NINTH INTERNATIONAL
CONFERENCE ON RADIATION
IN VARIOUS FIELDS OF RESEARCH
June 14-18, 2021 | Hunguest Hotel Sun Resort | Herceg Novi | Montenegro

Purification of aqueous solutions from strontium ions by natural and synthetic sorbents under increased radiation background

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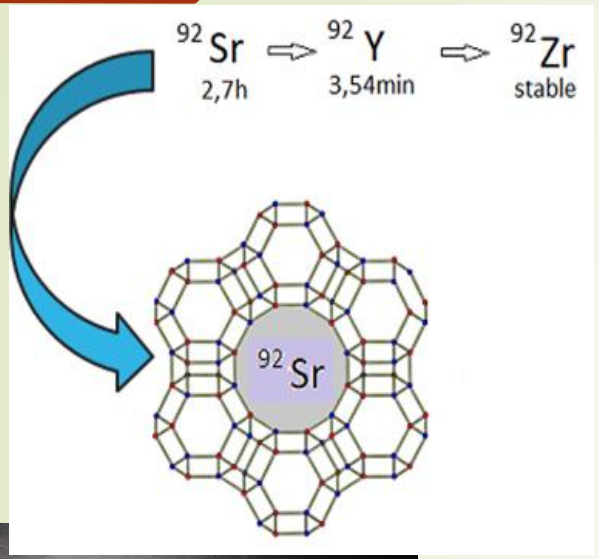
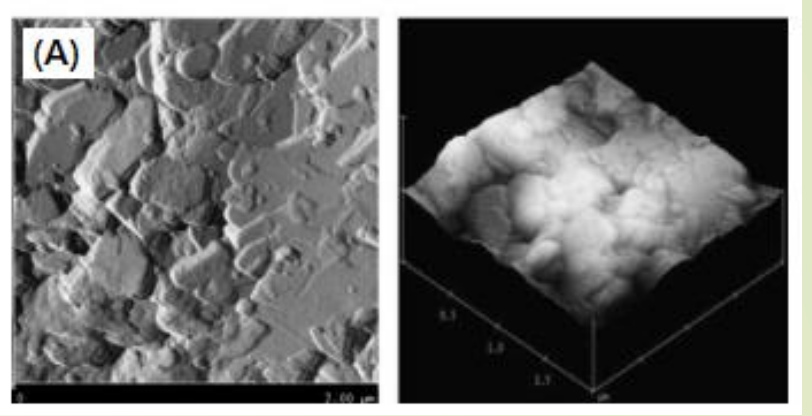
Zeolites, carbon and ion exchange resin

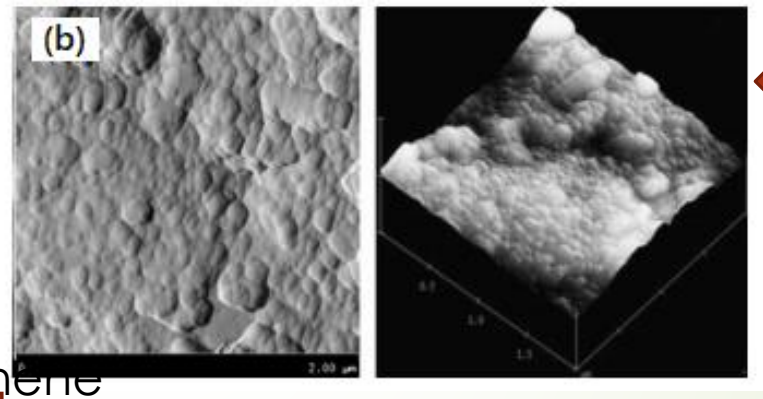
NATURAL ZEOLITES



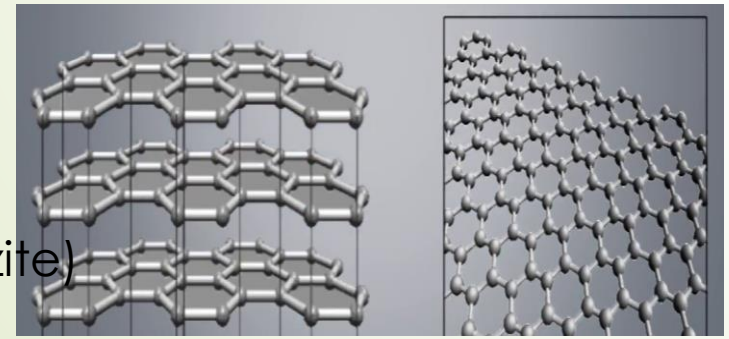


Klinoptilolite and Mordenite (imagine
Were adapted from
Literature source

Activated carbon
Graphite and graphene



X-type zeolite (Faugazite)



The active center of adsorption in this cation exchange
resin is a sulfo- group $-SO_3H$, $HS(=O)_2OH$

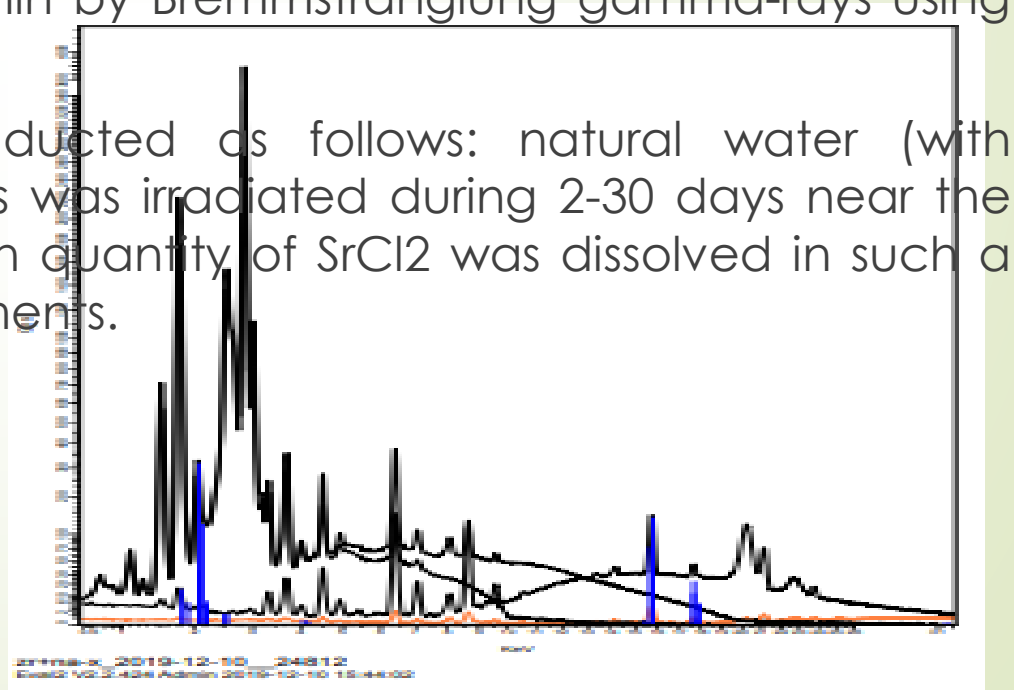
C-ResinH + NaCl = C-Resin Na + HCl

***n* C-Resin Na + M^{n+} = *n* C-Resin M + *n* Na^+**

Experimental technique

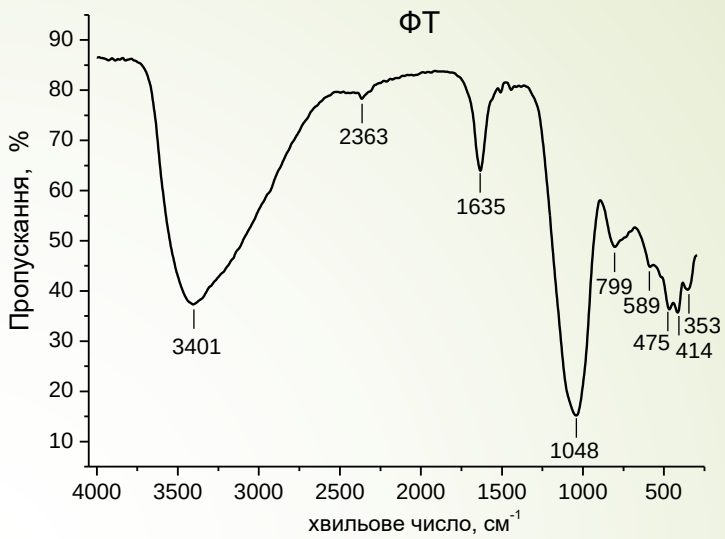
- Titanium phosphate and activated carbon, natural zeolite from Transkarpathia region and commercial available ion exchange resin were chosen as objects of investigations.
- Titanium phosphate and activated carbon were synthesized in ISPE, NAS of Ukraine. For some adsorbent the IR-spectroscopy and XRF analysis were provided.
- The stable isotopes of strontium were used in the form of $SrCl_2$. Initial and residual concentration of Sr^{2+} were determined using direct complexonometric titration.
- Adsorbents were irradiated during 30 min by Bremmstranglung gamma-rays using electron axelerator Betatron B-25.
- Model solutions prepared were conducted as follows: natural water (with significant amount of nature Fe (II) ions was irradiated during 2-30 days near the Pu(a)Be neutron source. Then, a certain quantity of SrCl2 was dissolved in such a water, and ready for adsorption experiments.

XRF-spectrum of zeolite



Results and discussion

adsorbent	q mmol/g	
zeolite	0,02045	Model solution
Cation exchanger	0,1936	Model solution
Activated carbon	0,0409	Model solution
Titanium phosphate	0,0306	Model solution
Strontium ions adsorption without irradiation		
zeolite	0,0125	Solution of $SrCl_2$ in dist. H_2O
Cation exchanger	0,1850	Solution of $SrCl_2$ in dist. H_2O
Activated carbon	0,0494	Solution of $SrCl_2$ in dist. H_2O
Titanium phosphate	0,0619	Solution of $SrCl_2$ in dist. H_2O
Strontium ions adsorption by irradiated adsorbents		
zeolite	0,0146	Model solution
Cation exchanger	0,1743	Model solution
Activated carbon	0,0619	Model solution
Titanium phosphate	0,00	Solution of $SrCl_2$ in dist. H_2O
Cation exchanger	0,139	Solution of $SrCl_2$ in dist. H_2O
Activated carbon	0,00	Solution of $SrCl_2$ in dist. H_2O



Titanium phosphate

IR spectrum of irradiated titanium phosphate, with impregnatedNH4OH molecules

adsorbent	q mmol/g	
Titanium phosphate	0,0306	Model solution
Titanium phosphate	0,0619	Solution of $SrCl_2$ in dist. H_2O
Titanium phosphate +NH_4OH	0,1523	Solution of $SrCl_2$ in dist. H_2O
Strontium ions adsorption by irradiated titanium phosphate		
Titanium phosphate	0,0153	Solution of $SrCl_2$ in dist. H_2O
Titanium phosphate +NH_4OH	0,2343	Solution of $SrCl_2$ in dist. H_2O

Conclusions

- Studies have shown a sufficient degree of stability and invariance of the sorption properties of titanium phosphate and carbon sorbent after irradiation with high-energy gamma quanta
- In this case, a known advantage of titanium phosphate is that, the titanium phosphate sorbent neutralizes the products of water radiolysis.
- It was shown, that increased sorption of strontium ions by titanium phosphate
- modified with NH4OH and irradiated with gamma quanta
- The decrease in the sorption of strontium ions from the model solution compared to distilled water, which is observed for titanium phosphate, can be explained by competition between Fe2 + and Sr2 + ions.
- It is shown that natural zeolite removes strontium ions from aqueous solutions the worst among investigated adsorbents. Clinoptilolite absorbs mainly Fe2 +
- ions from the model solution, which simultaneously contains Fe2 + and Sr2 + ions.