

Sposób witrifikacji zużytych sorbentów z wbudowanymi w ich strukturę wysokoaktywnymi pierwiastkami metodą zol-żel

Method for vitrification of used sorbents with high-active radicals inbuilt in their structure by sol-gel method

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The management of a sorbent with radioisotopes bound in its matrix is highly challenging. Among the many methods of radioactive waste immobilization, vitrification is considered the best. The main advantage of this method is the possibility of the incorporation of a large number of the elements into the matrix and the production of durable and small volume wastes which, in turn, prevents leaching of radionuclides to the environment.

Indisputable advantage of the method according to the invention is the application of CSGP method (ascorbic acid as the catalyst), because it allows to obtaining of silica glass with spent sorbent containing high-level radioactive elements (e.g. Cs, Sr, Co) stably bound in its structure.

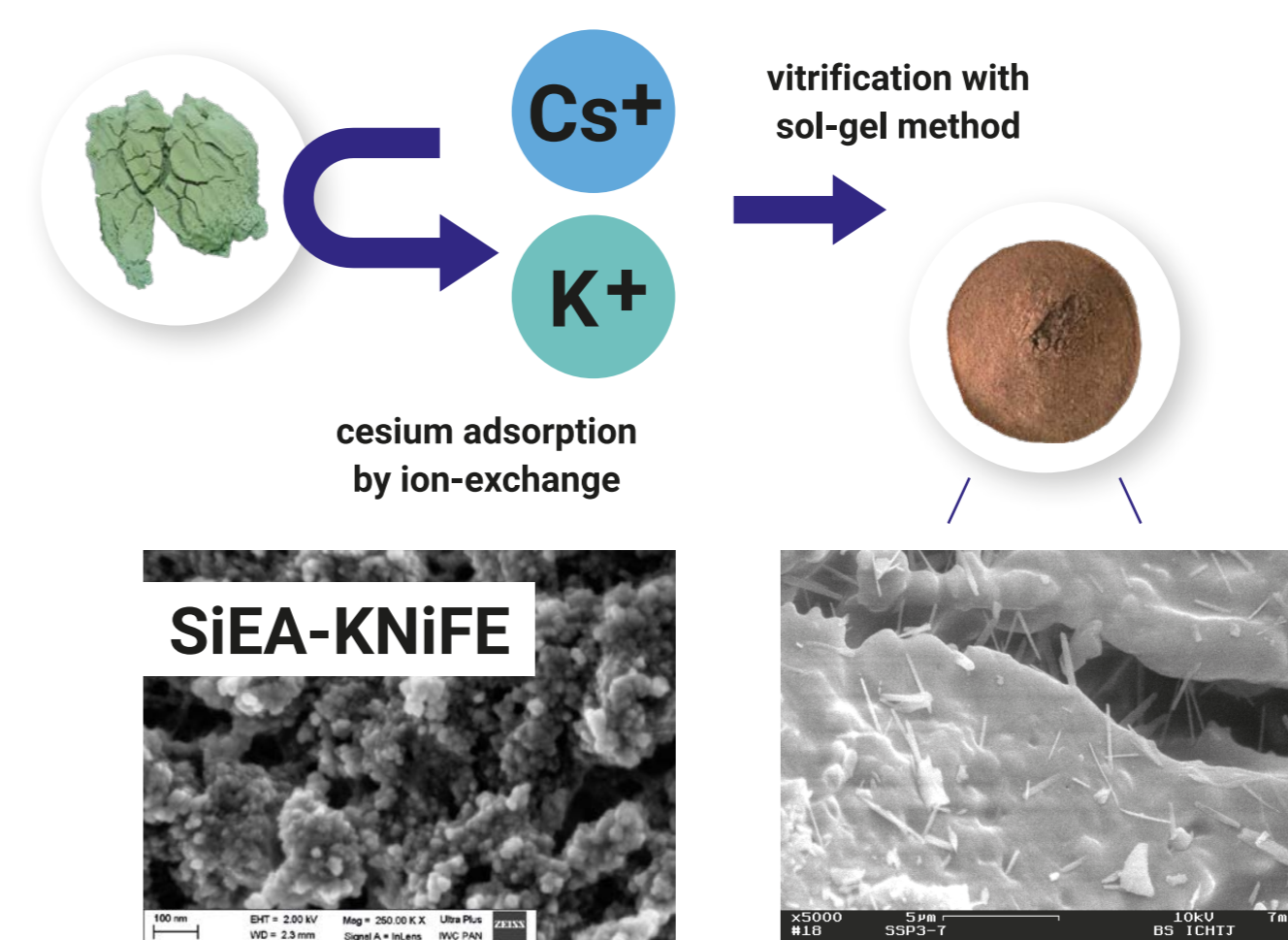
Fig. 1



Radioactive waste

Borosilicate glasses are the materials most widely applied to form the vitreous matrix. However, some of the fission products, especially radiocesium, are volatile at temperatures much lower than that necessary for the glass to melt, which means that some of the radioactive cesium can escape from the matrix during the melting process. The sol-gel methods that require low processing temperatures help to alleviate this drawback.

Fig. 3

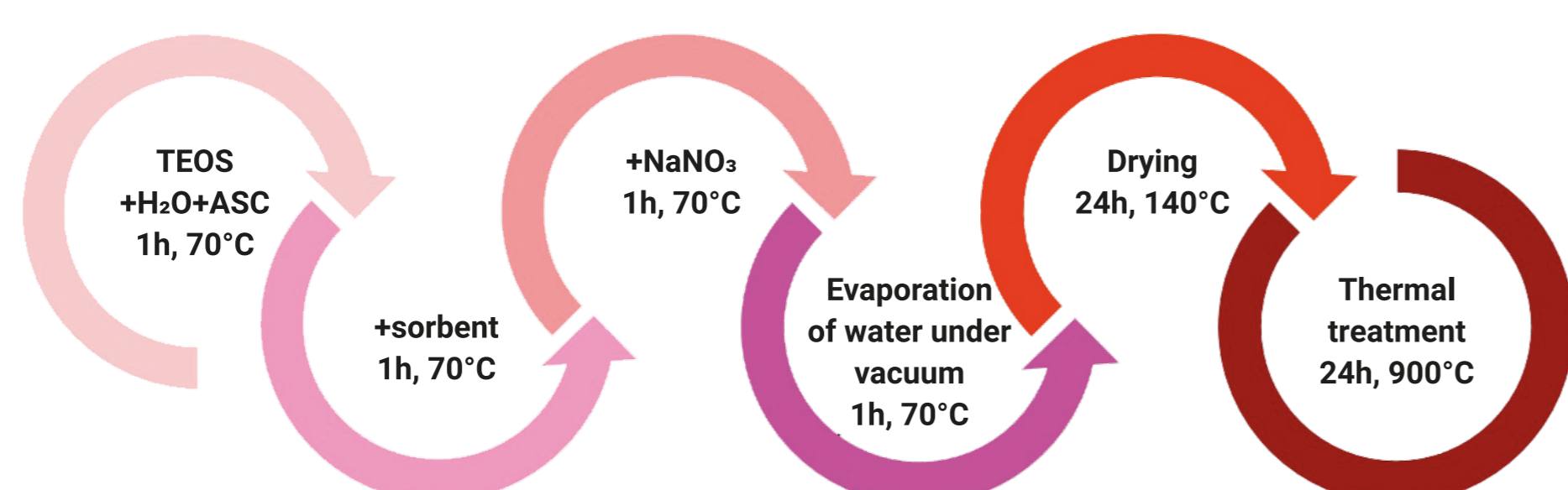


Embedding of the spent sorbent in the glass

Moreover, the application of sol-gel method and additional incorporation of the sodium in the glass structure resulted in decrease of vitrification temperature to 900°C, what makes the process facile and faster. Mentioned advantages result in lower energy consumption in the process of radioactive waste disposal and enable to bind spent sorbent stably in the vitrification matrix, especially in the silica glass.

The subject of the present invention is a method for vitrification of used sorbents with high-active radicals inbuilt in their structure by sol-gel method for permanent disposal radioactive waste before its storage in the bunker. The method according to the invention is to apply for the system containing sorbent, SiO₂ and MeO, preferably sodium as the metal (Me) decreasing vitrification temperature.

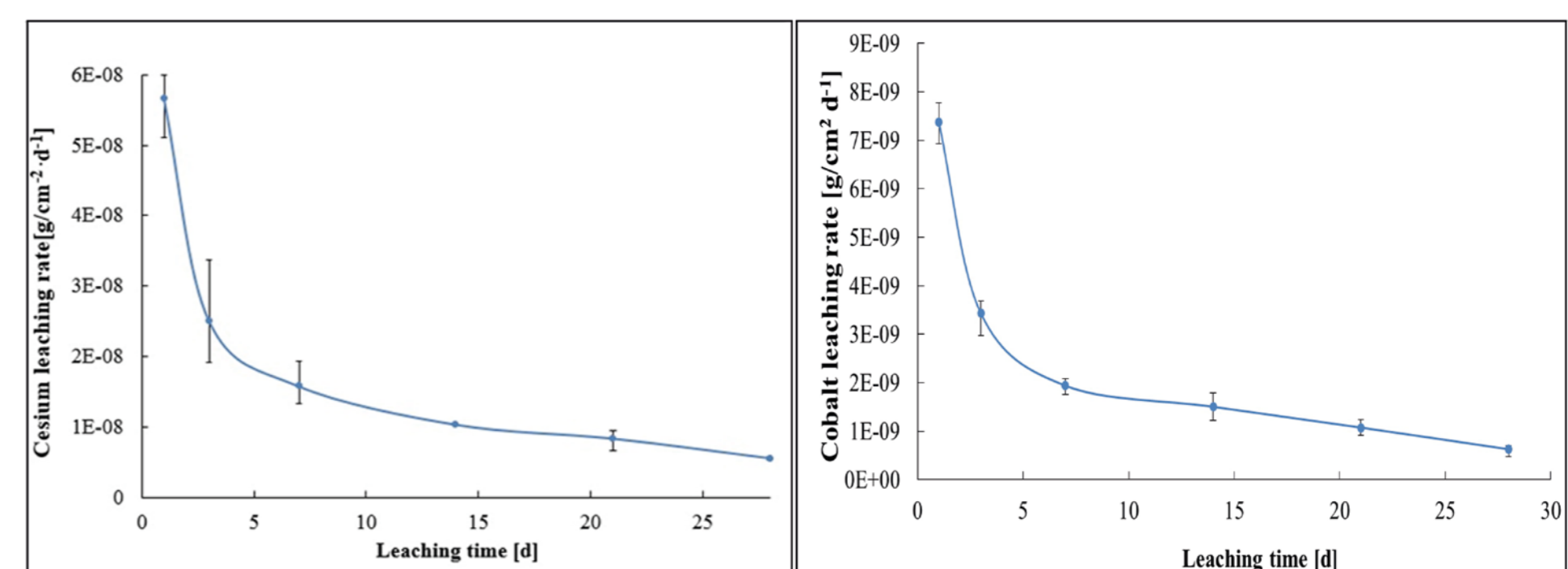
Fig. 2



Method for vitrification of used sorbents with high-active radicals inbuilt in their structure by sol-gel method for permanent disposal radioactive waste before its storage in the bunker

Fig. 4

Radioisotopes leaching rate from the vitrified glass in time



Maximal rate of cesium leaching from the obtained glass was determined as $5.66 \times 10^{-6} \text{ g}/(\text{cm}^2 \text{ day})$

Maximal rate of cobalt leaching from the obtained glass was determined as $7.638 \times 10^{-7} \text{ g}/(\text{cm}^2 \text{ day})$

ASTM D3987-12, in Standard Practice for Shake Extraction of Solid Waste with Water, ASTM International, West Conshohocken, PA (2012)