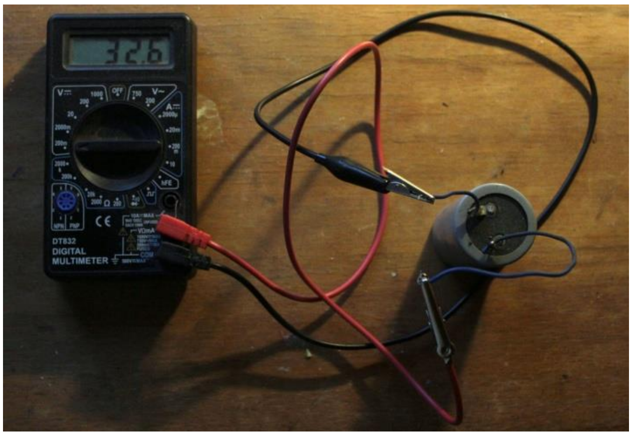
Correlation of the residual charge of an electrolytic capacitor with the Earth's magnetic field

Evgeny Arsyukhin, Russia

The effect of the diurnal variation of the residual charge of the electrolytic capacitor is revealed. The change in voltage between the capacitor plates correlates with high accuracy with the daily change in the strength of the Earth's calm magnetic field. We were unable to find a description of such an effect in the literature. It can be interesting for school teachers to organize simple experiments at school.

A fully discharged electrolytic capacitor spontaneously charges due to dielectric polarization. On January 12 2020, for educational purposes, we set up a simple experiment to demonstrate the effect of dielectric polarization. The experiment was conducted in the European part of Russia, in a small village, 25 kilometers from a small town and 120 kilometers from a metropolis. A low-power transmission line approaches the village. Geographical latitude - 56 degrees. Local time is +3 hours to universal time. The ambient temperature ranged from minus 5 to plus 5. The weather was even.



Experimental setup

A 2000 microfarad ELNA capacitor was connected to a simple household multimeter. The results were in full accordance with the theory. We carefully discharged the capacitor. In 50 minutes, he gained a maximum voltage of 4.5 millivolts. Further, the capacitor began to lose voltage due to charge leakage, and after five hours the voltage dropped to 1.3 millivolts.

It seemed interesting to us to see how the tension would behave further. We watched the multimeter for five days. The multimeter did not turn off. We understood that a multimeter can also charge a capacitor to some extent. The readings were taken every 30 minutes during the day, and every 2-3 hours at night.

For data processing, we converted hours and minutes to fractions of a day. This made it possible to visually compare the results obtained on different days. We found that voltage fluctuations show a clear diurnal course, which, with some variations, is repeated from day to day. The data are given in the graph at the end of the article.

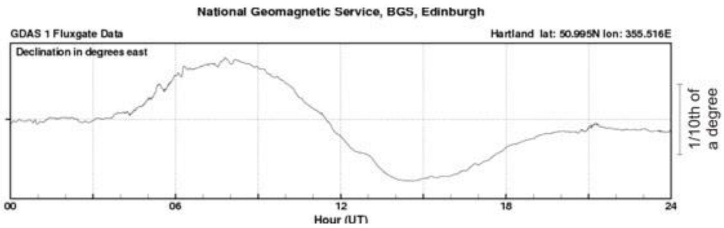
At about 4 a.m. local time, the voltage reaches its maximum value. Then it drops quite sharply, reaching a minimum of about 17 hours. In some cases, the voltage reversed polarity. Further, the voltage rises quickly enough. On the graphs, the horizontal axis shows time in fractions of a day from the local midnight, and the vertical axis shows multimeter readings in millivolts.

These fluctuations cannot be associated with local interference, since the rhythm of the village is completely different. The maximum electricity consumption, respectively, the inclusion of electrical appliances is observed about 20-22 hours. We could expect a pronounced acute extremum around this time. But the data is completely different.

We noticed that the picture that we observed completely coincides with the diurnal oscillations of the Earth’s calm magnetic field (1). According to the Magnetic Observatory in Edinburgh, England, the Earth's magnetic field is at its maximum in the early morning hours, and decreases to a minimum of about 15-17 hours.

We did not find a description of such an effect in the literature. We attribute this effect to the magnetodielectric effect. A change in the Earth's external magnetic field leads to a change in the orientation of the dielectric particles in the electrolyte. We are surprised that the effect is so pronounced and noticeable even by the most primitive equipment.

The results of our study may be of interest to school teachers to demonstrate subtle physical effects to students. Perhaps this is a cheap way to set up observation of the Earth’s magnetic field for educational purposes.



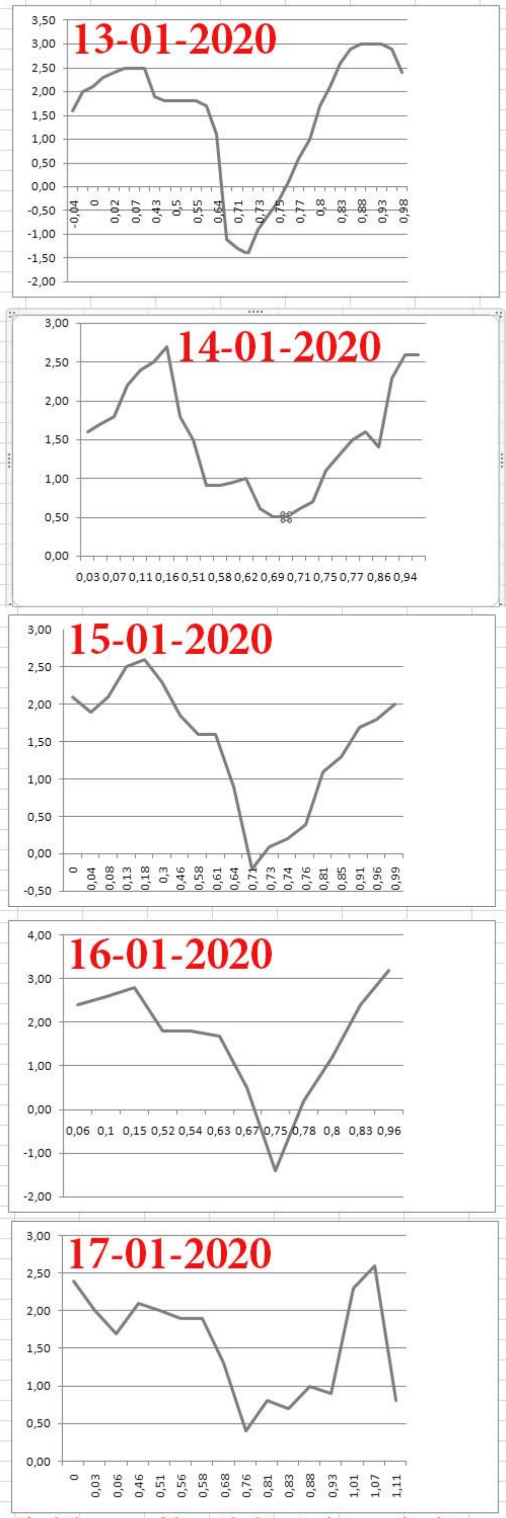
The daily course of the calm magnetic field of the Earth according to the observatory in Edinburgh

References

1.http: //www.geomag.bgs.ac.uk/education/earthmag.html

Contact author

sience_2020@mail.ru



The daily course of the residual tension between the plates of the electrolytic capacitor. On the horizontal axis - time in fractions of a day. Vertical - voltage in millivolts.