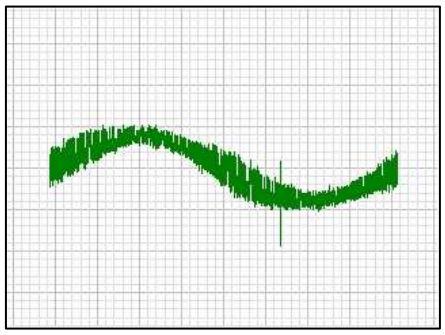
- Gas insulator is normal air at the voltage in cylinder 1.8 bar

The example of partial discharge measurement on the oval time base, it would start at PD voltage at 5.77 kV in the angle 135 and 225 degree, value at 8.14 pc.



PD Detector 1 - 3/15/2008 4:23:29 PM
Discharge = 8.14 pC, Voltage = 5.77 kV

The example of result of partial discharge on the sine wave time base, it would start voltage at 5.82 kV. before peak position of negative cycle, value at 8.32 pc.



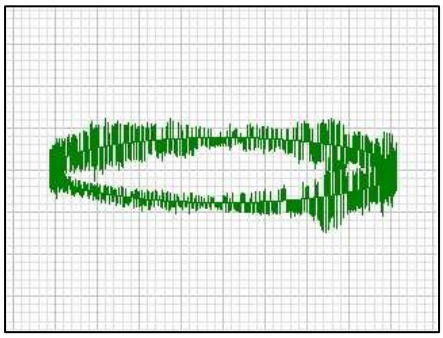
PD Detector 1 - 3/15/2008 4:23:32 PM
Discharge = 8.32 pC, Voltage = 5.82 kV

The example of result of partial discharge on the sine wave time base, it would start voltage at 5.82 kV. in the position at 310 degree, value at 102.33 pc.

PD Detector 1 - 3/15/2008 5:00:40 PM
Discharge = 102.33 pC, Voltage = 3.00 kV

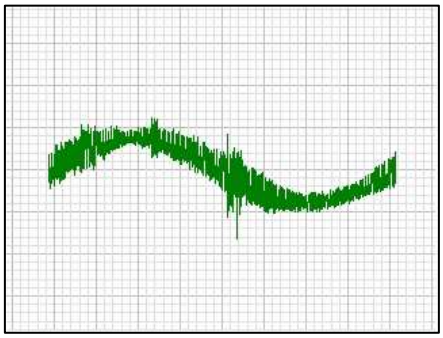
- Gas insulator is SF6 at the voltage in cylinder 1.8 bar

The example of partial discharge on the oval time base, it would start at PD voltage 3.85 kV. in the angle position 230 degree, value 4.63 pc



PD Detector 1 - 3/15/2008 5:14:36 PM
Discharge = 4.63 pC, Voltage = 3.85 kV

The example of partial discharge on the sine wave time base, it would start at PD voltage 5.74 kV. before the peak position of negative cycle, value at 4.67 pc

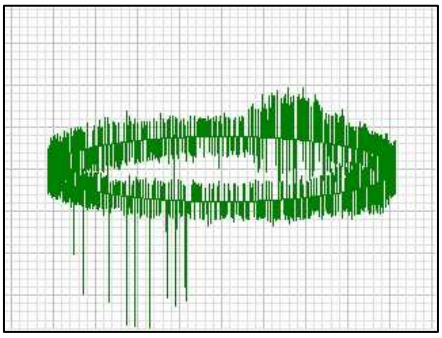


PD Detector 1 - 3/15/2008 5:14:58 PM
Discharge = 4.67 pC, Voltage = 5.74 kV

Example of Test Result in high voltage cable XLPE size 185 sq.mm.

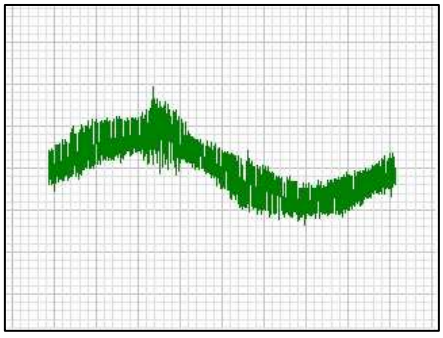
- Gas insulator is normal air at the voltage in cylinder 1.8 bar

The example of partial discharge measurement on the oval time base, it would start at PD voltage at 3.06 kV in the angle 310, value at 8.87 pc



PD Detector 1 - 3/15/2008 6:14:10 AM
Discharge = 8.87 pC, Voltage = 3.06 kV

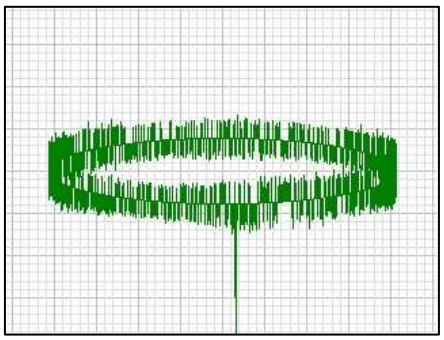
The example of result of partial discharge on the sine wave time base, it would start voltage at 2.97 kV. in the peak position of positive cycle, value at 9.19 pc.



PD Detector 1 - 3/15/2008 6:14:52 AM
Discharge = 9.19 pC, Voltage = 2.97 kV

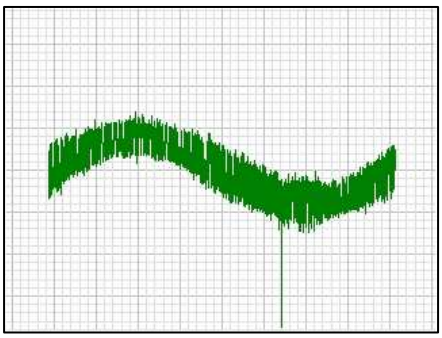
- Gas insulator is SF6 at the voltage in cylinder 1.8 bar

The example of partial discharge on the oval time base, it would start at PD voltage 18.07 kV. in the angle position 265 degree, value at 14.35 pc



PD Detector 1 - 3/15/2008 7:21:35 AM
Discharge = 14.35 pC, Voltage = 18.07 kV

The example of partial discharge on the sine wave time base, it would start at PD voltage 18.03 kV. before the peak position of negative cycle, value at 15.27 pc.

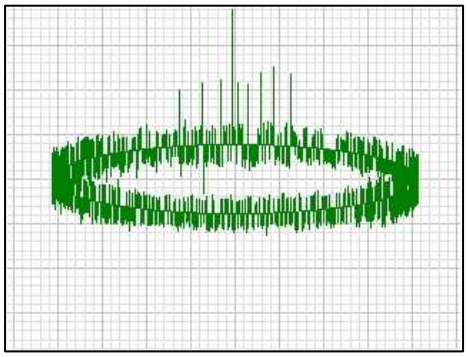


PD Detector 1 - 3/15/2008 7:22:01 AM
Discharge = 15.27 pC, Voltage = 18.03 kV

Example of Test Result in high voltage cable XLPE size 150 sq.mm.

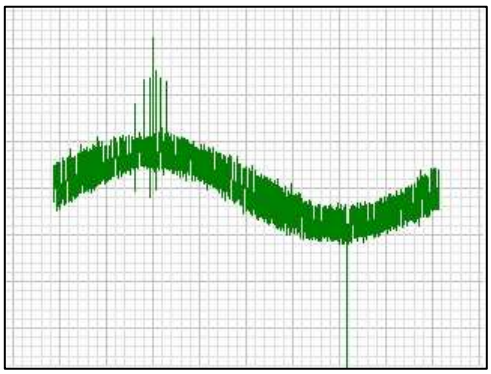
- Gas insulator is normal air at the voltage in cylinder 1.8 bar

The example of partial discharge measurement on the oval time base, it would start at PD voltage at 6.89 kV in the angle 90, value at 8.63 pc



PD Detector 1 - 3/15/2008 10:51:20 AM
Discharge = 8.63 pC, Voltage = 6.89 kV

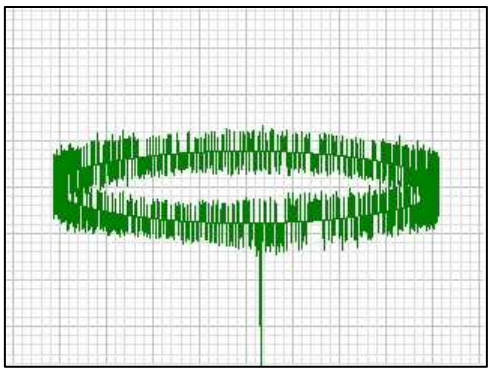
The example of result of partial discharge on the sine wave time base, it would start voltage at 7.02 kV. in the peak position of positive and negative cycle, value at 9.84 pc.



PD Detector 1 - 3/15/2008 10:51:23 AM
Discharge = 9.84 pC, Voltage = 7.02 kV

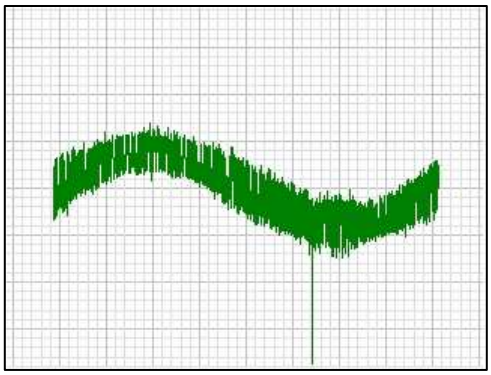
- Gas insulator is SF_6 at the voltage in cylinder 1.8 bar

The example of partial discharge on the oval time base, it would start at PD voltage 18.07 kV. in the angle position 265 degree, value at 14.35 pc



PD Detector 1 - 3/15/2008 7:21:35 AM
Discharge = 14.35 pC, Voltage = 18.07 kV

The example of partial discharge on the sine wave time base, it would start at PD voltage 18.03 kV. before the peak position of negative cycle, value at 15.27 pc



PD Detector 1 - 3/15/2008 7:22:01 AM
Discharge = 15.27 pC, Voltage = 18.03 kV

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5. Biographies (Optional)

Supawud Nedphograw received his B.Eng. and M.Eng.degrees in Electrical Engineering from Rajamangala University of Technology Thanyaburi (RMUTT),King Mongkut's Institute of Technology Ladkrabang (KMITL.) He has worked as lecturer at the Department of Electrical Power Engineering of RMUTT. since June 1998. In November 2006 he worked as lecturer and Head ,Department of Electrical Power Engineering in RMUTP, Thailand. His main research interests are applications of highvoltage Technology, highvoltage applications and Power energy saving.

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