RESEARCH OF THE BEHAVIOR OF DIAMAGNETICS IN A NONUNIFORM MAGNETIC FIELD FOR USE IN SEPARATION TECHNOLOGIES

United Nations Educational, Scientific and Cultural Organization

Junior Academy of Sciences of Ukraine under the auspices of UNESCO

Author: Oleksandr Stasovskyi, Dnipro Lyceum of Information Technologies at DNU
Supervisor: Oleh Orlianskyi, Associate Professor of Theoretical Physics Department, DNU, Dnipro

Introduction

Magnetics are used in many technological processes. However, the use of diamagnetic compared to ferromagnetic and paramagnetic is somewhat limited. Unlike ferro- and paramagnetic, they also behave strangely - they repel magnets. It is important and interesting to investigate the properties of the processes by which this occurs, to consider the magnitude of the contribution of this effect and find it to solve problems, such as oil spills in open water.

Project aim and tasks

Research of interaction of diamagnetic with a nonuniform magnetic field; explanation of the phenomenon of diamagnetism at the model level, analysis of the magnitude of its influence and the possibility of its use in separation technologies.

- Development of a simplified theoretical model of interaction of diamagnetic with the magnetic field;
- Numerical estimates of the interaction depending on the parameters;
- Conducting experiments with different magnetic.

Results

The magnetism interaction force with the magnetic field has been calculated:

$$f_x = \frac{\mu - \mu_0}{\mu\mu_0} B \frac{\partial B}{\partial x} = \frac{1}{2}\frac{\mu - \mu_0}{\mu\mu_0}\frac{\partial B^2}{\partial x}.$$

Using this formula, the velocity of the ice-forms was estimated $v \approx 3$ *km/a*, which is approximately 1% of their real velocity.

To confirm the theory, a series of experiments on the interaction of ice with a nonuniform magnetic field were carried out:

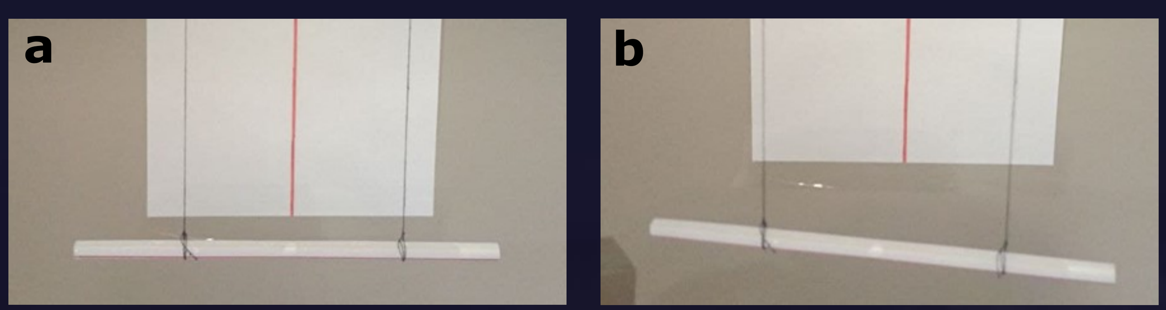


Fig. 1. Ice without the influence of the magnetic field (a) and under the influence (b)

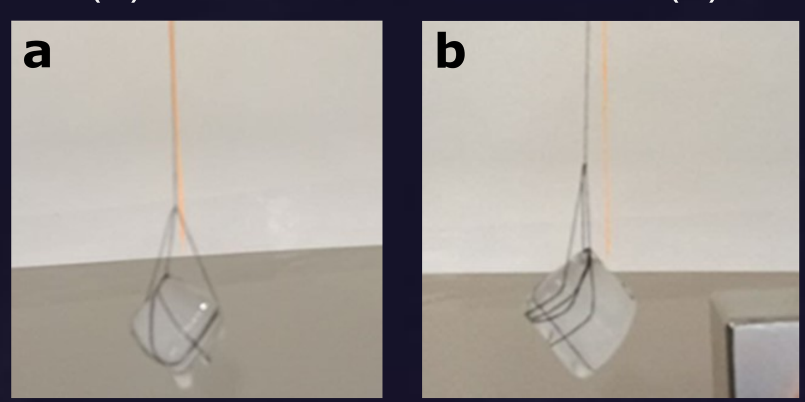


Fig. 2. Ice without the influence of the magnetic field (a) and under the influence (b)

One and the same drop of water under the influence of the magnetic field of different intensities:

Fig. 3. Water without influence (a), under weak (b) and under strong influence of the magnetic field (c)

Diamagnetic levitation of pyrolytic graphite:

Fig. 4. Pyrolytic graph without pressure (a), with medium (b) and with the largest additional mass (c)

The experimental part with the petroleum slick was carried out in three stages:

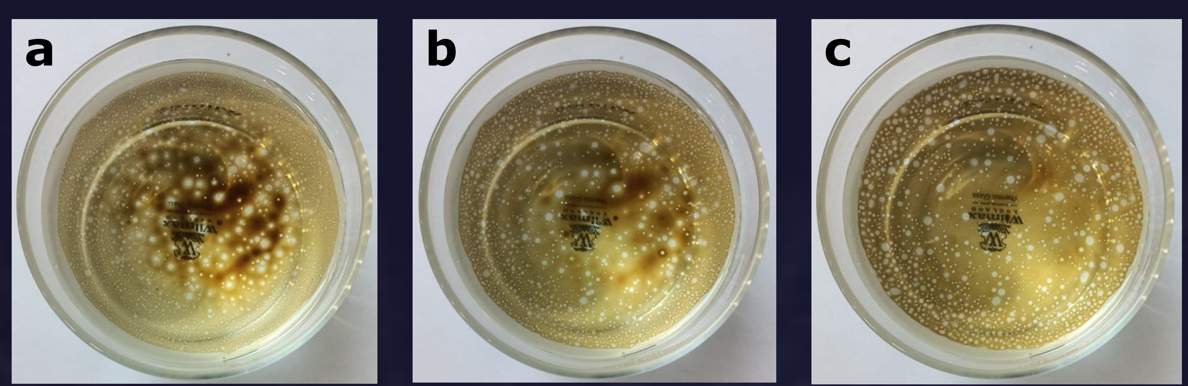


Fig. 5. Oil slick in one (a), two (b) and three (c) minutes without the influence of the magnetic field

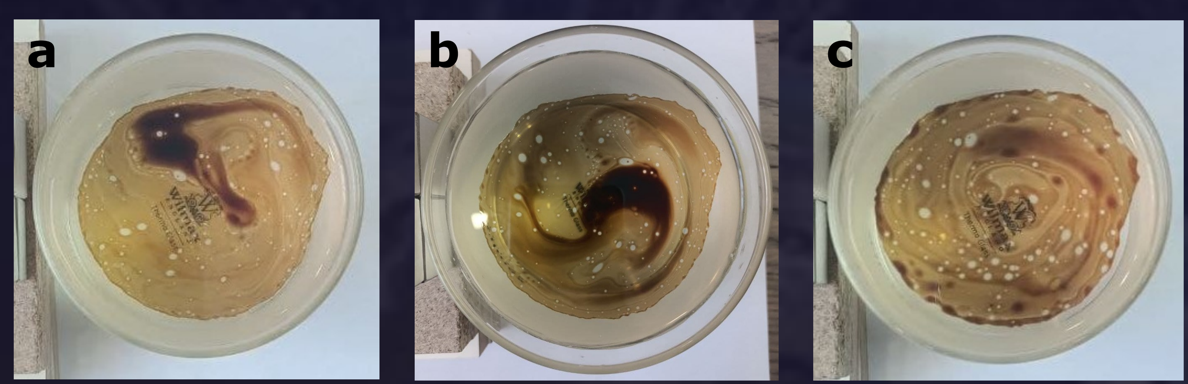


Fig. 6. Oil slick in one (a), two (b) and three (c) minutes under the influence of magnetic field

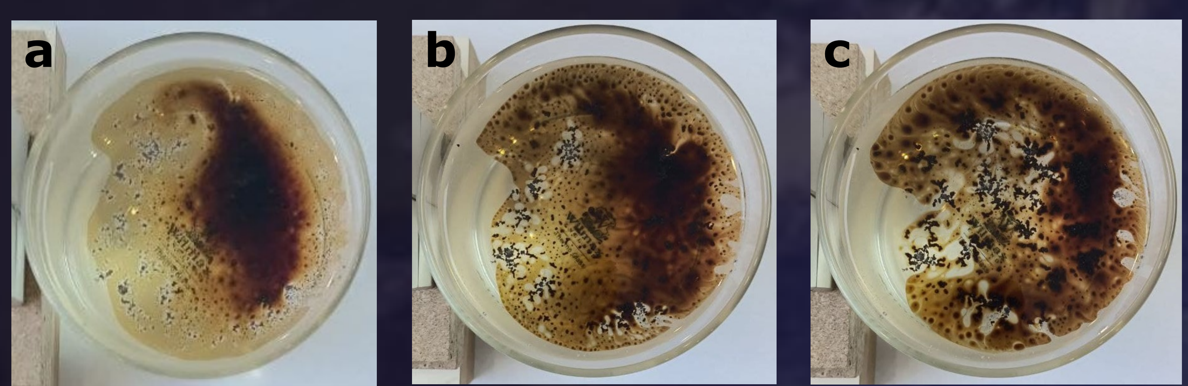
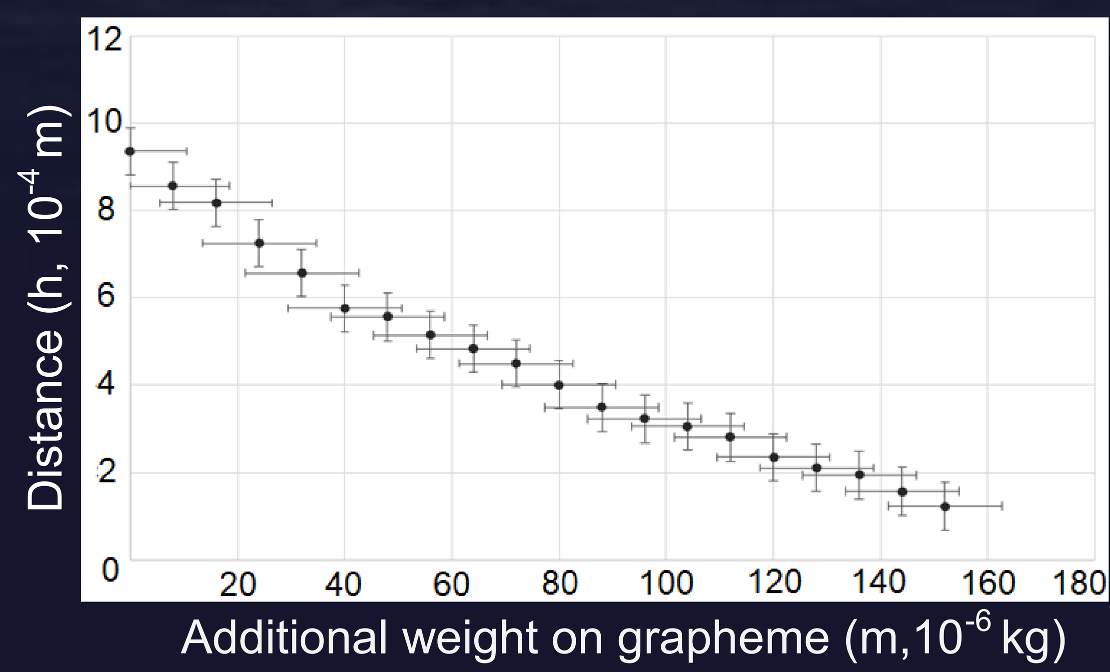
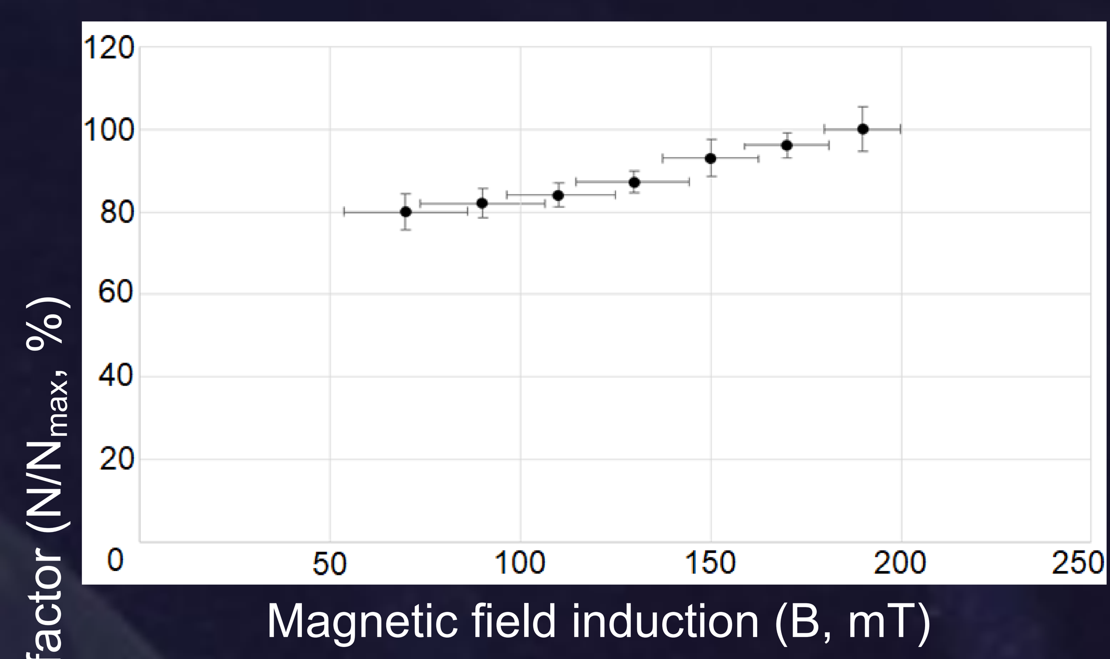


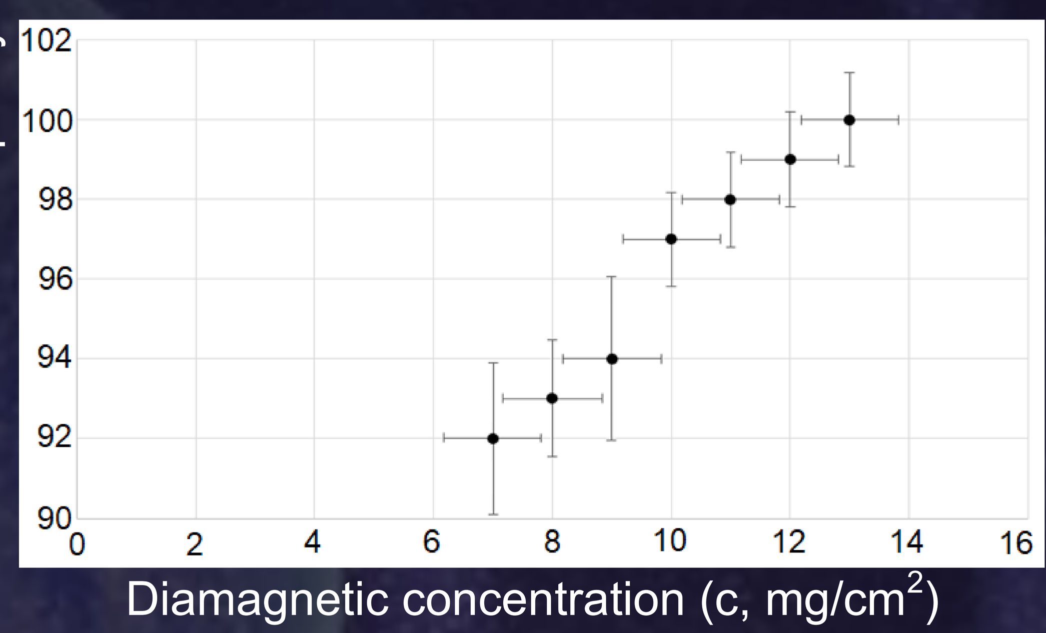
Fig. 7. Oil slick in one (a), two (b) and three (c) minutes with diamagnetic powder

Experimental dependence of the height of levitation of pyrolytic graphite on the pressure:



As a result, a series of experimental dependencies was obtained:





Conclusions

In this work, using a simplified model, we theoretically calculate the expression of the interaction force of a diamagnet with an inhomogeneous magnetic field and propose a theoretical explanation of diamagnetism at the level of school physics, which can give a visual representation of its cause. One reason for the drift of glaciers toward the equator has been proposed. An assessment of the additional contribution to their velocity indicates that the diamagnetic nature of ice should be taken into account. Hypotheses have been advanced about the "cleaning" of hydrogen clouds, the mechanism of water appearance on the Moon, and the possible reason for the difference in the composition of the planets of the solar system, which may be relevant to the issues of planet formation. With the emergence of more and more powerful magnets, one can envision more attention to diamagnetic in technology, such as the proposed method of oil spill response, based on magnetic oil separation.