



Contribution ID: 384

Type: Verbal

Development Testing of the Membrane Installation Designed for Purification of Liquid Low-Level Waste from the Radiochemical Plant

Friday, May 16, 2014 11:00 AM (15 minutes)

Development testing of the membrane installation designed to purify low-level solutions of the radiochemical plant was carried out. The purification technology of liquid radioactive wastes (LRW) includes the stages of selective sorption, ultrafiltration and two-phase reverse osmosis.

LRW salt content is caused by hardness salts and sodium nitrate. LRW activity is due to radionuclides of cesium, strontium, cobalt, plutonium, americium, etc. In addition, the wastes contain oxalates, sulfates, phosphates and surface-active substances.

The objective of the tests performed was to purify radioactive drain solutions for them to meet the established regulatory requirements and to specify technical parameters of the purification process.

The two operating modes of the treatment installation were tested: the maximum purification mode (selective sorption + ultrafiltration + two-phase reverse osmosis) and the more economical operating mode (selective sorption + ultrafiltration + one-phase reverse osmosis).

It was demonstrated during the tests that the use of the combined process of selective sorption and ultrafiltration ensures 99 % purification of the solutions from ^{137}Cs . The content of the selective agent of 2-3 mg/l is enough to achieve the above-stated values.

In the course of the installation testing in the economical operating mode the volumetric activity in the treated water varied from 5 to 6 Bq/l for alpha-emitting nuclides, and from 20 to 30 Bq/l – for beta-emitting nuclides. In compliance with the regulatory documents in effect in the Russian Federation the treated water with such volumetric activity may be used for technical purposes without any restrictions.

The use of the installation in the maximum purification mode (two-phase reverse osmosis) allows decreasing approximately by an order of magnitude the volumetric activity of the water treated at the first phase of the reverse osmosis. The volumetric activity of alpha-emitting nuclides in the final purified water was reduced to the level less than 0.5 Bq/L, while the volumetric activity of beta-emitting nuclides achieved 4.0 Bq/l.

More than 16,000 m³ of liquid low-level wastes (LLW) were treated during the development testing.

The obtained results demonstrated that the proposed combination of membrane and sorption methods enables efficient purification of liquid LLW. The treated water may be used in the water circulation network of the Mayak PA or discharged into the open hydrographic system without any restrictions.

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Session Classification: Separation Methods, Speciation 5

Track Classification: Separation Methods, Speciation