Effects Of Thermal And Electro-Osmotic Flux On Grounding Electrodes

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Abstract

Electricity has become the main source of heat, power, and light used in the modern world. Much of the technological advances made over the last few decades are due to electrical energy. One of the essential components of the electrical system is the grounding network. The continuous adequacy of the electrical service, maintenance, and safety is based on the importance given to the project and the construction of the grounding networks.In these applications, soil characteristics and dynamics are essential to meet electrical safety standards. Depending on the properties of the soil and in case of failure in grounding, the electrode may be damaged, thus preventing the use of the transmission system, in addition to possible human losses.

In other words, the project needs a grounding system that requires an accurate assessment of soil conditions.Studies and research on soil heating around an electrode, present a gap regarding the interactions between electro-osmotic, electrical and thermal phenomena considering a transient and dynamic behavior of the process of raising the temperature of the soil, from the continuous injection of the electric current in the electrode. This work intends to present the perspectives of the research on the performance of the soil in the vicinity of an active grounding system, considering the behavior of the electrical potential and its correlations with electro-osmosis and thermal flow. If through the grounding system, currently flows with significant intensity, from the Joule Effect, there will be an increase in heat generated in the soil. This type of unstable condition causes the electrode to dry out, which can be driven by extremely high values of electrical and thermal resistivity of the environment.

Therefore, we aim to establish a coupled model of electro-osmotic and thermal fluxes in the soil, considering the establishment of an electric field generated by the presence of current in the electrode, causing an apparent disturbance around.A hypothesis with stratified soil was simulated using the software COMSOL Multiphysics®. Considering an electrode as a metal rod in a vertical position located 1m deep from the ground level. From the Batteries and Fuel Cells Module, the Joule Effect and Heat Transfer in Porous Media interfaces were worked on. In contrast, the electro-osmotic flow was modeled from the Electric Currents physics interface, contained in the basic configuration of COMSOL®. For the reproduction of the electric potential, an equation that represents the parameter in stratified soils, named Vtot, was inserted. In the electro-osmotic process, the electrode represents the anode (positive pole), where the water flow is directed to the cathode (negative pole), as shown in Figure 1. For the electrical grounding system, the cathode is located at long distances from the anode.The expected results aim to prove the effects of the electro-osmotic and thermal flux on the dryness of the electrode, from the coupling with the Joule effect and the establishment of the electric field.

Figures used in the abstract

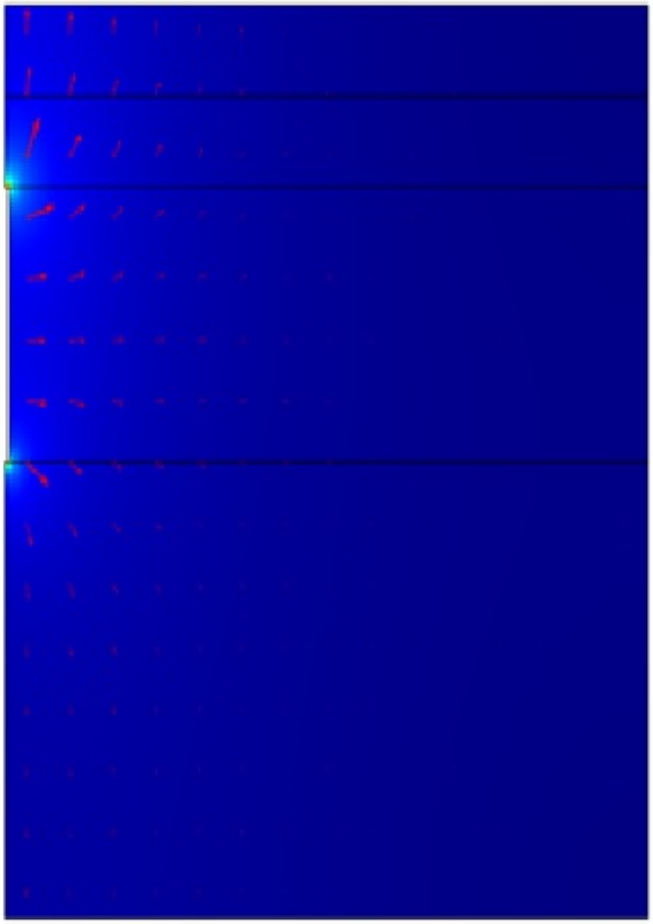

Figure 1 : Figura 1: Flow – velocity electroosmosis term