# SELECTIVITY OF INTERGEL SYSTEM BASED ON HYDROGELS OF POLYACRYLIC ACID AND POLY-4-VINYLPYRIDINE TO NEODYMIUM AND CERIUM IONS

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Rare-earth elements are widely used in many applications (from space technologies to electronics, etc.) [1-4]. Modern technologies of rare-earth metals production are based on their extraction from industrial solutions by ion-exchangers [5-8]. Any ion-exchange resin has selectivity to a certain rare-earth metal ion, restructuring of it is impossible.

Previous investigations showed that hydrogels in result of remote interaction undergo significant changes of electrochemical, conformational and sorption properties [9-13]. Each intergel system have maximum values of sorption properties in relation to certain rare-earth metal at certain hydrogels molar ratios. Aim of the study is to show that change of hydrogels molar ratio in intergel system hydrogel of polyacrylic acid (hPAA) – hydrogel of poly-4-vinylpyridine (hP4VP) provides changing of selectivity in dependence of ion nature.

Intergel system interacts with neodymium nitrate solution. Result of such interaction is sorption of the metal ions. Figure 1 shows dependence of extraction degree of $Nd^{3+}$ ions of the intergel system hPAA-hP4VP from hydrogels molar ratios in time.

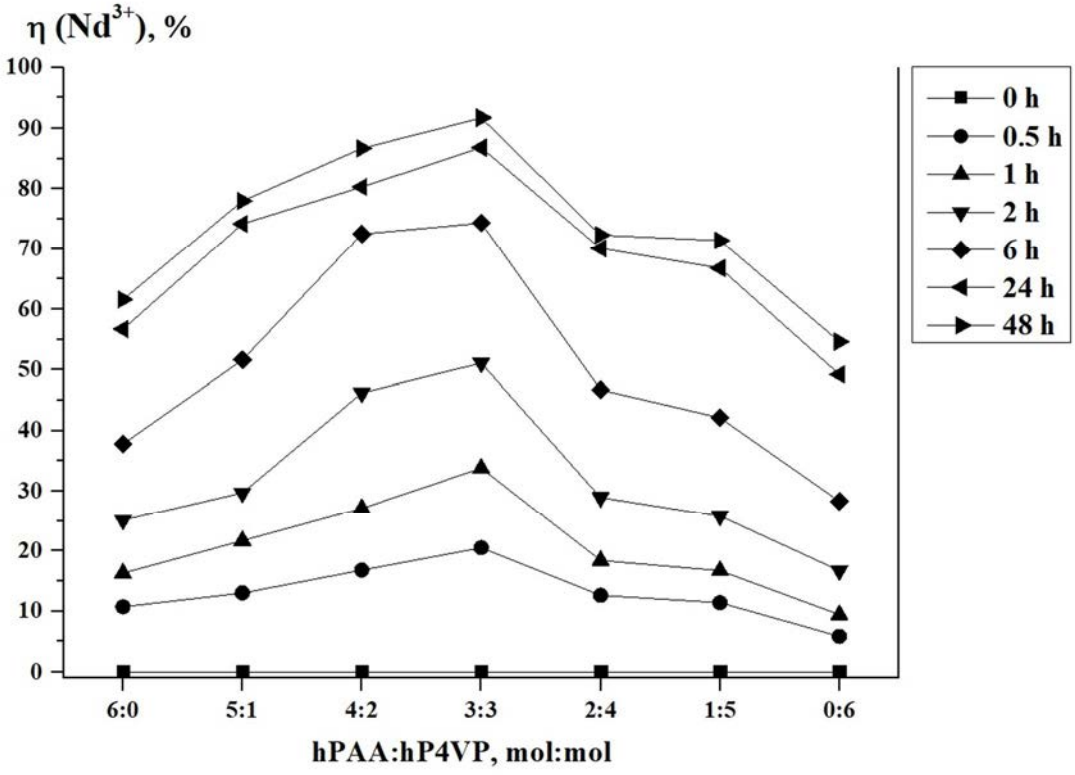


*Fig. 1. Extraction degree (in relation to $Nd^{3+}$ ions) of intergel system hPAA-hP4VP*

As seen from figure 1, there are areas of maximum and minimum extraction degree. Such areas are hPAA:hP4VP=5:1, 4:2 and 3:3 ratios. High ionization of polymer structures occurs at their mutual activation at these ratios. Maximum sorption of neodymium ions occurs at 4:2 ratio, wherein 91.7% of neodymium is extracted at 48 hours of interaction of the intergel system with salt solution. Sorption degree of individual hydrogels of PAA and P4VP is 61.6% and 54.6% (at 48 hours) respectively.

Figure 2 represents dependence of polymer chain binding degree (in relation to neodymium ions) of the intergel system hPAA-hP4VP from time. Polymer chain binding degree of the individual hydrogels of PAA and P4VP is not sufficiently high (at 48 hours 50.2% and 45.6% of neodymium is bind respectively). Result of mutual activation of polymer hydrogels is significant increase of sorption ability of the hydrogels in intergel pairs in comparison with initial hydrogels. High values of polymer chain binding degree are observed at hPAA:hP4VP=5:1, 4:2 and 3:3 ratios. Maximum values are reached at 3:3 ratio at 48 hours of remote interaction of hPAA and hP4VP, binding degree is 73.9%.

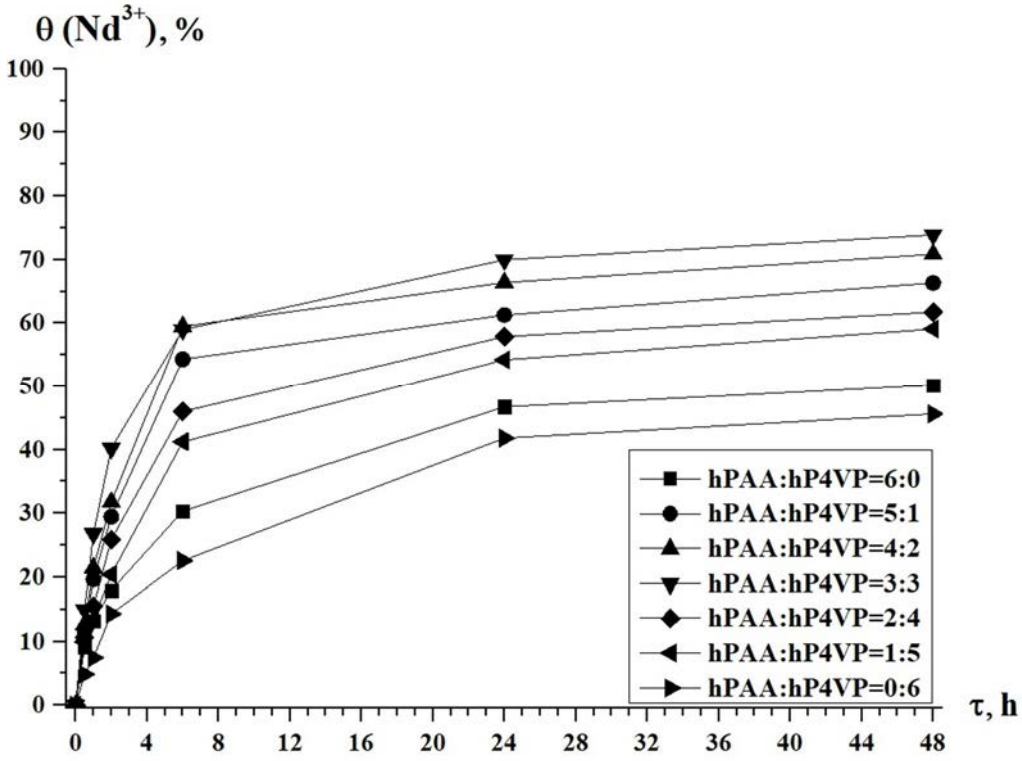


*Fig. 2. Polymer chain binding degree (in relation to $Nd^{3+}$ ions) of intergel system hPAA-hP4VP*

Dependence of cerium ions extraction degree of the intergel system hPAA-hP4VP is shown on figure 3.

As seen from figure 3, maximum amount of cerium ions is sorbed by the intergel system hPAA-hP4VP at hPAA:hP4VP = 1:5 ratio. Extraction degree of cerium ions at 48 hours at this ratio is 92.3%. Obtained results indicate that cerium ions extraction degree by the individual hydrogels of polyacrylic acid and poly-4-vinylpyridine is not very high, sorption degree is 63.3% and 56.7% for polyacrylic acid and poly-4-vinylpyridine hydrogels respectively. The rest intergel pairs in the intergel system hPAA-hP4VP also have significantly higher values of cerium ions extraction degree comparatively with extraction degree of cerium ions of initial hydrogels of PAA and P4VP.

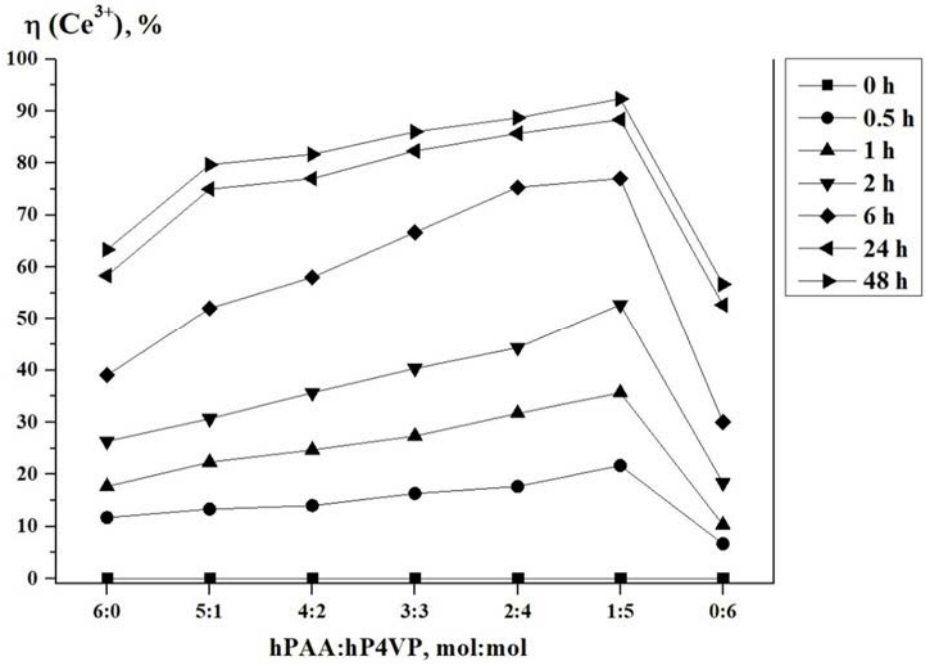


*Fig. 3. Extraction degree (in relation to $Ce^{3+}$ ions) of intergel system hPAA-hP4VP*

Figure 4 shows dependence of polymer chain binding degree (in relation to cerium ions) of the intergel system hPAA-hP4VP from time. Maximum values of polymer chain binding degree in the intergel system are observed at hPAA:hP4VP=1:5 ratio at 48 hours, binding degree is 76.6%. High values of polymer chain binding degree are also seen at hydrogels ratios hPAA:hP4VP=2:4 and 3:3. It indicates to high ionization degree of macromolecules in result of mutual activation of polyacrylic acid and poly-4-vinylpyridine hydrogels. Polymer chain binding degree of individual hydrogels of polyacrylic acid and poly-4-vinylpyridine at 48 hours is 52.5% and 47.0% respectively.

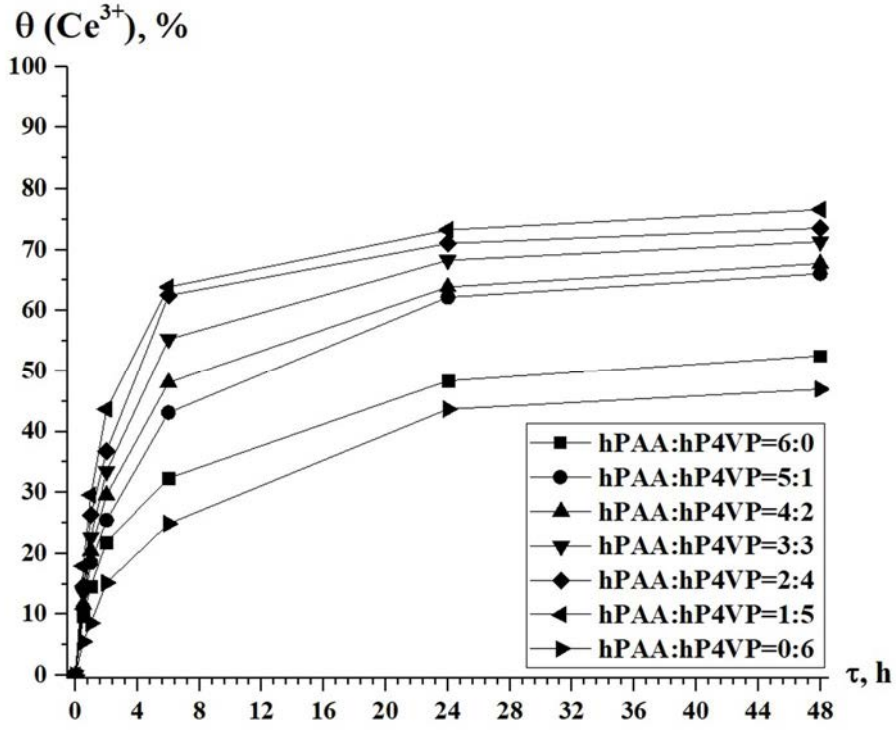


*Fig. 4. Polymer chain binding degree (in relation to $Ce^{3+}$ ions) of intergel system hPAA-hP4VP*

Obtained results show opportunity to control selectivity of the intergel system based on rare-crosslinked polymer hydrogels of polyacrylic acid and poly-4-vinylpyridine by changing hydrogels molar ratios.

Conclusions

1. ***Individual polymer hydrogels of polyacrylic acid and poly-4-vinylpyridine do not have high values of sorption properties (extraction degree, polymer chain binding degree) in relation to $Nd^{3+}$ and $Ce^{3+}$ ions. Sorption degree of hPAA 61.6% and 63.3%, of hP4VP is 54.6% and 56.7% respectively to $Nd^{3+}$ and $Ce^{3+}$ ions. Binding degree of hPAA 50.2% and 52.5%, of P4VP is 45.6% and 47.0% respectively to $Nd^{3+}$ and $Ce^{3+}$ ions.***
2. ***Intergel system hPAA-hP4VP has the highest values of sorption properties in relation to $Nd^{3+}$ ions at hPAA:hP4VP=3:3 ratio. Extraction degree is 91.7%, polymer chain binding degree is 73.9%.***
3. ***Intergel system hPAA-hP4VP has the maximum values of sorption properties in relation to $Ce^{3+}$ ions at hPAA:hP4VP=1:5 ratio. Sorption degree is 92.3%, polymer chain binding degree is 76.6%.***
4. ***Selectivity of the intergel system hPAA-hP4VP can be re-arranged by chaining of hydrogels molar ratios.***

Acknowledgments

The work was financially supported (the work was made due to the grant funding of the Project: AP05131302) by the Committee of Science of Ministry of education and science of the Republic of Kazakhstan.

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