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# THE CAVITATION EFFECT ON THE ELECTROMAGNETIC FIELD

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**Summary:** *It is generally known, that liquids, including water, are electrically conducting. The electric conductivity magnitude among others depends on the minerals concentration. Using the additives it is possible to increase the electric conductivity.*

## 1. INTRODUCTION

The flowmeters principle is also based on the electromagnetic conductivity. However the electromagnetic voltage magnitude caused by the movement of current carriers that are drifted in the flow is very small. It is possible to enhance the voltage by cavitation, which increases velocity of the moving charges by several orders of magnitude compared to non-cavitating flow. Following figures show the moving cavitation bubbles.

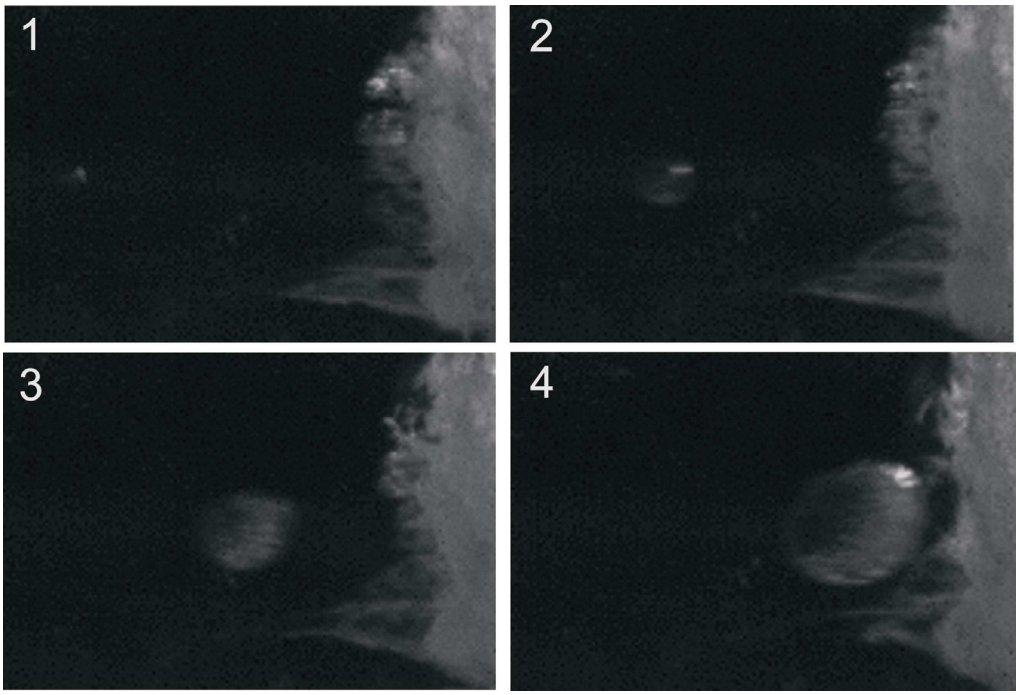


Fig. 1 Cavitation bubbles movement

The collapse and velocity of the bubbles is a dimension higher than the moving liquid.

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The cavitation bubble (of spherical shape – see Fig. 2) collapse is described by the Rayleigh- Plesset equation:

$$\frac{3}{2}R^{\bullet 2} + RR^{\bullet\bullet} + 2\frac{\sigma}{\rho R} - \frac{1}{\rho}\left[p(0) + \frac{2\sigma}{R_0}\right]\left[\frac{R_0^3}{R^3}\right]^{\kappa} + 4\eta\frac{R^{\bullet}}{R} = +\frac{1}{\rho}\left[p(0) - p_N(t)\right] \qquad (1)$$

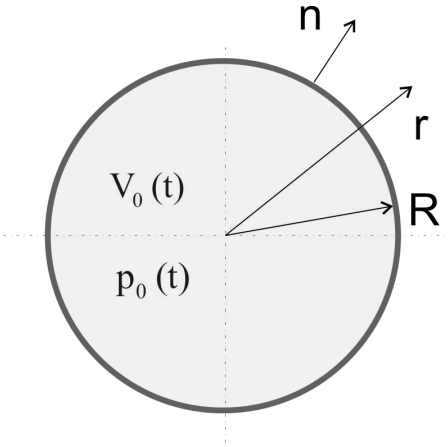


Fig. 2 The spherical shape cavitation bubble

| Input parameters | |
|---|---|
| $p(0)$ | 100000 Pa |
| $\sigma$ | Surface tension |
| $R_0$ | Starting radius |
| $f_{ext}$ | 26500 Hz |
| $p_N$ | $p_a \sin(2\pi f_{ext} t)$ |
| $R_0$ | 0,0000045 m |
| σ | 0,0725 N.m$^{-1}$ |
| κ | 1,33 |
| ρ | 998 kg.m$^{-3}$ |
| η | 0,01 Pa.s |

Fig. 3 The input parameters

Fig. 4 shows the cavitation bubble diameter change as a function of time calculated by the Rayleigh- Plesset equation (1).

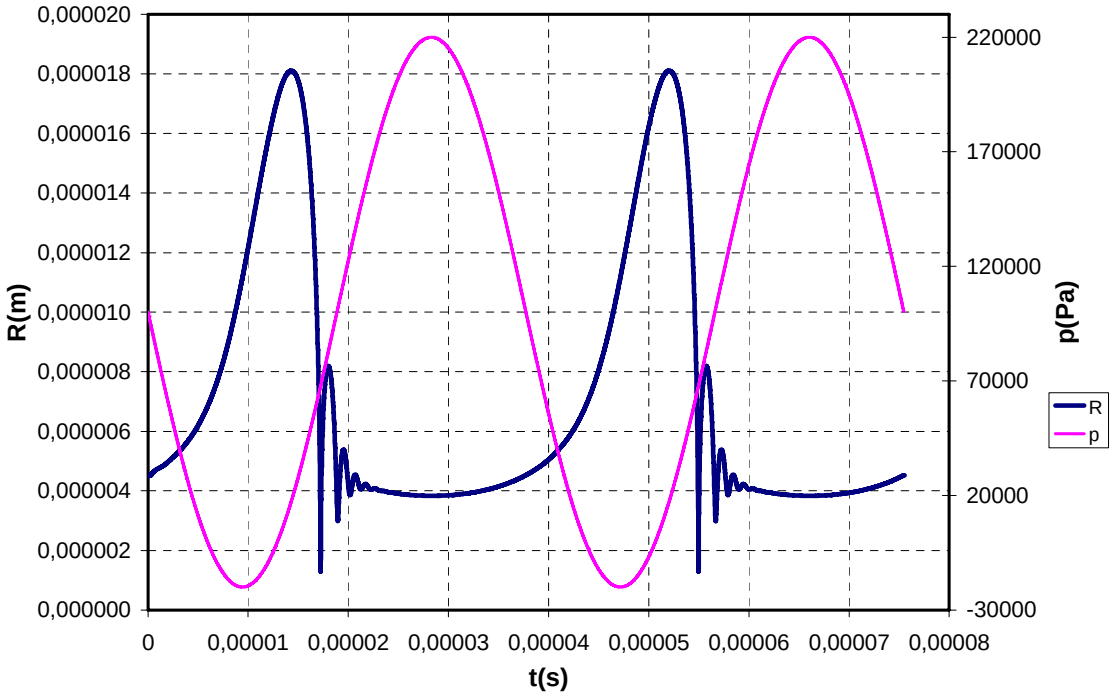


Fig.4 Cavitation bubble diameter change as a function of time

It is obvious that velocity of cavitation bubble collapse can significantly affect the values of the magnetic induction, magnetic field, permanent magnet close to the pipe.

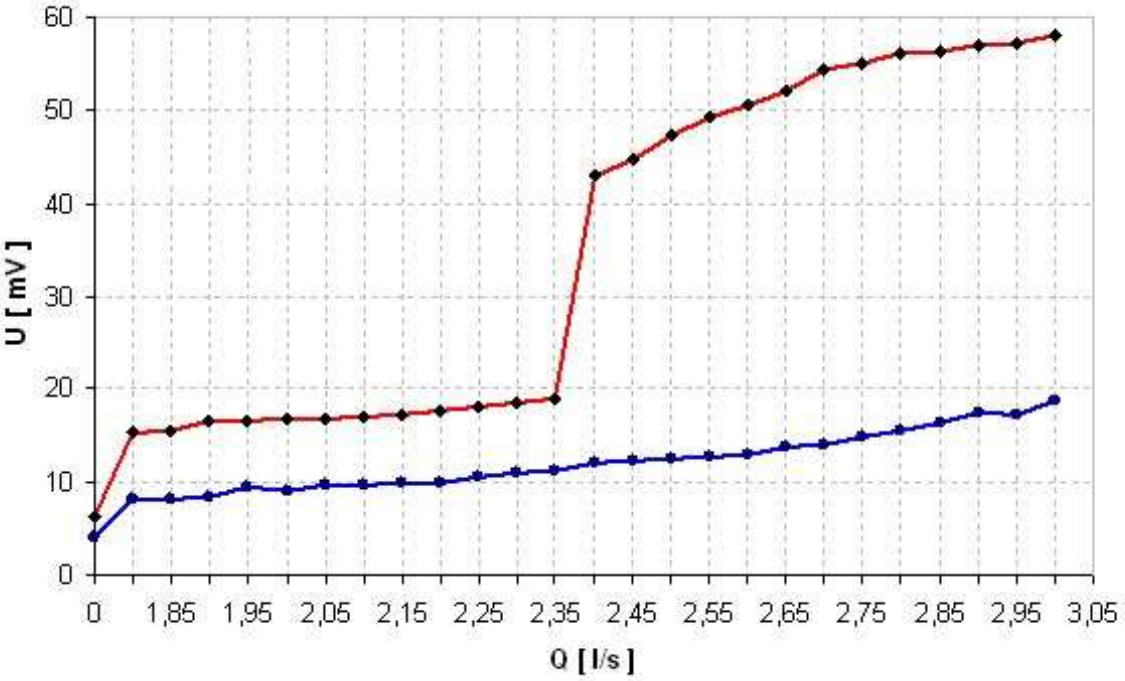


Fig. 5 The flow - electromotive tension dependence

Electromagnetic voltage magnitude is result of cavitation effect on the magnetic field

## 2. EXPERIMENT

Next figure (Fig. 6) shows the experimental device with the cavitation pipe with the permanent magnets and the point electrodes for the electromotive tension induced by the cavitation. Fig. 7 shows the cavitation bubbles creation.

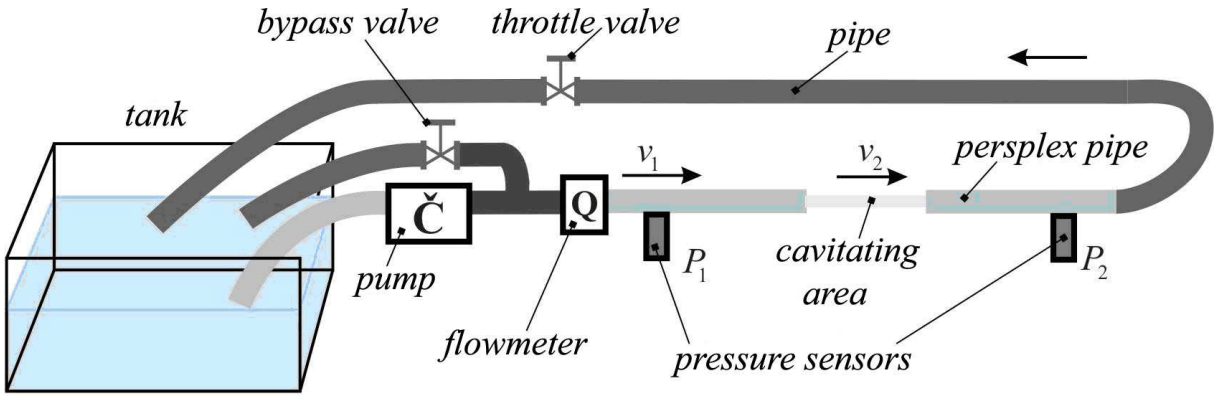


Fig.6 The experimental device with the cavitation pipe

One the following figures already visualized the bubbles creation and cavitation cloud that wholly fulfilled the cavitation pipe.

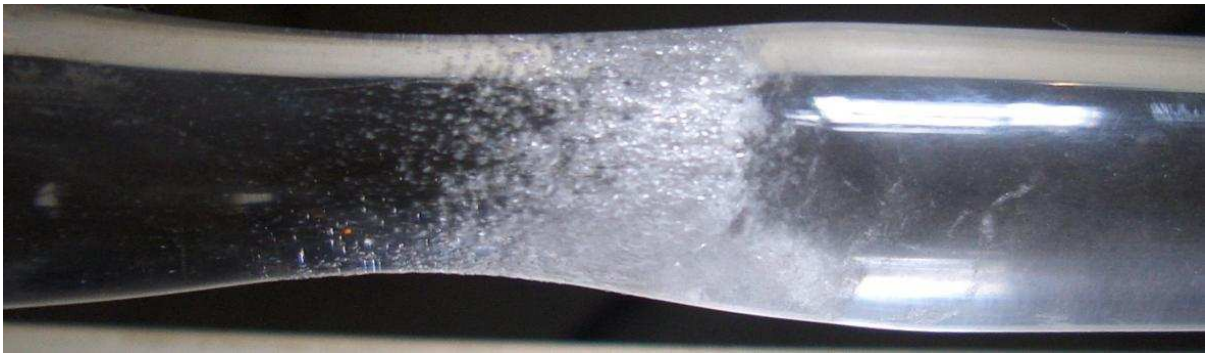

Fig. 7 The cavitation bubbles creation

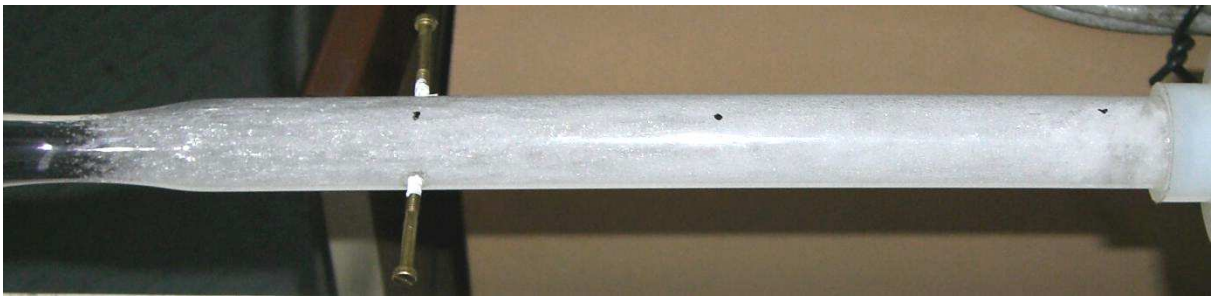

Fig. 8 The cavitation cloud

The cavitation effect on the magnetic field results the electromotive tension magnitude. See Fig. 5. This magnitude has step changed in the cavitation cloud (Fig. 8). It depends on the electrical conductivity of the liquid. The conductivity magnitude was changed by the salt addition. The results are shown on Fig. 9.

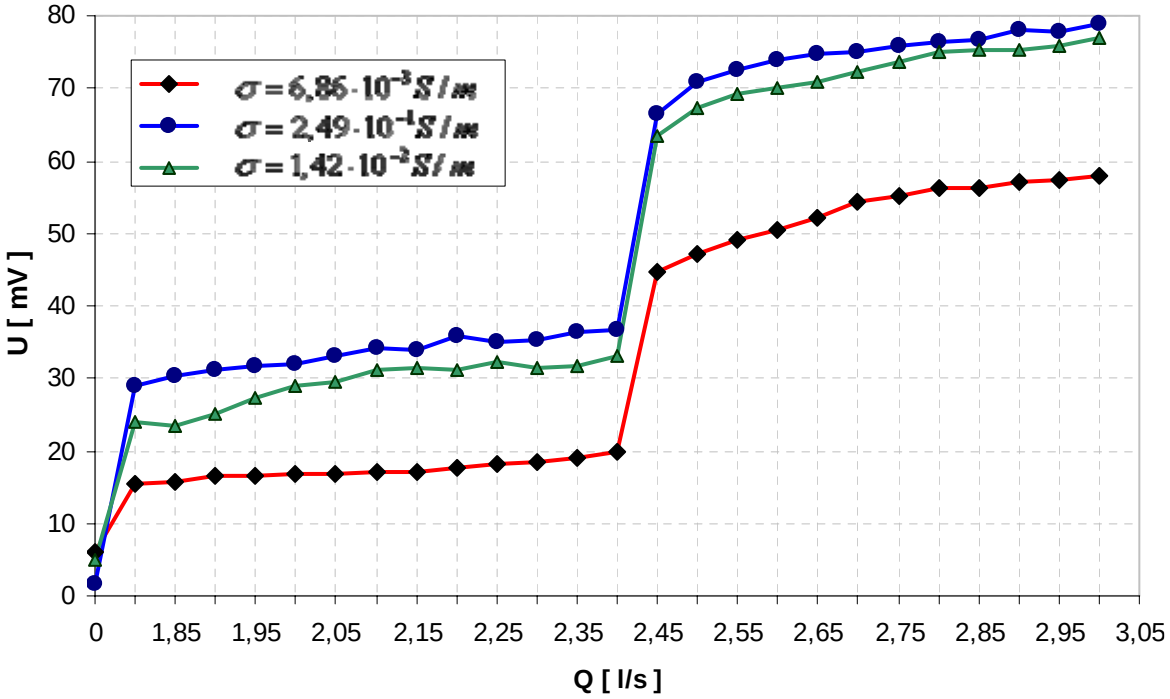


Fig. 9 The electrical conductivity effect on the electromotive tension magnitude

The cavitation bubbles collapse is connected with the high frequencies see Fig. 10.

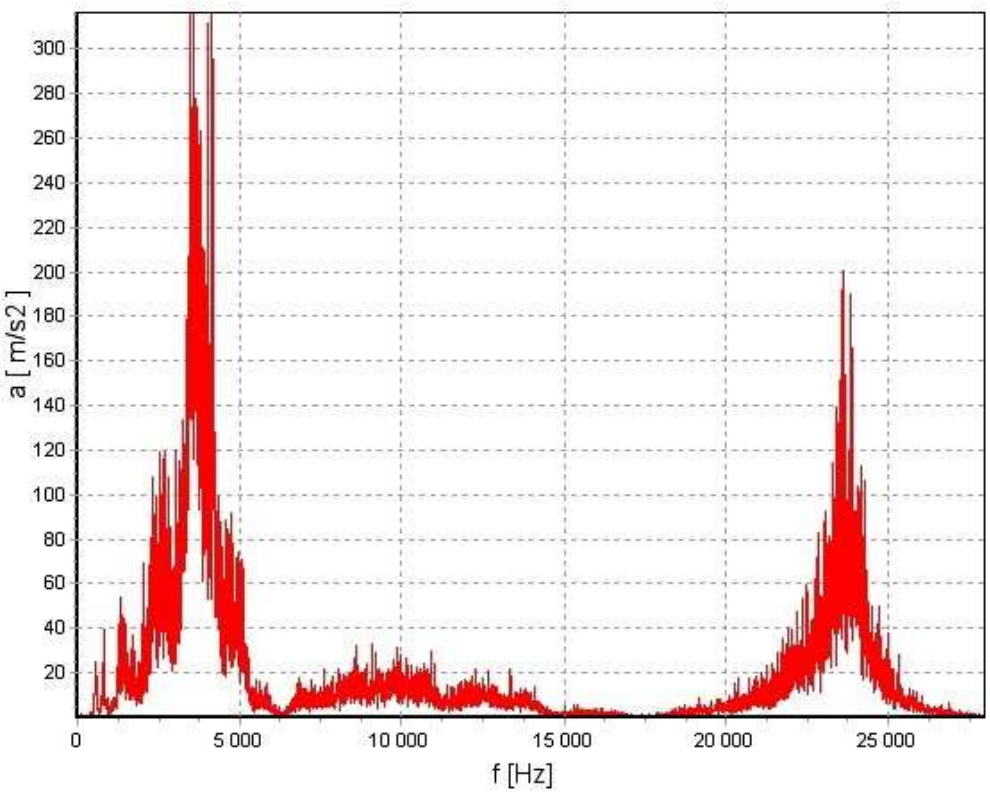


Fig. 10 The frequency spectrum for the cavitation bubbles collapse

The original pipes were made of a glass. Fig. 11 shows the pipe disruption that shows evidence of strong dynamical processes in the cavitation, which is under way of very high acceleration.

Fig. 11 The disruption point of the glass cavitation pipe

## 3. CONCLUSION

By the performed experiment it was acknowledged that the cavitation bubbles bear as the electric charge with the high speed of movement. Its movement in the magnetic field is possible to use both for identification of the cavitation creation beginning and the electric energy micro resources.

## 4. ACKNOWLEDGEMENT

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