DETERMINATION OF URANIUM CONTENT IN WATER SAMPLES

INTRODUCTION
This method is designed to measure mass concentration of uranium in samples of natural, drinking and waste water by luminescence using the FLUORAT®-02-2M analyzer.

MEASUREMENT METHOD
Uranium concentration in an aqueous solution is determined by measuring the intensity of retarded fluorescence of uranyl ions (λ=530 nm) after activation by ultraviolet radiation. The luminescence of the solution is increased by addition of sodium polysilicate (pH 8–10).
To eliminate interfering influence conditioned by fast fluorescence and constant background component, the analyzer is switched to the mode of counting photons at certain times of delay in relation to the activation impulse.
The analyzed solution is diluted to decrease the suppressing action of its components. The remaining influence of the sample is excluded by quantitative determination by additive method.

CONCENTRATION RANGES
The range of measured concentrations of uranium in aqueous solutions is 0.002–1.0 mg/l.

EQUIPMENT AND REAGENTS
The following equipment and reagents are required for measurements:
- FLUORAT®-02-2M Analyzer
- Certified uranium solution with a mass concentration of 1 g/l
- 66% Nitric acid UPG
- Sodium hydroxide UPG
- Amorphous silicon dioxide UPG
- Double distilled water

PREOPERATIONAL PROCEDURES
Preoperational procedures include the following: sample collection and preparation, preparation of auxiliary and calibration solutions, and the adjustment of the analyzer.

Sample collection
Samples of natural, drinking or waster water are collected according to ISO 5667 Standard. The volume of the taken sample should be not less than 25 ml. The sample is conserved by addition of concentrated nitric acid in the proportion of 7 ml for one liter of the sample. The conserved sample can be stored for 1 month.
The suspended particles are separated by filtration of the solution through a “blue ribbon” dry filter (Whatman No 44 or S&S No 589 Blue Ribbon) or by centrifugation.

Device calibration
The light filter 1 is used in the activation channel and the filter 8 is used in the registration channel for all measurements. Calibration is done by measuring the signals of phosphorescence of solutions with known content of uranium in the form of uranyl ions (0.00 and 0.100 mg/l). Solutions with the known content of uranyl ions are mixed with the solutions of sodium polysilicate and double distilled water in proportion of 1:1:10.

Sample treatment
An aliquot is treated in a way similar to the treatment of calibration solution. The volume of the sample should be 0.5 ml.
MEASUREMENTS
Prior to measurements, the analyzer is calibrated using the standard calibration solutions, and the measurement range and stability of calibration characteristics are checked. The uranium concentration in samples is determined by the additive method.

EXAMPLE OF REAL ANALYSIS
Calibration diagram:
Uranium (FLUORAT®-02-2M)

<table>
<thead>
<tr>
<th>C</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.0012</td>
</tr>
<tr>
<td>100.0</td>
<td>0.3811</td>
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</tbody>
</table>

Measurement results:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Content, mg/l</th>
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<tbody>
<tr>
<td></td>
<td>Sample</td>
</tr>
<tr>
<td>Drinking water, city of S., Russian Federation</td>
<td>0.002</td>
</tr>
</tbody>
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