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Effect of Different Polluted Condition on Electric Field along an Insulator

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Abstract- Insulator is one of the more usage and important equipment in power network. Due to the advantages of Silicon insulator it used in many condition especially in polluted condition so knowing the electric field intensity on the surface of that is necessary. In this paper at first silicon insulator and its advantages are explained then by using Finite Element Method (FEM) the polluted condition to know their effect on insulator is simulated. The results of the simulation showed the effect of each kind of pollution.

Keywords- *FRP, Insulator, Maxwell, polluted condition.*

I. INTRODUCTION

Silicon rubber insulator is one of the equipment that has suitable performance in distribution network. Up until recently due to the ductile composite insulator, it uses instead of the insulator they used before them. But gradually during the operation shows various characteristic that caused the market of silicon rubber insulator is increasing. Silicon rubber insulator to compare with other insulator such as glass insulator, porcelain insulator and polymer has some advantage. Some of them are in below [1] [2] [3]:

1. Excellent hydrophobicity
2. Good resistance to ultra violet that caused the silicon insulator has more life that other insulator
3. Flexibility (high mechanical strength)
4. Light weigh
5. Good electrical performance
6. Small volume
7. Convenient maintenance

Duo to the above tips the best choice for reign with various pollutions is using the silicon coating, because by using the silicon insulator the coast of cleaning and maintenance will reduced.

The SIR insulator structure with fibreglass insulator bars FRP is showed in figure 1. As can be seen, FRP core is placed between two metal electrodes. To protect the FRP core from natural stress such as ultra violet, ozone,... and also to create creep distance to reduce length of insulator, the sheds is used.

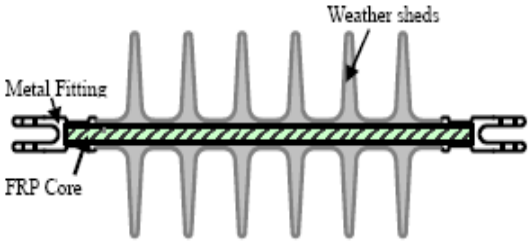

Figure 1: The SIR insulator structure with fibreglass insulator bars FRP

Corona phenomena may happen in the air around insulator in high electric field strength. Corona occurs on all types of transmission lines, but it becomes more noticeable at higher voltages (345 kV and higher). That caused acoustic noise, radio interference, energy losses, ozone, … and that ozone and ultra violet has effect such as fatigue and premature aging in insulator. In other hand electric field intensity may cause partial discharge this in turn can be broken insulators in terms of mechanical and electrical.

Similar studies on the electric field and potential distribution, such as [4] and [5] has been done. . In this paper effect of pollution on distribution potential and electric field on the surface of silicon rubber insulator as 2D by using stronger software such as MAXWELL is presented.

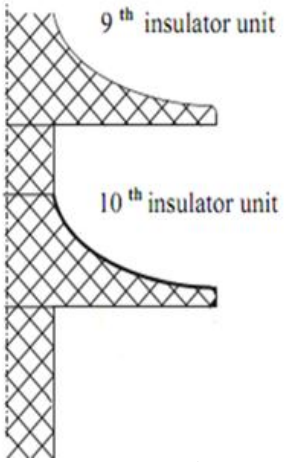

Figure 2: The model of insulator

Detailed simulation parameters are given in Table:

Table: Simulation parameters

Material	relative permitivity
Cement dust	8
Silicon rubber	4
FRP	7
Plywood dust	1.5

There are many relative permittivities due to the many kind of pollution and so only some of them are showed in table. In this study only the plywood dust and Cement dust is used as pollution.

II. SIMULATION RESULTS

In this part the simulation results for two different conditions is presented. Plywood dust and cement dust is used as pollution with relative permittivity that shows in table 1 in pollution condition.

A. Pollution of plywood dust

Figure 3 shows the electrical field intensity distribution on surface of insulator with pollution on the surface of insulator. To shows pollution condition and effect of that on electrical field intensity a layer of pollution is used on the surface of insulator.

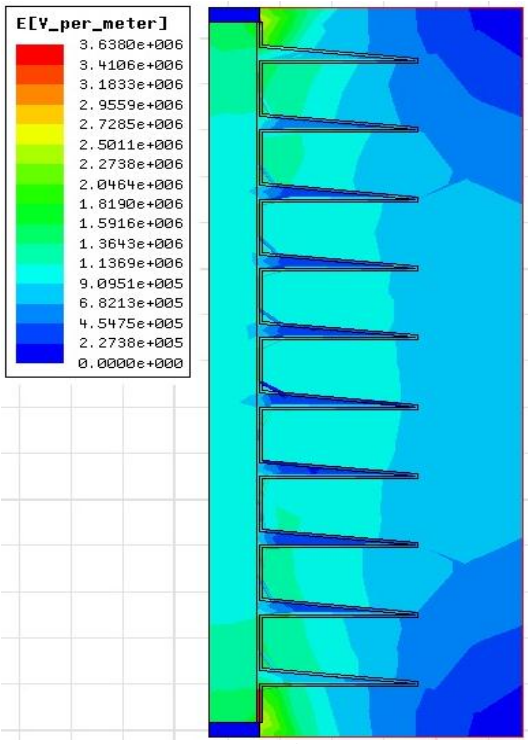

Figure 3: Electrical field intensity

In figure 4 the electric field diagram on silicon surface in polluted condition with plywood dust is given.

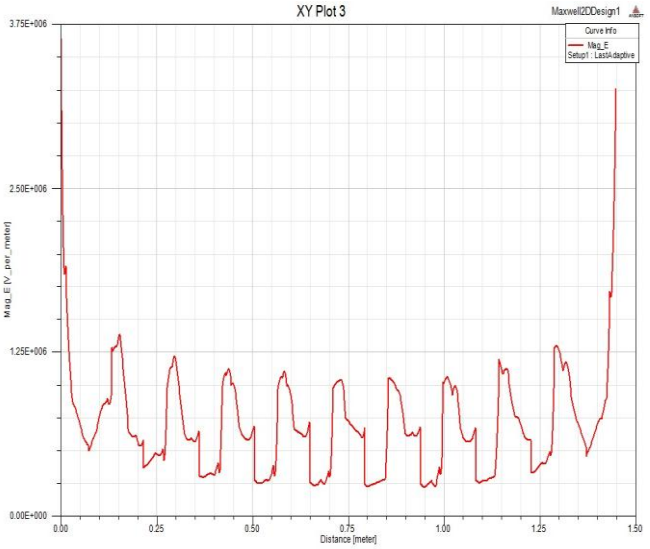

Figure 4: Electrical field intensity diagram

It is clear from this figures the electric field intensity is more than the normal value so the probability of electrical break in polluted condition is more than the condition without pollution.

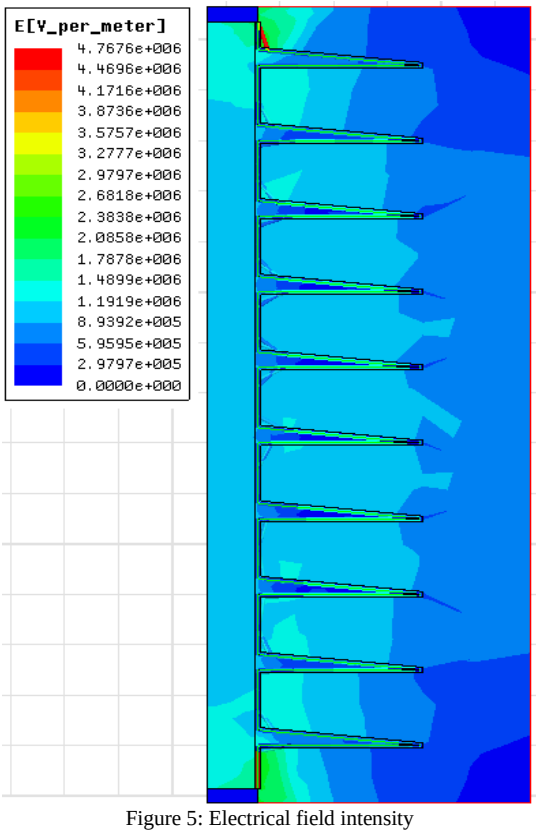

Figure 5: Electrical field intensity

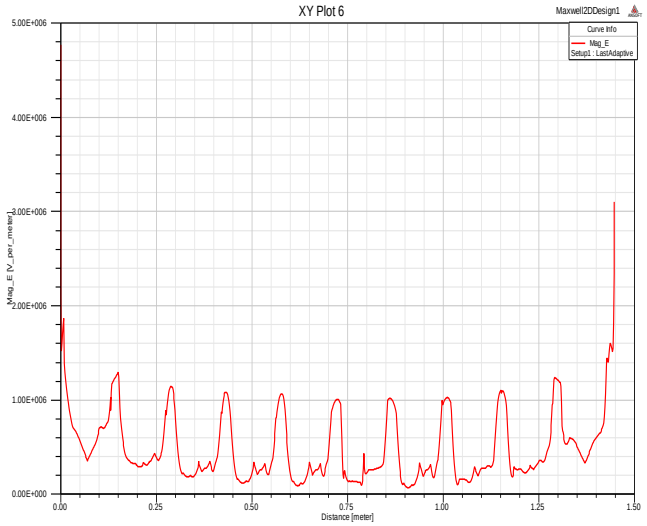

Figure 6: Electrical field intensity diagram

Figure 5 shows by increasing the permittivity probability of electrical break in polluted condition with cement dust is more than the condition with plywood dust. So the value of permittivity has relative direct relation with the probability of electrical break.

It is important to reduce this electric field and one of the goals is control this electric field intensity. The common way is using the corona ring but the design and the location of corona ring is more important to control the electric field intensity. As future work the design of corona ring is considered.

III. CONCLUSION

This study has presented electrical field in polluted condition for silicon rubber insulators. Simulation contains two different polluted conditions. As is clear from the simulation results there is difference between the electric field distributions in two different polluted conditions. It is clear the probability of electrical break in polluted condition with cement dust is more than the pollution condition with plywood dust and this related to the permittivity of each area. By using the corona ring this probability is reduced and as future work the design of corona ring is considered

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