DEVELOPMENT OF RHENIUM-188 EXTRACTION GENERATOR

V. Romanovski*, D. Wester**, S. Bartenev*, M. Zykov*, G. Kuznetsov****, L. Shlkjar****, G. Kodina***, S. Erofeev*, N. Usacheva*, V. Buntsev*, E. Kolobov*

* Khlopin Radium Institute, St.-Petersburg, Russia
** Pacific Northwest Laboratory, Richland, USA
*** State Scientific Center - Institute of Biophysics, Moscow, Russia
**** Research and Development Institute of Construction Technology, Moscow, Russia

One of the most promising directions in radiochemistry is the production of radionuclides for nuclear medicine including both diagnosis and therapy of some sicknesses. Khlopin Radium Institute (KRI) is the largest regional producer of radiopharmaceuticals in Russia. The preparations based on Tc-99m, I-123 and Ga-67 which are produced at KRI meet the needs of St.-Petersburg clinics. The top-quality Tc-99m has already been produced for 8 years on centrifugal contactor from Mo-99 generated by Mo-98 activation in nuclear reactor. Methylethylketone (MEK) is used as extractant.

As the St.-Petersburg market is saturated with diagnostic radiopharmaceuticals, a decision was made on development of a therapeutical preparation on the basis of rhenium-188, daughter nuclide of W-188. The first step on the road to solving this problem is the production of highly pure isotonic Re-188 solution. For this purpose, it was decided to use the widely accepted extraction technology for Tc-99m production, since the Mo-99 - Tc-99m pair is a close analog of the W-188 - Re-188 pair in the chemical properties. It should be noted that the extraction generator of Re-188 offers some advantages over the sorption one. First of all, the extraction generator is less sensitive to specific activity of W-188. Therefore, the initial W-188 can be produced on exposure of the enriched W-186 target or even from natural tungsten in reactors with neutron flux of $5 \cdot 10^{13}$ $n \cdot cm^{-2} \cdot s^{-1}$ - $1 \cdot 10^{14}$ $n \cdot cm^{-2} \cdot s^{-1}$. This considerably reduces the cost of initial material. Secondly, the rhenium solution obtained in the extraction generator has high purity relative to inorganic ions, and thus the Re-188 solutions with high specific activity can be produced.

Re-188 production process involves several stages. Irradiated target of tungsten trioxide is dissolved in alkaline solution. After keeping this solution during 1-2 days, Re-188 is extracted by MEK. MEK is evaporated until dry. Resultant residue is dissolved in isotonic solution. Re-188 is extracted in centrifugal contactor. Centrifugal contactor affords high performance and process rate, short contact time between aqueous and organic phases and correspondingly decrease of radiation loads on extractant.

Research and Development Institute of Construction Technology has developed for this process a facility consisting of two centrifugal contactors. Semicounter-current centrifugal contactor with immobile heavy phase is a singly-stage nonramming apparatus with centrifugal separation of emulsion into phases.

For developing the contactor, a series of physico-chemical properties of aqueous solutions to be used in the process was studied (density and viscosity, in particular). Extraction of rhenium and tungsten from simulated alkaline solutions with MEK was investigated. The distribution coefficients of rhenium and tungsten were determined. It is shown that the rhenium distribution coefficients attain the values of 22-27, depending on composition of solutions. These values are much lower than in the case of technetium, but are sufficient for complete

recovery of rhenium. The best composition of aqueous solution was accepted as follows: 2.5 M/l KOH + 2.5 U/l K_2CO_3 + 200 g/l W. The W distribution coefficients therewith were below 0.01 for all the investigated solutions.

Centrifugal contactor was tested on simulated conditions. It was found the following: Re yield is more than 85%; radiochemical purity is above 99%; pH values of Re-188 aqueous solution are in the range of 6.5-7.5; content of stable elements is practically determined only by quality of aqueous solutions being used for Re-188 dissolution.