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DETERMINATION OF ELECTRODE SPACINGS IN LABORATORY TANKS TO OBTAIN APPROPRIATE VALUE OF ELECTRIC VOLTAGE

In the study, the results of electrical potential distribution in dimensional limited and electrically insulated volume are presented. An estimation of distance of feeding electrodes on resulting voltage values of measurements in limited area referenced to unlimited area are also presented.

Key words: numerical simulation, numerical experiment, stationary flow of current.

Introduction

1. Numerical simulations of electrical potential distribution in limited area.

In case of electrical measurements in limited area of laboratory's tests, determination of laboratory's tank dimensions and electrode spacings are very important to get appropriate results of electrical measurements. In order to achieve this, numerical simulations of electrical potential distribution in parametrically changed conditions using Comsol 4.3b program were performed.

1.1 Basic assumptions and initial values

The area of electrically insulated tank is L3 = 3[m] with depth 0.4[m] and 0.2 [m], The reference areas are L10 = 10[m] and L15 = 15[m] with the same depth as the regarded tank. The reference areas represents infinite medium with conductance about 200 [S]. The electrodes with potentials –10 [V] and +10[V] are placed on the top of tank. We solved the primary problem with stationary conditions and the parametrically changed parameters were: length of laboratory's tank (L), distance of electrodes (d) and depth of conducting medium (H). Schematic figure of configuration is presented in Fig.1.

1.2 Numerical simulations

To get appropriate results of numerical simulation we set an electrical insulation on all boundaries of domain, material with conductance 200[S] and user's free tetrahedral mesh. In study options we choose parametric solver for stationary conditions. The snapshot of this program is presented on Fig. 2. After numerical simulation of stationary processes using DC current's module we get distribution of electric potential on the top of tank limited to distance of electrodes (Fig. 3).

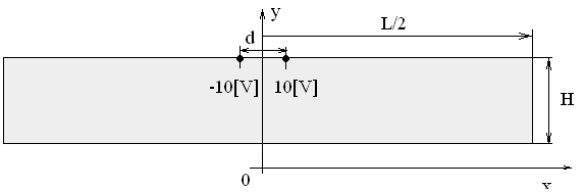

Fig. 1. Configuration of laboratory's tank

2. Evaluating accuracy of voltage measurements

In field measurements of electric potential, the analyzing area is infinite, but in case of laboratory's tank the area is limited by the surrounding non conducting walls. To evaluate the influence of the walls on results of measurements we used the results of potential for the area with length L3 3[m] (laboratory tank) and L10, L15 representing an infinite medium and we calculated the percentage error of measurements due to insulated walls (Fig. 4).

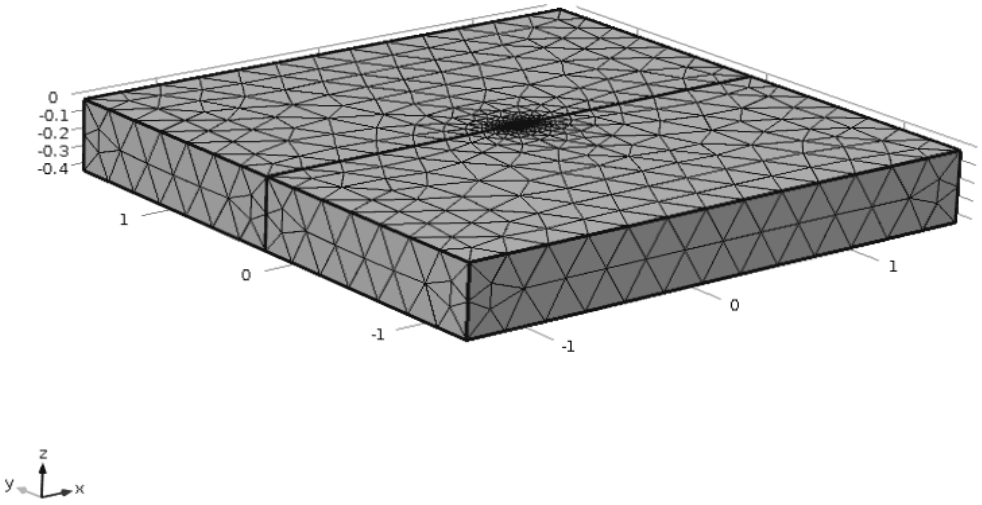

Fig. 2. Free tetrahedral meshing in Comsol Multiphysics

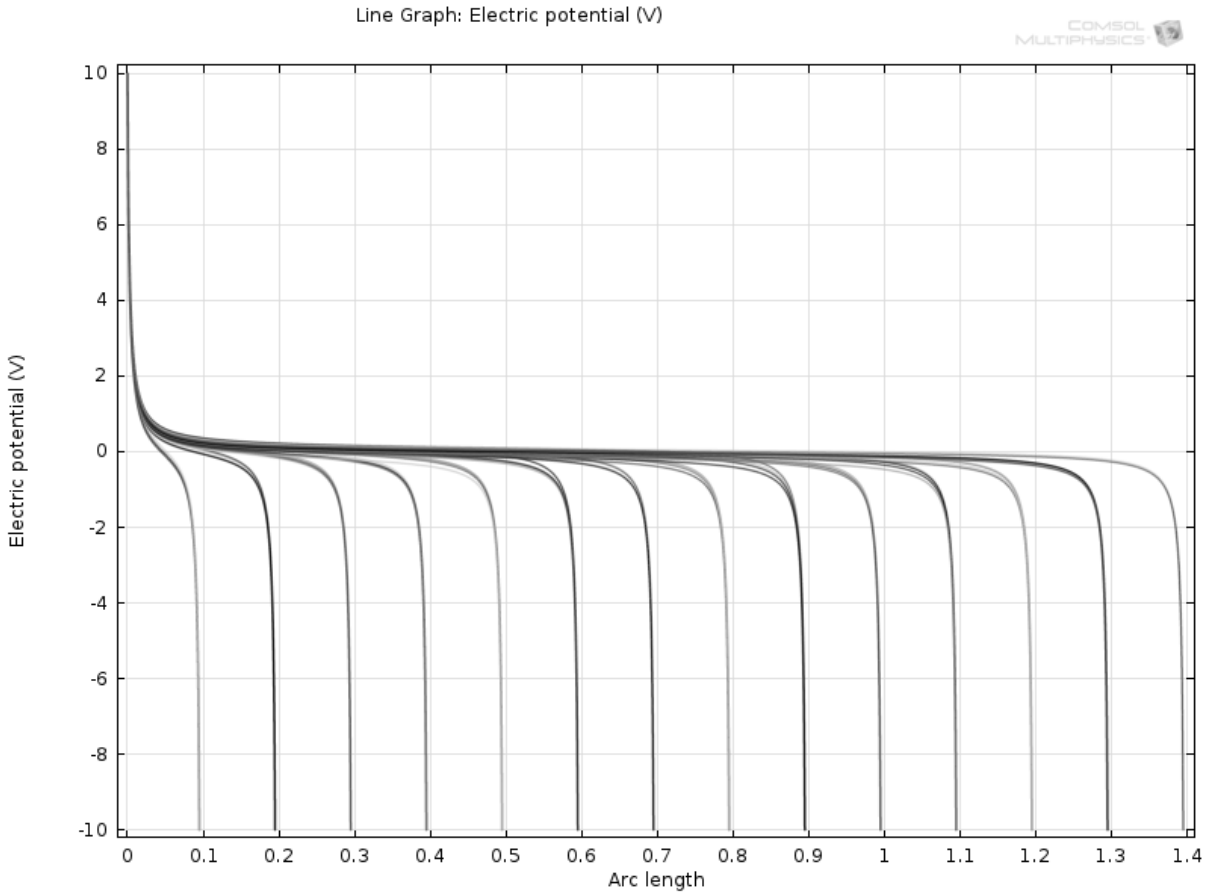

Fig. 3. Distribution of electric potential with different parametric conditions

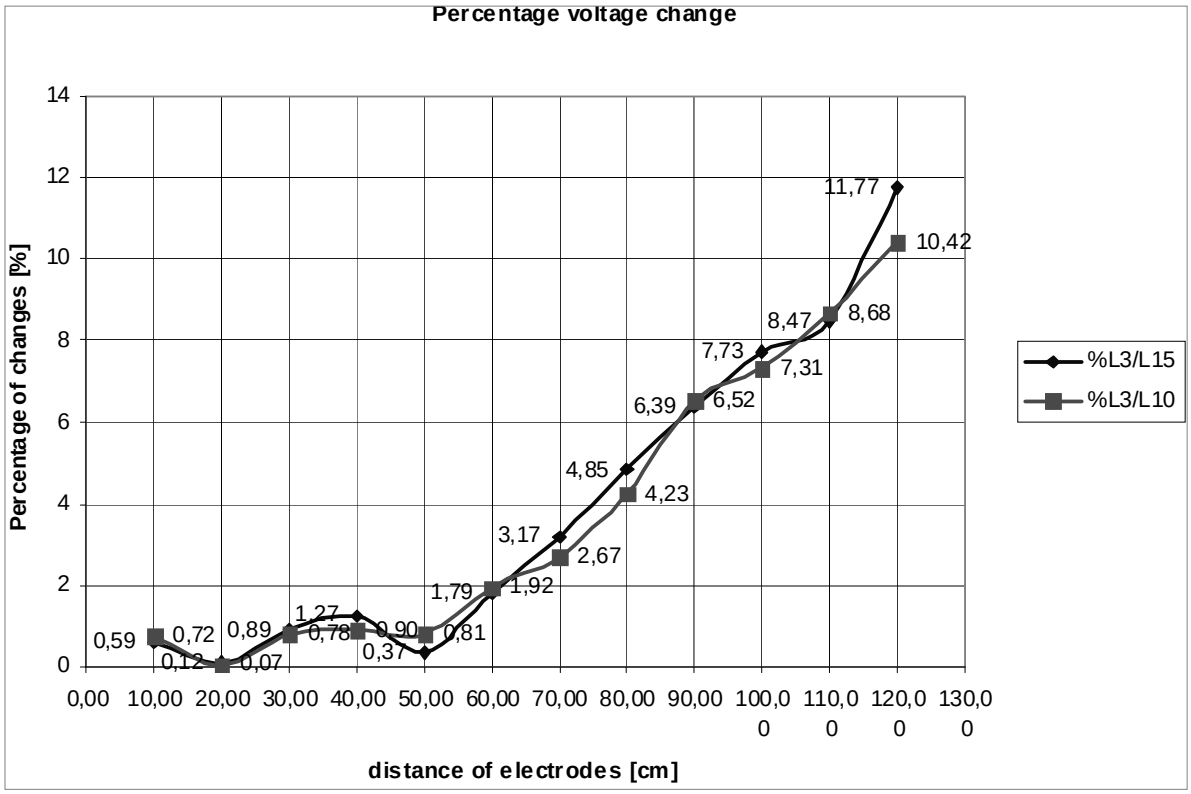

Fig. 4. Percentage voltage change vs distance of electrodes

On the Fig. 3 the changes of proper values of voltage in limited area of laboratory tank are presented. The minimum influence of nonconducting wall on electric voltage is for electrodes with distance up to 50 [cm] (1/6 of the length of tank). For the best results, the current electrodes must be located on maximum distance equal 1/3 of the length of the laboratory tank, where the error is about 7.5 %.

References

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ВИЗНАЧЕННЯ РОЗМІЩЕННЯ ЕЛЕКТРОДІВ У ЛАБОРАТОРНИХ БАКАХ ДЛЯ ОТРИМАННЯ АДЕКВАТНОЇ ЕЛЕКТРИЧНОЇ НАПРУГИ

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У роботі наведено результати дослідження розподілу електричного потенціалу в обмеженому та електроізольованому середовищі. Також наведено оцінку впливу відстані між живильними електродами на величини результуючої напруги вимірювань у обмеженому середовищі відносно необмеженого.

Ключові слова: чисельне моделювання, чисельний експеримент, стаціонарний потік струму.

ОПРЕДЕЛЕНИЕ РАЗМЕЩЕНИЯ ЭЛЕКТРОДОВ В ЛАБОРАТОРНЫХ БАКАХ ДЛЯ ПОЛУЧЕНИЯ НЕОБХОДИМОГО ЭЛЕКТРИЧЕСКОГО НАПРЯЖЕНИЯ

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В работе приведены результаты распределения электрического потенциала в ограниченной и электроизолированной среде. Также приведена оценка влияния расстояния между питающими электродами на величину результирующего напряжения измерений в ограниченной среде относительно неограниченной.

Ключевые слова: численное моделирование, численный эксперимент, стационарный поток тока.

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