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ELECTRONIC EFFECTS BY MOVING OF THE DISPERSE SYSTEMS

Abstract

The paper is devoted to the study of nature of electrokinetic effects, appearing by moving of structured disperse system in pipes and porous media. The dependence of electropotential appearing by moving of these systems on properties of the fluid, the material of conductor, velocity of movement and so on was shown.

The results of the experiments on regulation of value of constant magnetic field on the system were lead.

By moving a number of structure systems in pipes and porous medium so-called: plug: formations, leading to clogging of pipe-lines and considerable filtrational resistence in the porous medium [1] appear. The reason of these phenomena is apperarance of certain structural formations in channels, which have electrokinetic, ,mechanical, chemical and similar to them nature.

The authors of the paper [2] show, that at the closing in of partiicles in aquous medium under the influence of the thermal motion or mechanical action repulsive forces prevent their direct adhesion. On their nature these forces may be electrostatic and structural ones. The first ones are connected with overlapping of double electric layers of particles, and the second ones- with interaction of the structured adsorbed films of water.

One of the most essential factors, defining the stability of disperse systems is the electrostatic interaction of diffusive layers of ions of particles.

An electrostatic field intensity of particles equals zero outside of double electric layer (DEL), therefore repulsive forces appear if and only if diffusive layers of particles are overlapped. The difference of the values of energy corresponding to non- overlapped and overlapped zones of DEL represents the electrostatics components of disjoining pressure.

The existence of the structural disjoining pressure and its dependence on thickness of the adsorbed film were experimentally proved by the numerous investigations of B.V. Deriagin and N.V. Churayev on an example of wetted surface of quartz [3]. Australian researchers in the field of physical chemistry Ya.Izraeshvili, and R.Pashtion of oriented molecules of water when cations are hydrated, calling it hydration.

For estimation of above mentioned properties of liquids we carry out experimental investigations. The investigations were carried out on experimental plant (fig.1), consisting of the following basic elements: the electropotentiometer U5-7 (1), the electrodes (2), glass pipe of 0,012m in diameter and 0,8m (3) in length with investigated system (5), source of air supply (4) and faucet (6).

The electrodes were placed on the entry and the exit of the pipe filled by the investigated disperse system. During the experiments the registration of the potential of accumulation was made, which was provided with connected of the input electrode to the hum of device and bottom contact fixed the potential of accumulation.

In the first series of the experiments top-down motion of the fluid (dispersed phase) was considered, in addition in the stand pipe, filled by the system, setting of particles occurs on the electrode, placed in lower part of the pipe.

Dorn, Billiter, Mekelt, Shtock and others faced with the similar phenomena in their investigations, whose results are introduced in paper [1].

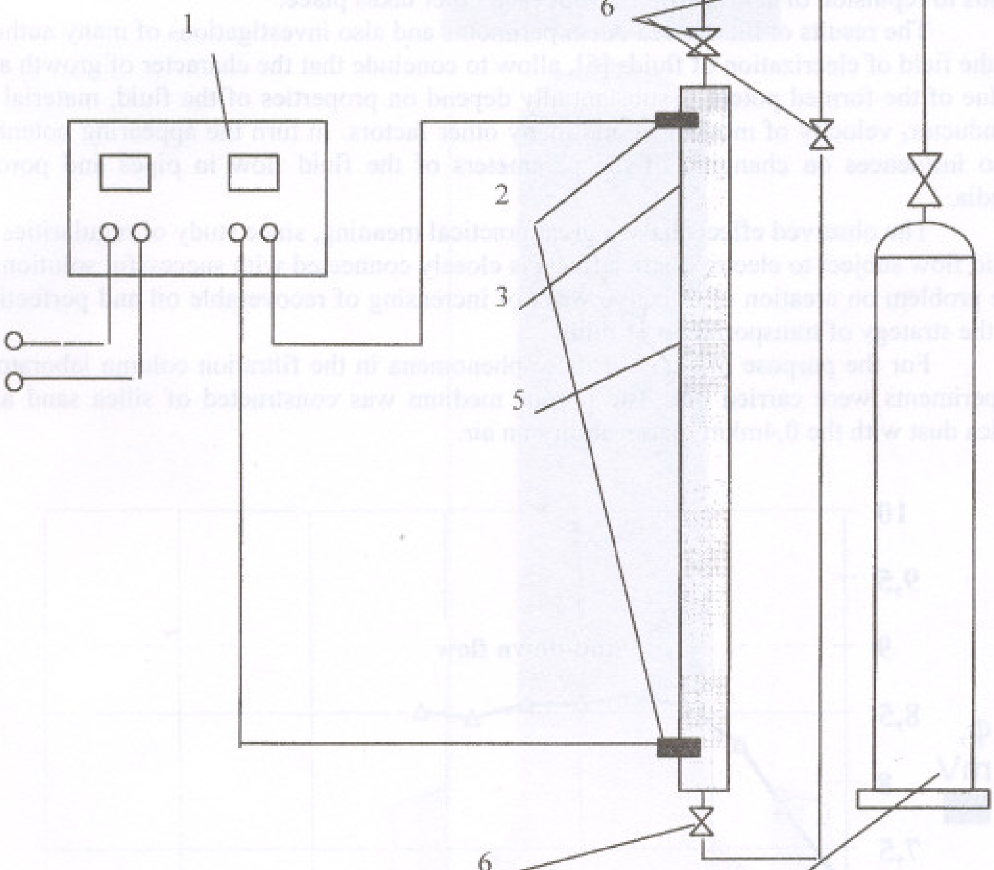


Fig.1.

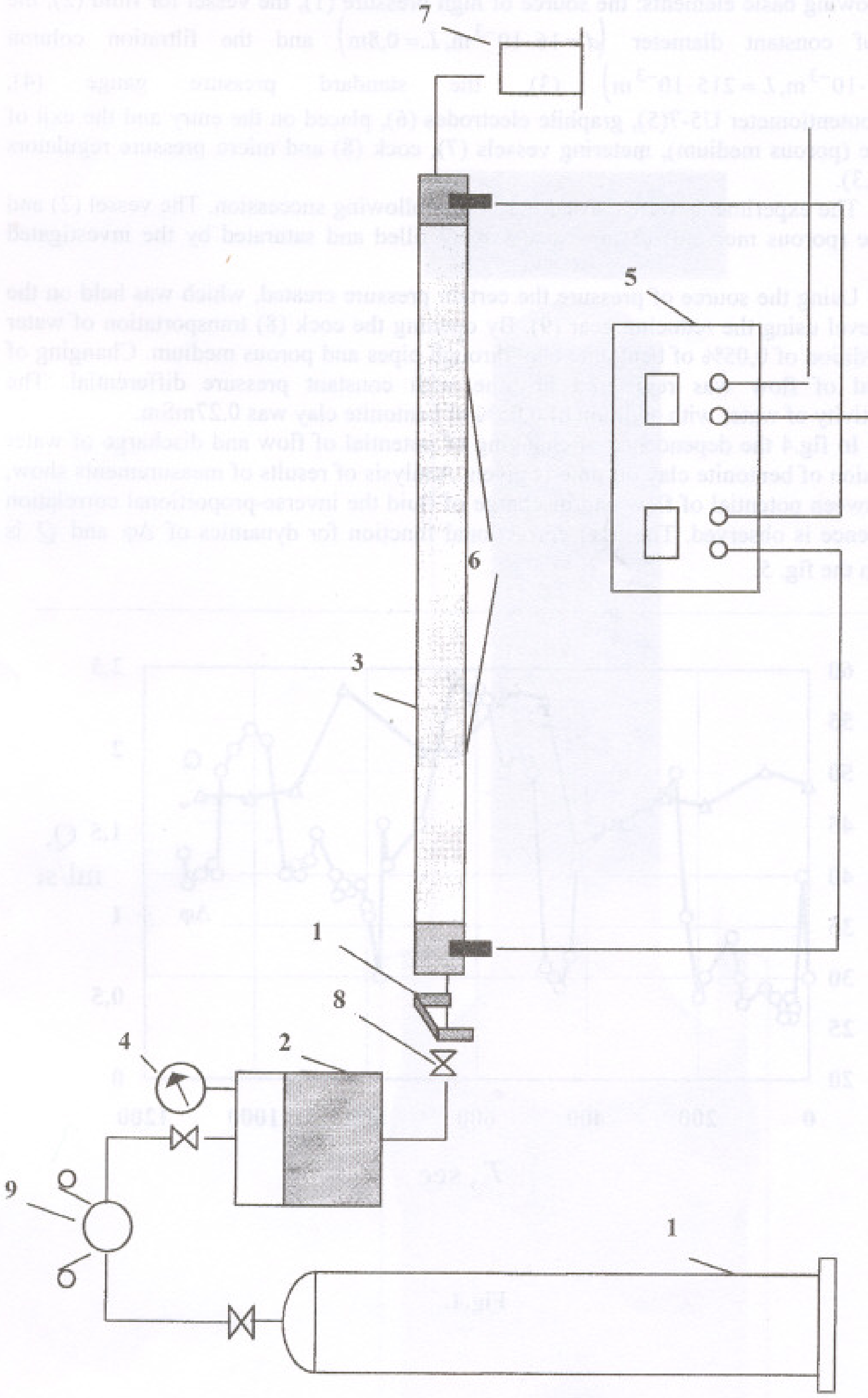


Fig. 3.

The investigations were carried out on the experimental plant , including the following basic elements: the source of high pressure (1), the vessel for fluid (2), the pipe of constant diameter $\left(d = 16 \cdot 10^{-3}\text{m}, L = 0{,}8\text{m}\right)$ and the filtration column $\left(d = 16 \cdot 10^{-3}\text{m}, L = 215 \cdot 10^{-3}\text{m}\right)$ (3), the standard pressure gauge (4), electropotentiometer U5-7(5), graphite electrodes (6), placed on the entry and the exit of the pipe (porous medium), metering vessels (7), cock (8) and micro pressure regulators (9) (fig.3).

The experiments were carried out in the following succession. The vessel (2) and the pipe (porous medium) (3) are successively filled and saturated by the investigated fluid.

Using the source of pressure the certain pressure created, which was held on the given level using the reducing gear (9). By opening the cock (8) transportation of water with addition of 0,05% of bentonite clay through pipes and porous medium. Changing of potential of flow was registered in time with constant pressure differential. The conductivity of water with addition of 0,05% of bentonite clay was 0.27mSm.

In fig.4 the dependence of changing of potential of flow and discharge of water suspension of bentonite clay on time is given. Analysis of results of measurements show, that between potential of flow and discharge of fluid the inverse-proportional correlation dependence is observed. The inter-correctional function for dynamics of $\Delta\varphi$ and Q is given in the fig. 5.

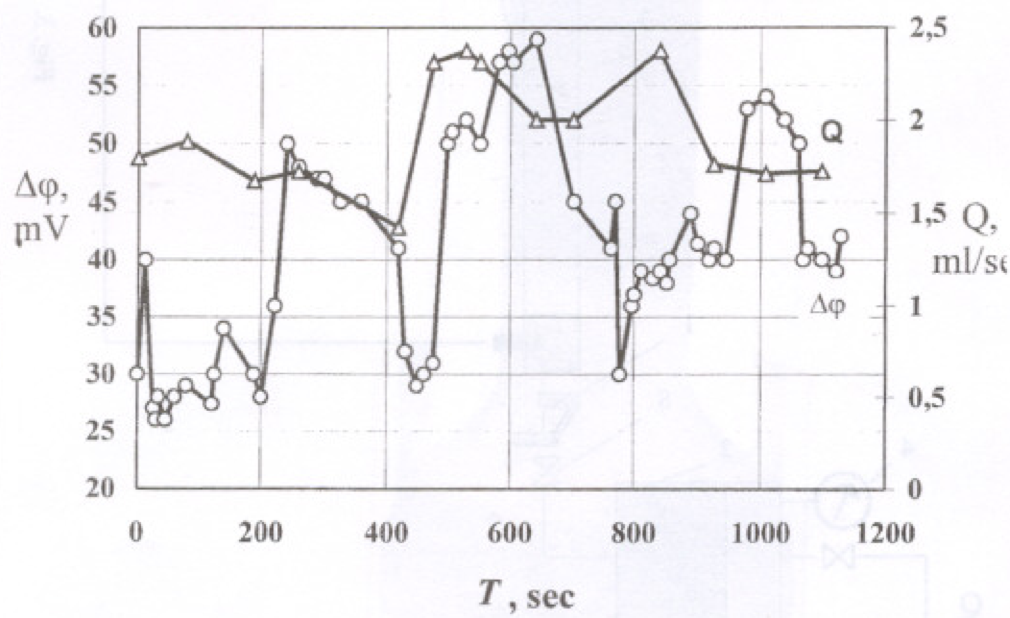


Fig.4.

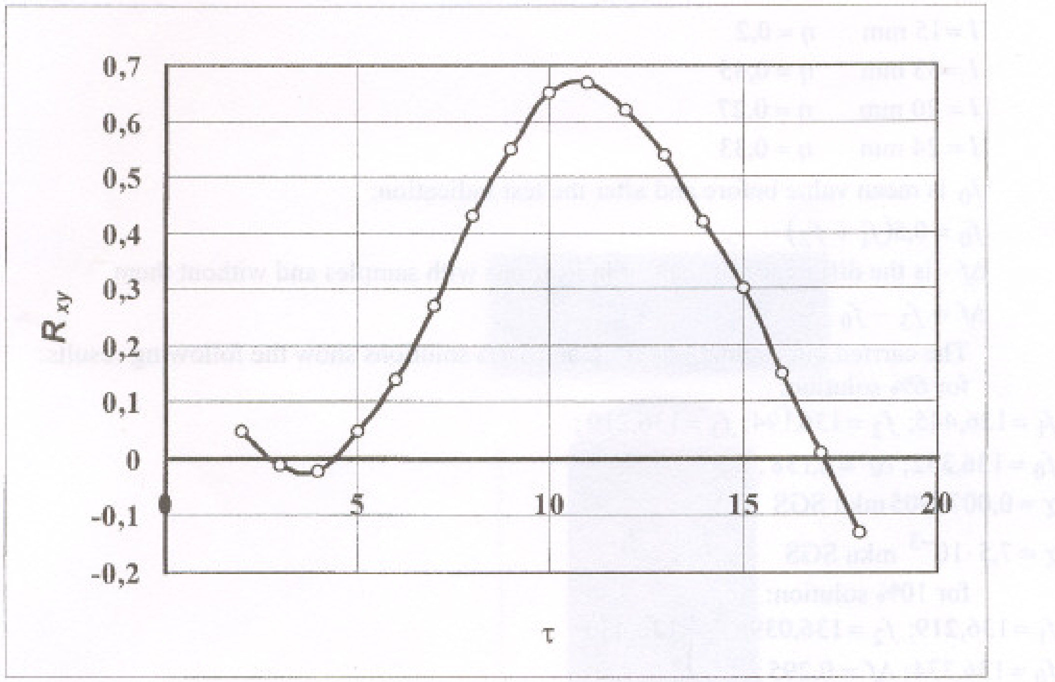


Fig.5.

The carried out investigations stimulated for the methods of control and improvement of hydrodynamic characteristics, one of which can serve the addition to fluid different accelerators, particularly, surfactants.

Along with this, last year investigations have shown the possibility of control of rheological parameters of fluids by means of treatment them by magnetic fields. This possibility is predetermined by the series of results, received in last years showing the effectivity of such action on electrokinetic phenomena in pipes and porous media.

In the carried out investigations magnetic susceptibility of model fluids, used in experiments previously was estimated. The estimation of magnetic susceptibility carried out in the laboratory of paleomagnetism of Institute of Geology of Academy of Sciences of Azerbaijan.

Before measurements test a sample of cubic form was placed on the special support of measuring block.

Adjustment of the device was tuned by calibration of scale, i.e. refinement of value of division of indixator. The value of division of a slot was choosen such that by installation the data unit of standard the indication coincides with the value of receptivity of the standard. By measurings a sample is placed on the detector so, that it maximally approaches to the poles of the detector. The measurement range must be so that scale reading were more than 10 points.

The scale reading which is obtained in microunits SGS (mku SGS) was written down.

Since the dispersion in is mostly irregularly distributed, for reliability improvement of the mean value was found.

With the help of the device χ is defined from values $\chi = \dfrac{0{,}159 \cdot \Delta\varphi}{\eta \cdot f_0}$,

where η is a constant of the device for the cube with samples

$l = 15$ mm $\eta = 0,2$

$l = 33$ mm $\eta = 0,45$

$l = 20$ mm $\eta = 0,27$

$l = 24$ mm $\eta = 0,33$

f_0 is mean value before and after the test indication;

$f_0 = 0,5(f_1 + f_2)$

Δf - is the difference of the test indications with samples and without them

$\Delta f = f_3 - f_0$.

The carried out estimations for 6 and 10% solutions show the following results:

for 6% solution:

$f_1 = 136,445$; $f_2 = 136,194$; $f_3 = 136,219$;

$f_0 = 136,332$; $\Delta f = 0,138$;

$\chi = 0,0074905$ mku SGS

$\chi = 7,5 \cdot 10^{-3}$ mku SGS

for 10% solution:

$f_1 = 136,219$; $f_2 = 136,039$; $f_3 = 136,450$;

$f_0 = 136,334$; $\Delta f = 0,295$;

$\chi = 0,016012$ mku SGS

$\chi = 16,0 \cdot 10^{-3}$ mku SGS

The carried out investigations of magnetizability serve as base of laboratory experiments on regulation of the above described effects of "blocking" by moving dispersion mediums by action of magnetic field on investigated systems.

In this case the action by magnetic field taking into account choice of magnetic field strength, corresponding to minimal potential difference was realized.

The carried out experiments on magnetic treatment of dispersion fluid (on magnetic field strength H equal 750E), moving in diamagnetic glass pipe on bottom-up and top-down show that after treatment of the earlier difference in accumulation of potential vanishes. The obtain results are given in the fig. 6.

Further in the paper the moving of the fluid in porous media for the purpose of estimation of potential of flowing before and after the magnetic action was considered. Magnetic field intensity was 50 Ersted.

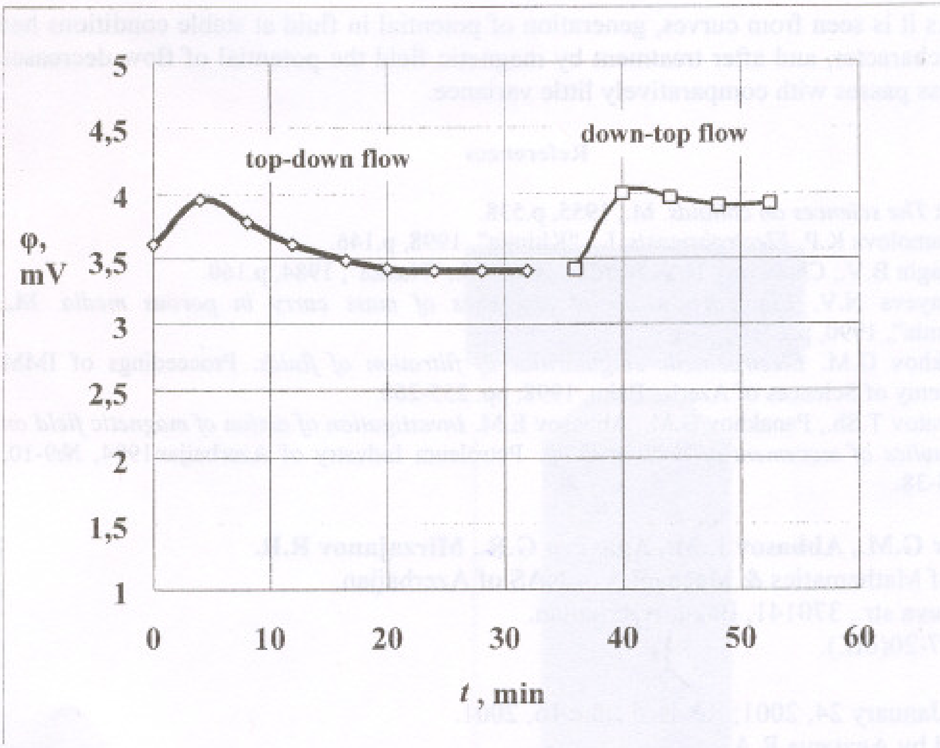
The investigations were carried out on the setup, represented in fig.3, superinduce the magnetic device (10).

The experiments were carried out in the following succession. The vessel (2) and the pipe (porous medium) (3)are successively filled and saturated by the investigated fluid.

With the help of the source of pressure (1) in the vessel the certain pressure, which was held on the given level using pressure regulator (9). By opening the cock (8) the transportation of water through the porous medium was realized.

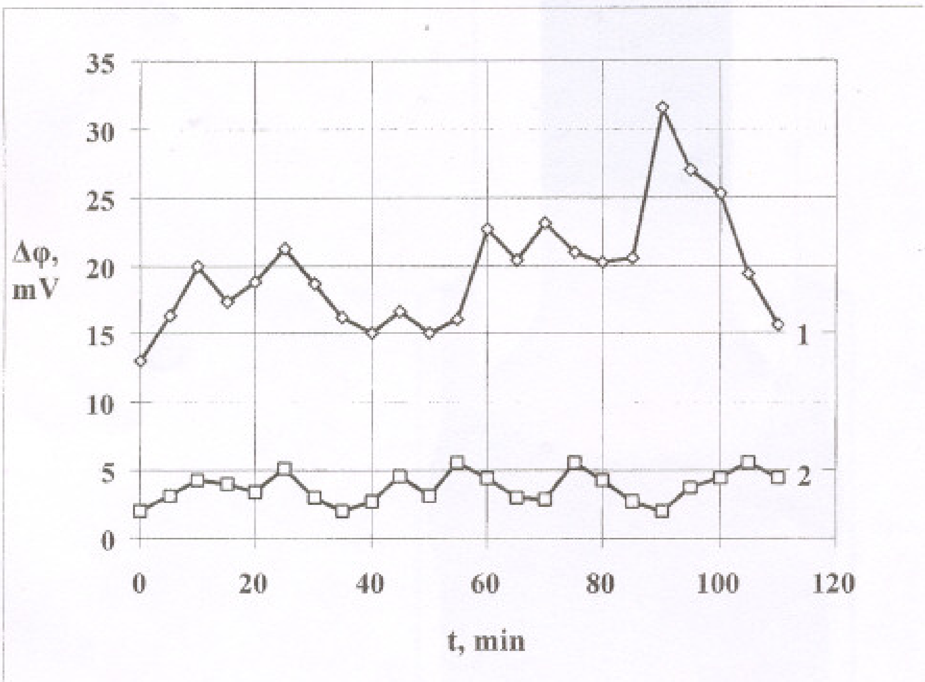
In the fig.7 (curve 1) curves of changing $\Delta\varphi(t)$ for fluid in time in const pressure differential are shown.

The analogous experiments were carried out turning on the magnetic device (fig.7, curve 2).



5
4,5
4
3,5
3
2,5
2
1,5
1
φ,
mV
top-down flow
down-top flow
0
10
20
30
40
50
60
t , min

Fig. 6.



35
30
25
20
15
10
5
0
Δφ,
mV
1
2
0
20
40
60
80
100
120
t, min

Fig.7.

As it is seen from curves, generation of potential in fluid at stable conditions has unsteady character, and after treatment by magnetic field the potential of flow decreases and process passes with comparatively little variance.

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