EVALUATION OF ELECTRIC FIELD FOR ELECTRODE OF A PULSE ELECTROACOUSTIC (PEA) EQUIPMENT

NURASILAH BINTI KHAMAR LUDIN

MASTER OF SCIENCE

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

We hereby declare that we have checked this thesis and, in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science

____

(Supervisor's Signature)

Full Name : DR AMIR IZZANI BIN MOHAMED

Position : SENIOR LECTURER

Date : 21st March 2022

____

(Co-supervisor's Signature)

Full Name : DR MOHD MAWARDI BIN SAARI

Position : ASSOC. PROF

Date : 21st March 2022

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at University Malaysia Pahang or any other institutions.

____

(Student's Signature)

Full name : NURASILAH BINTI KHAMAR LUDIN

ID Number : MEE15006

Date : 21st March 2022

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ABSTRAK

Penggunaan elektrik telah menunjukkan peningkatan yang tinggi pada masa kini. Ini disebabkan oleh jumlah pengguna yang meningkat dalam sistem tenaga dengan tahap keselamatan yang tinggi. Grid sistem kuasa menghubungkan loji janakuasa melalui talian penghantaran voltan tinggi dan saluran pengedaran kepada pengguna. Saluran penghantaran arus terus voltan tinggi (HVDC) biasanya digunakan untuk memindahkan kuasa yang dihasilkan ke kawasan beban. Transmisi HVDC menunjukkan kerugian yang lebih rendah, kos rendah, mudah dikawal dan diselaraskan berbanding transmisi arus bolak voltan tinggi (HVAC). Di saluran penghantaran HVDC, kabel kuasa (PE) telah banyak digunakan sebagai penebat elektrik untuk kabel kuasa kerana sifat elektrik dan mekanikalnya. Dalam dua dekad ini, usaha yang baik telah dilakukan untuk memahami dengan lebih lengkap taburan cas di dalam bahan dielektrik. Terdapat dua jenis kaedah yang digunakan iaitu kaedah merosakkan dan tidak merosakkan. Walau bagaimanapun, kaedah tidak merosakkan mempunyai hasil yang lebih baik dalam memberikan perincian mengenai taburan cas pada bahan dielektrik. PE berketumpatan rendah digunakan dalam kajian ini sebagai sampel yang dipilih kerana sifatnya yang berketumpatan dengan julat 0,910 - 0,925 g / cm3, daya intermolekul yang lebih lemah, kekuatan tegangan yang lebih rendah, kemuluran yang lebih tinggi dan dapat dihasilkan di bawah tekanan tinggi. Selain itu, ia juga bersifat yang sangat baik seperti kehilangan dielektrik rendah, kekuatan dielektrik tinggi, kelembapan kimia, pengambilan kelembapan rendah dan kemudahan penyemperitan, menjadikannya mudah digunakan dalam banyak jenis aplikasi daya. Dalam kajian ini, pengaruh medan elektrik dengan elektrod tepi yang berbeza pada bahan dielektrik dianalisis menggunakan Kaedah Elemen Limit (FEM). Kesimpulannya, kita dapat melihat bahawa medan elektrik lebih tinggi pada bahan penebat dielektrik apabila jejari (r) mendekati 0mm kerana sisi elektrod yang tajam. Apabila jejari tepi elektrod meningkat, medan elektrik berkurang. Ini membuktikan bahawa sisi elektrod mempunyai pengaruh terhadap medan elektrik dalam bahan dielektrik. Medan elektrik juga semakin berkurang apabila jurang antara elektrod meningkat. Dengan adanya epoksi semasa simulasi tidak memberikan impak yang tinggi terhadap taburan medan elektrik tetapi diperlukan untuk memperbaiki penebat dan mengelakkan pelepasan antara elektrod. Dalam pemeriksaan ini, perhitungan lapangan dilakukan dengan menggunakan FEM.

ABSTRACT

The usage of electricity had shown a higher number of increments nowadays. It is due to a higher number of users requesting an improvement of power system equipment with a high level of reliability and safety. The power system grid connects the power plants through the high voltage transmission lines and distribution lines to the consumers. The high voltage direct current (HVDC) transmission line is usually used to transfer the power being generated to the load area. HVDC transmission shows lower losses, low cost, easy to control and adjust compared to the high voltage alternating current (HVAC) transmission. In the HVDC transmission line, the polyethylene (PE) power cable has been widely used as electrical insulation for power cables due to its electrical and mechanical properties. In the last two decades, a significant effort has been made to understand better the internal charge distribution inside dielectric materials. There are two types of methods being used which were destructive and non-destructive methods. However, the development of the non-destructive method has a better result which gives details about charge distribution inside a dielectric material. Low-Density Polyethylene was used during this study as sample selected due to its characters with a density range between 0.910 – 0.925 g/cm^3, weaker intermolecular forces, lower tensile strength, higher ductility and can be produced under high pressure. However, it also has excellent properties such as low dielectric loss, high dielectric strength, chemical inertness, low moisture uptake and ease of extrusion, making it easy to use in many kinds of power applications. In this study, the effect of an electric field with different edge electrodes on dielectric material was being observed and analyzed using the Finite Element Method (FEM). Based on the results, we can see that the electric field is higher at dielectric insulating materials when the radius(r) approaches 0mm due to the sharp edge of the electrode. As the radius of the electrode edge increases, the electric field decreases. It proves that the edge of an electrode has an effect on the electric field in a dielectric material. The electric field additionally diminishes as the gap between electrodes increases. The presence of epoxy during the simulation didn't give a high impact on the electric field distribution but it needed to improve the insulation and prevent the discharge between the electrodes. In this examination, the field calculations were done utilizing the FEM.

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