# Report on the test of the Anolyte produced by the unit ENVIROLYTE

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## OBJECTIVE

The aim of the present study was to check the presence of toxic disinfection by-products, chlorite ($ClO_2^-$) and chlorate ($ClO_3^-$) in the Anolyte and to measure the acute toxicity of water treated by the Anolyte.

Anolyte was produced according to instructions given by representatives of ENVIROLYTE INDUSTRIES INTERNATIONAL LTD. Two different regimes were tested and according to these regimes Anolyte is called Anolyte Medium (pH= 2 - 3; ORP 1100 mV; $C_{ac}$300 mg/l) and Anolyte Strong. (pH= 2 - 3; ORP 1100 mV; $C_{ac}$500 mg/l). The Anolyte for examination was produced immediately before the test.

Ion chromatography was used for determination of chlorates and chlorites. The experiments were carried out utilising Ion Chromatograph CVET-3007 with the analytical column 6x600 mm filled with sorbent HIKS-1. 2.4 mM $Na_2CO_3$ aqueous solution was used for elution. Flow rate was 4.5 ml/min and the pressure 40-50 atm. The solutions of $NaClO_3$ with the concentration of $ClO_3^-$ -ion of 29.15 and 7.29 mg/l were used as standards.

The preliminary runs demonstrated that under conditions mentioned above $ClO_3^-$ - ion could be separated successfully from chloride ($Cl^-$) and determined at the level down to 0.5 mg/l. Chlorates were determined directly in the diluted Anolyte, the chlorites were detected in diluted Anolyte after the heating at 100$^o$ C for 5 minutes to convert chlorites to chlorates.

Anolyte medium was diluted 1:200, 1:100 and 1:20. No peak responsible for the presence of chlorate in all dilutions was observed. Also the tests with heated samples diluted the same way did not show the presence of chlorate (see chromatograms 1-3). Anolyte strong was diluted 1:200, 1:100 and 1:20. No peak responsible for the presence of chlorate in all dilutions was observed.

Also the tests with heated samples diluted the same way did not show the presence of chlorate (see chromatograms 4-6).

**CHEMICAL ANALYSIS**

Both Anolytes, medium and strong were tested by chemical methods used by ENVIROLYTE (see pp. 11-13). According to the qualitative tests, for analysis of chlorate and chlorite proved no presence of chlorite and chlorate ions in the Anolyte.

It may be concluded that the Anolyte obviously contains the following forms of active chlorine: hypochlorous acid (HClO), hypochlorous ion ($ClO^-$), free chlorine ($Cl_2$), and chloride ion ($Cl^-$). No presence of chlorite and chlorate ions was determined in the Anolyte.

**TOXICITY TESTS**

*Daphnia magna* 24 hours acute toxicity tests were carried out according to Finnish standard SFS 5062.

The dilutions used were:
Anolyte medium 1:100, 1:500 and 1:2000.

Anolyte strong was diluted 1:50, 1:200 and 1:500.
The corresponding data are presented in Table.

Table. The acute toxicity of Anolyte.

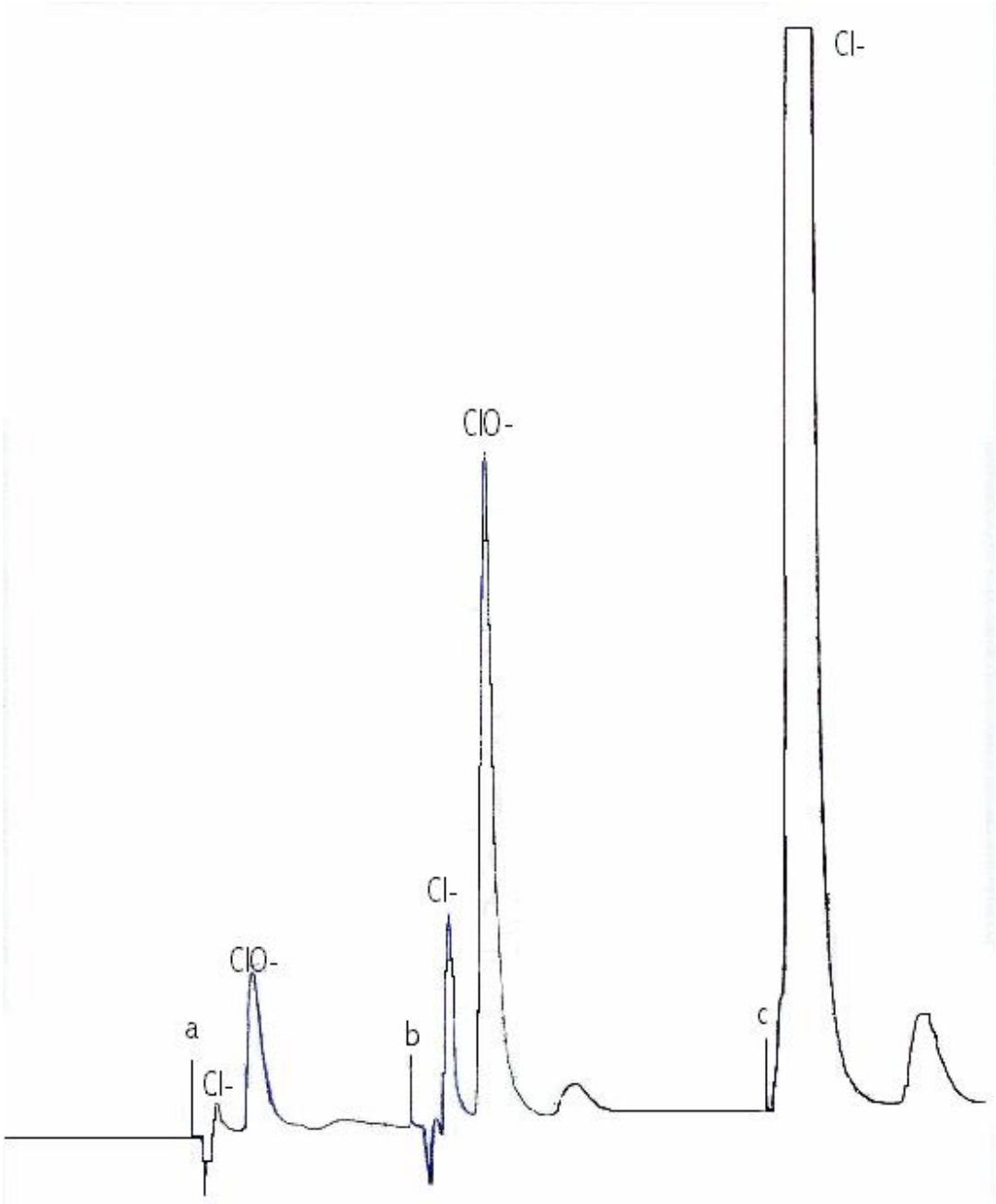
| Anolyte type | Dilution | $EC_{50}$; % (confidence limit) | $EC_{50}$; % for initial Anolyte |
|---|---|---|---|
| Anolyte medium (c.ac ~350mg/l) | 1:100 | 25 (22.5-28) | 0. 25 |
| | 1:500 | Not toxic | |
| | 1:2000 | Not toxic | |
| Anolyte strong (c.ac ~500mg/l) | 1:50 | 13 (11-16) | 0. 26-0. 28 |
| | 1:200 | 56 (52-59) | |
| | 1:500 | Not toxic | |

The toxicity test demonstrated that there were no acute effects for the Anolyte diluted 1:500 or more. No significant differences in the toxicity of two Anolytes (strong and medium) were observed. It should be noticed that the *Daphnia magna* test utilized in the present study indicates the acute toxicity, and the chronic one which is determined by other specific tests.

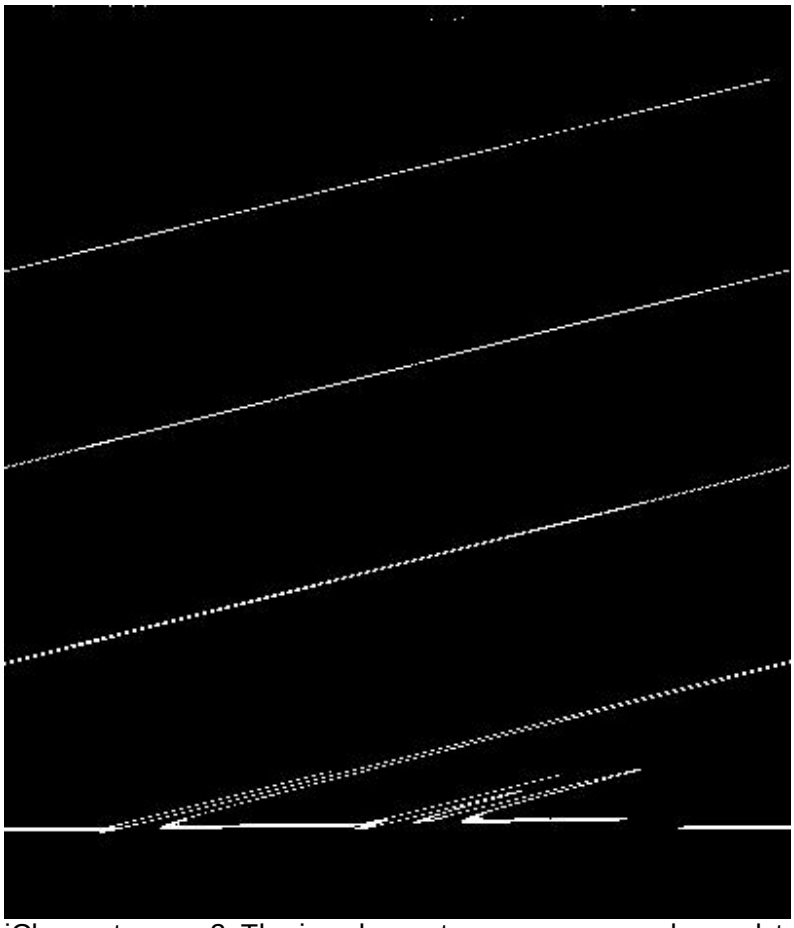
**REFERENCES.**

1. SF-standard 5062. *Finnish Standard*. *Water quality*. Determination of the acute toxicity with water flea, Daphnia magna Straus. 1984.
2. Hautman, D.P., Bolyard, M. Using ino chromatography to analyze inorganic disinfection by-products. *Journal AWWA*, 1992, vol. 84, No. 11, p. 88-93.

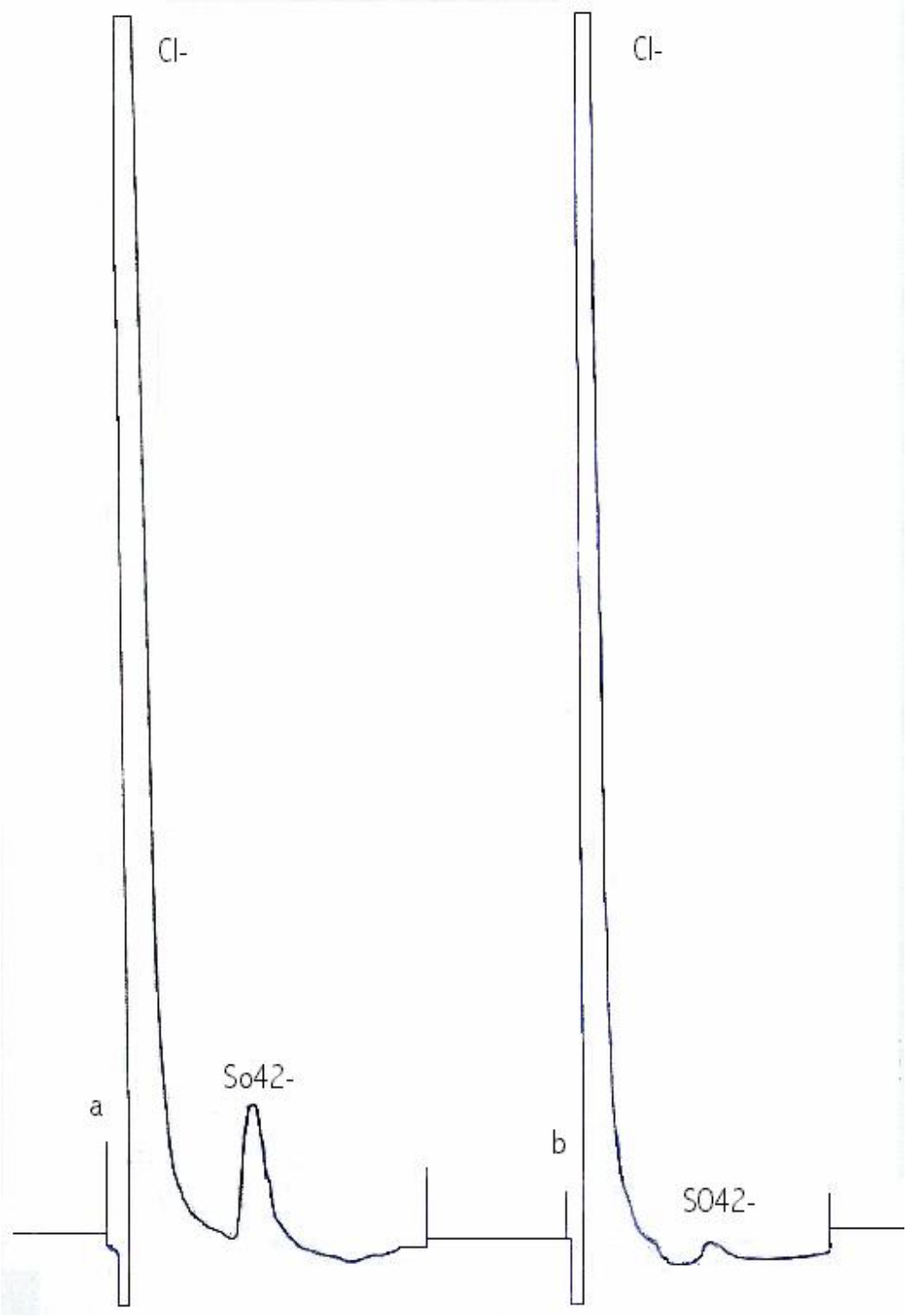
3. Plaff, J.D., Brockhoff, C.A. Determining Inorganic disinfection by-products by ion chromatography. *Journal AWWA*, 1990, vol. 82, No. 4, p. 192-195.



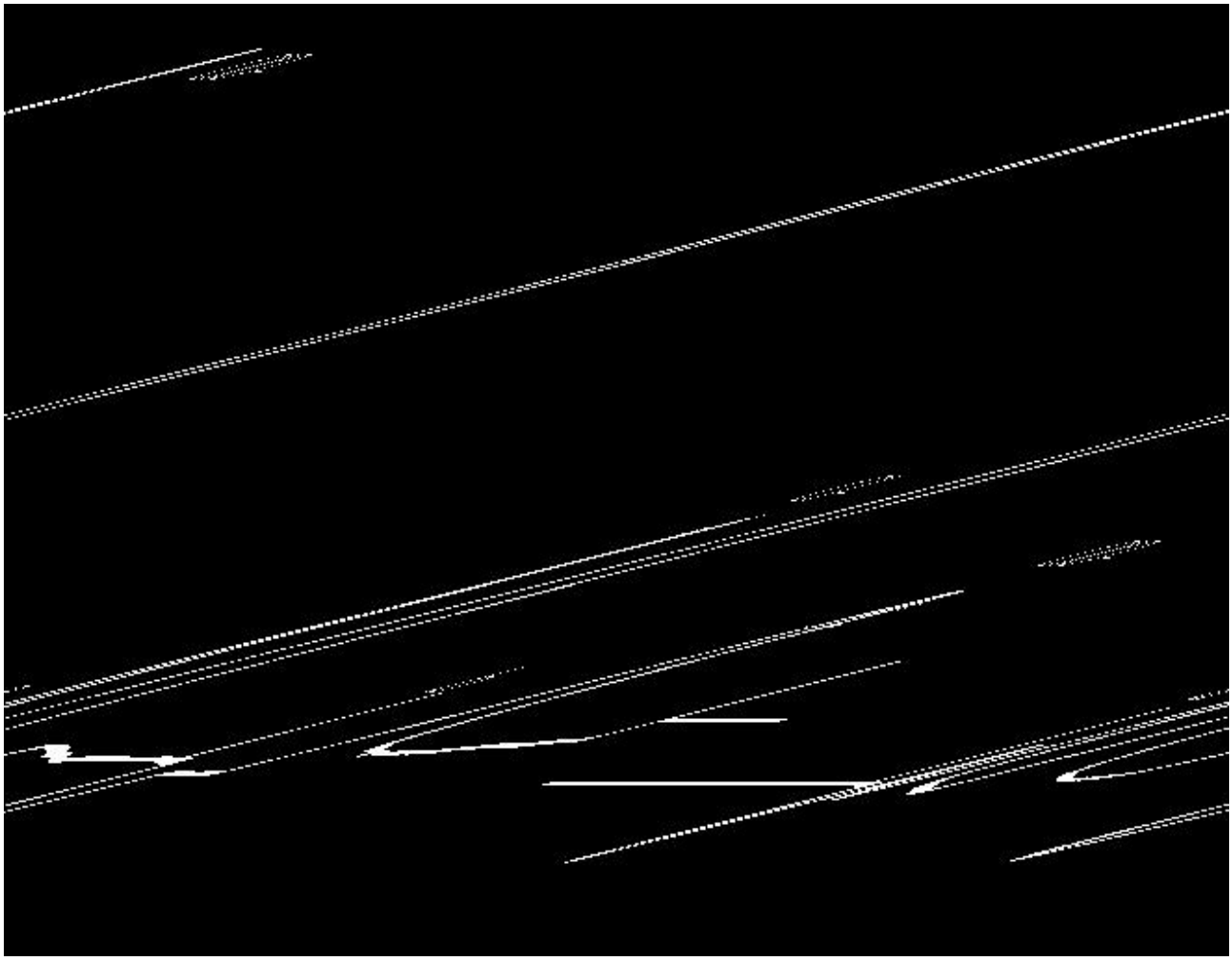

Chromatogram 1. The ion chromatograms: a - standard ($ClO_3^-$) with concentration 7.29 mg/l; b - standard ($ClO_3^-$) with concentration 29.5 mg/l; c - sample anolyte medium 1:20.



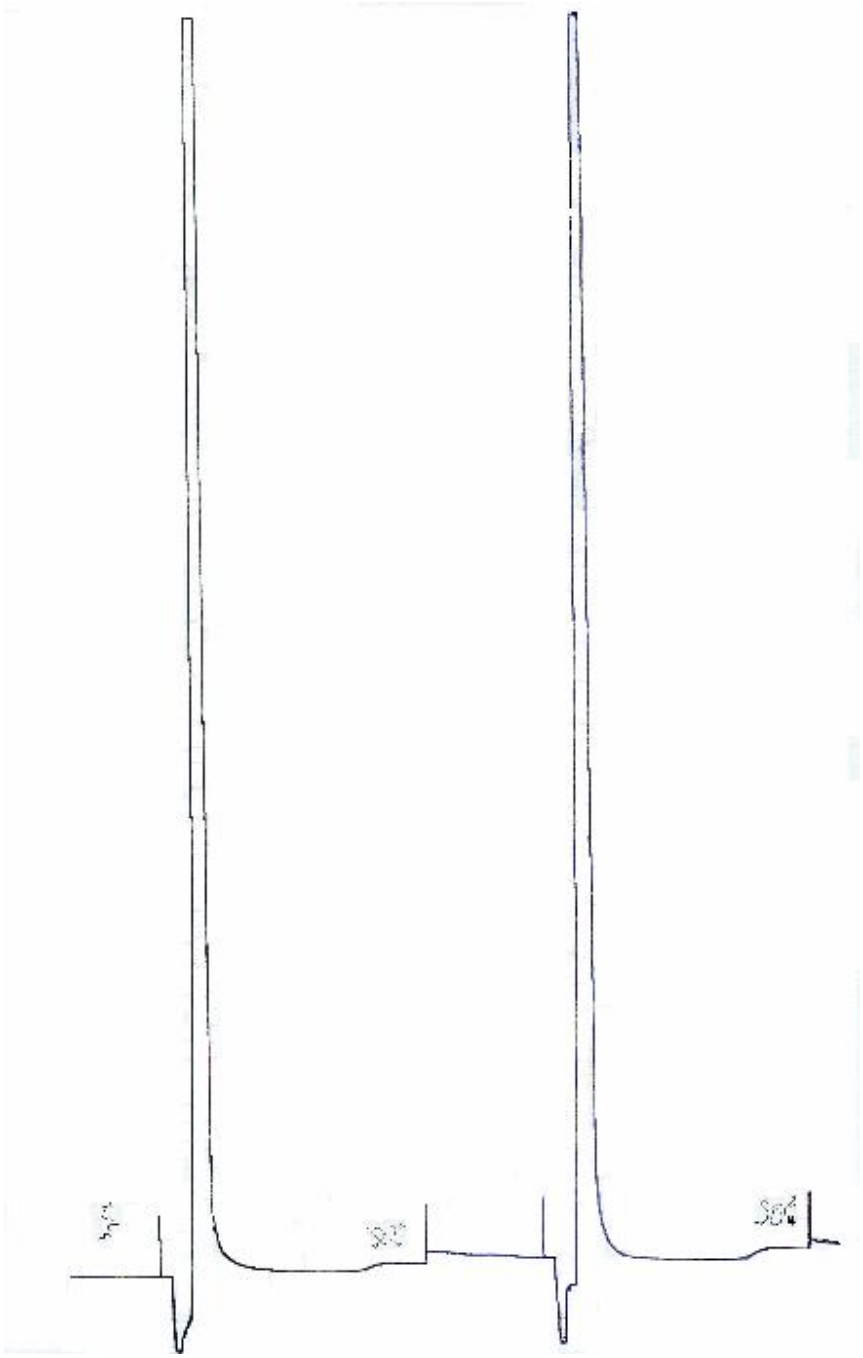
jChromatogram 2. The ion chromatograms: a - sample, anolyte medium 1:200; b - standard ($ClO_3^-$) with concentration 29.5 mg/l.



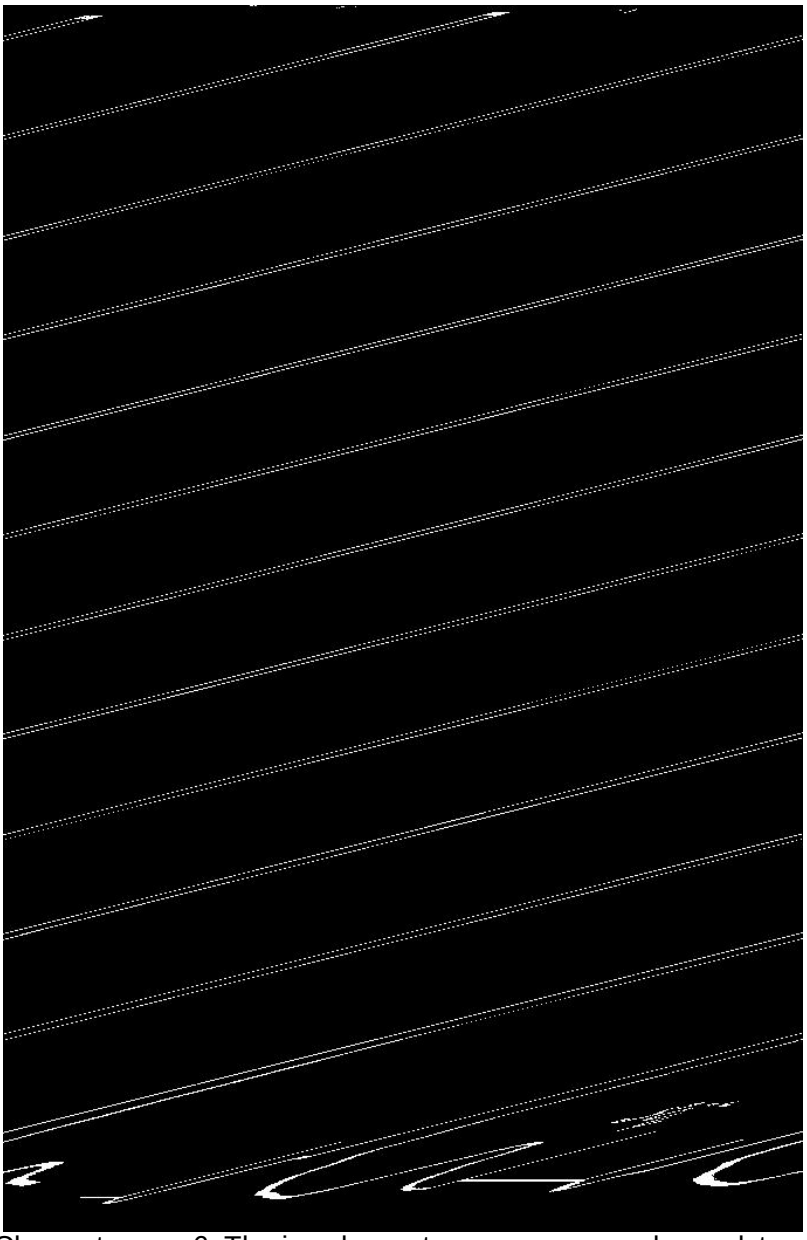
Chromatogram 3. The ion chromatograms: a - sample, anolyte medium 1:100; b anolyte medium 1:200. $SO_4^{2-}$ ion was added to the sample to ascertain the efficiency of chromatographic conditions.



Chromatogram 4. The ion chromatograms: a - standard ($ClO_3^-$) with concentration 29.5 mg/l; b - standard ($ClO_3^-$) with concentration 7.29 mg/l.



Chromatogram 5. The ion chromatograms: a, b - sample, anolyte strong 1:200.



Chromatogram 6. The ion chromatograms: a - sample, anolyte strong 1:20; b - anolyte strong 1:20. $SO_4^{2-}$ ion was added to the samples to ascertain the efficiency of chromatographic conditions.