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The Influence of Gaseous Media on Biefeld-Brown Effect

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ABSTRACT

The goal of the paper was to investigate the influence of the surrounding gaseous medium on the force generated by a high voltage capacitor with asymmetrical electrodes during the so called Biefeld-Brown effect. A series of measurements of the generated force in two common technical gasses - pure oxygen and pure sulfur hexafluoride show that the surrounding medium does influence the generated force in such a way as was predicted by a previously derived formula giving a mathematical and physical description of the phenomenon. Thus the experiments prove the rightness of the derived formula and its predicted relation between the ion mobility coefficient and the generated force.

Keywords: Biefeld-Brown effect, high voltage, ion mobility coefficient, gaseous medium, asymmetrical capacitor, sulfur hexafluoride

INTRODUCTION AND BASIC THEORY

Biefeld-Brown effect is an electrical phenomenon, which can be observed on a high voltage capacitor with highly asymmetrical electrodes [1]. When voltage higher than the corona inception voltage (for the current medium) is applied to the capacitor electrodes, the smaller of the two electrodes starts ionizing the medium around itself, thus generating charged particles. These are accelerated (due to the electric field) towards the larger electrode and on the way collide with the neutral molecules of the surrounding medium (most commonly air). During these collisions the charged particles transfer their momentum to the neutral molecules. This generates a force (see Figure1) affecting the whole capacitor in the direction from the larger electrode towards the smaller electrode (independent of the polarity of the applied voltage), while also generating a stable and directed neutral air flow in the opposite direction.

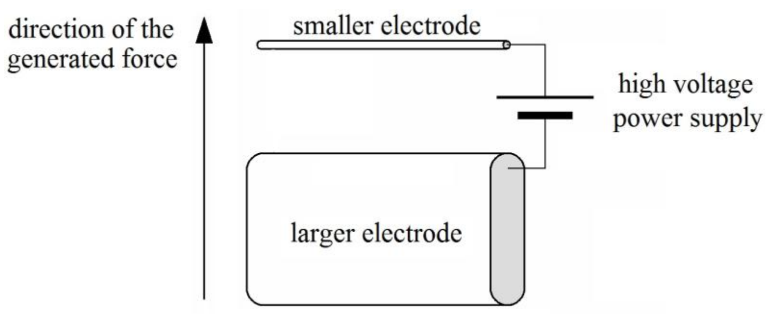

Figure1. *Principle of the force generated on the asymmetrical capacitor*.

The author of this paper has in a previous publication [2] presented a detailed mathematical and physical description, which lead to deriving the following formula using basic physical laws and equations. The formula itself describes the magnitude of the generated force F (i.e. the force moving the whole capacitor):

$$F = (I \,.\, d) / \mu, \qquad (1)$$

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where I is the electrical current flowing through the capacitor, d is the distance between the capacitor electrodes and μ is the ion mobility coefficient. The apparent linear relation between the generated force F, the electrical current I and the distance between electrodes d has been measured and proven [3], while the ion mobility coefficient was always considered invariable.

THE EXPERIMENT

The main goal of this paper is to experimentally evaluate the influence of the ion mobility coefficient μ on the generated Biefeld-Brown force F. To achieve this, we measured the generated force in two different gaseous mediums. The practical realization of the experiment was not easy, since the whole measuring setup had to be enclosed in an air-tight chamber filled with a chosen gaseous medium. For this purpose a measuring chamber (dimensions 250 x 400 x 600 mm) has been constructed using see-through Plexiglass sheets. The whole measuring setup enclosed in the measuring chamber can be seen in figure2.

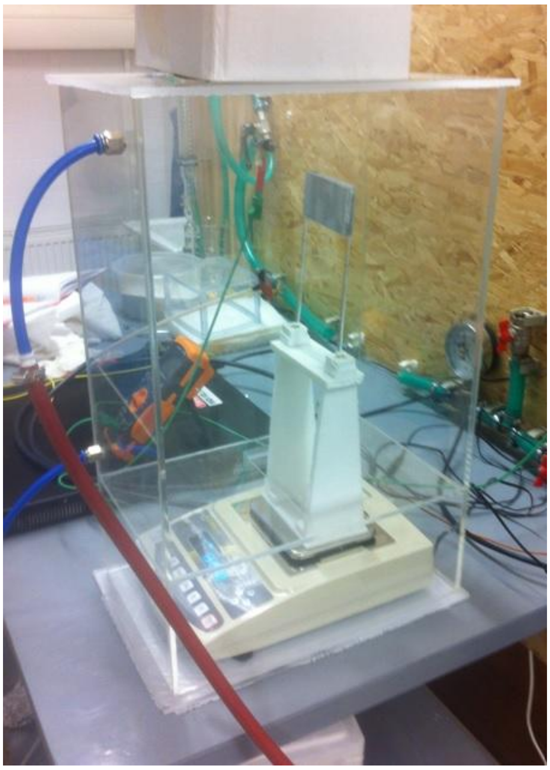

Figure2. *The whole measuring setup: digital balance, Styrofoam support and the asymmetrical capacitor inside the measuring air-tight chamber.*

To measure the electrical current I flowing through the circuit we used a multimeter Agilent U1252B in the range of μA. Since the generated force F is relatively small to be measured by any normal means (in the range of mN), we used a digital balance KERN PEJ620-3M to measure the force as an increase of weight, which can then be simply transformed back into force [3]. Lastly we used the high voltage power source Glassman FX to supply the capacitor with DC voltage in the range of tens of kV.

First of the measured gasses was pure (> 99%) sulfur hexafluoride – SF_6. This technical gas is well known for its exceptional insulating properties and is commonly used for pressure filling of high voltage transformers, etc. As a general rule [4] the higher is the weight of the moving particle the lower is the ion mobility coefficient μ. As the molecules of sulfur hexafluoride are much heavier than the molecules of oxygen, which will be used as the second gaseous medium, this choice should produce good results, since the ion mobility coefficient of sulfur hexafluoride molecules is also much lower then that of the oxygen molecules. Pure (> 99%) oxygen as the second gaseous medium was used because of its availability.

MEASUREMENT RESULTS

The results of the measurements can be seen in figure3. It shows the relation between the force F generated on the asymmetrical capacitor and the electrical current I flowing between the capacitor electrodes for both measured gases.

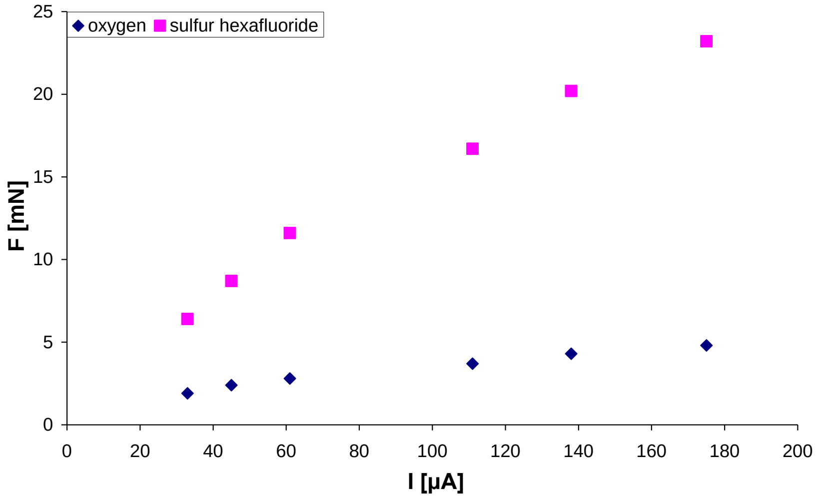

Figure3. *Relation between the force* F *generated on the asymmetrical capacitor and the electrical current* I *flowing between the capacitor electrodes for oxygen and sulfur hexafluoride.*

Figure3 clearly shows, that for the same electrical current *I*, the generated force *F* is far greater in sulfur hexafluoride than in oxygen. This proves our earlier hypothesis, according to which the much heavier sulfur hexafluoride ions having a considerably lower ion mobility coefficient μ cause a distinctively greater force to be generated on the capacitor, than the lighter and also more "mobile" oxygen ions, just as the derived formula (1) predicted. This can also be considered an experimental proof of the inclusion in the formula (1) of the ion mobility coefficient μ as a parameter characterizing the properties of the medium surrounding the asymmetrical capacitor.

CONCLUSION

The results of our measuring of the Biefeld-Brown force generated on a high voltage capacitor with asymmetrical electrodes in oxygen and sulfur hexafluoride empirically prove the formula (1) as it pertains to the ion mobility coefficient of the medium, in which the capacitor is placed. The lower the ion mobility coefficient μ, the higher the force *F* generated at the same electrical current.

Another important fact obtained through this research is the knowledge that the only phenomenon responsible for the generation of the force during the so called Biefeld-Brown effect is the motion of charged particles between electrodes through a neutral medium. This disproves previously published theories such as electrogravity [5] or dielectrophoresis [6].

Further important for any possible practical application of this phenomenon is the fact, that due to its outstanding insulating properties sulfur hexafluoride enables the capacitor to work at voltages and currents much higher than in oxygen or air (without a spark discharge), thus making it possible to reach a much higher generated force *F*.

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Jiří Primas, was born in 1982 in Liberec, Czech Republic. In 2008 he received an engineering degree (Ing.) in Mechatronics at the Technical University of Liberec, where he also received his doctoral degree (Ph.D.) in Applied sciences in engineering in 2014.