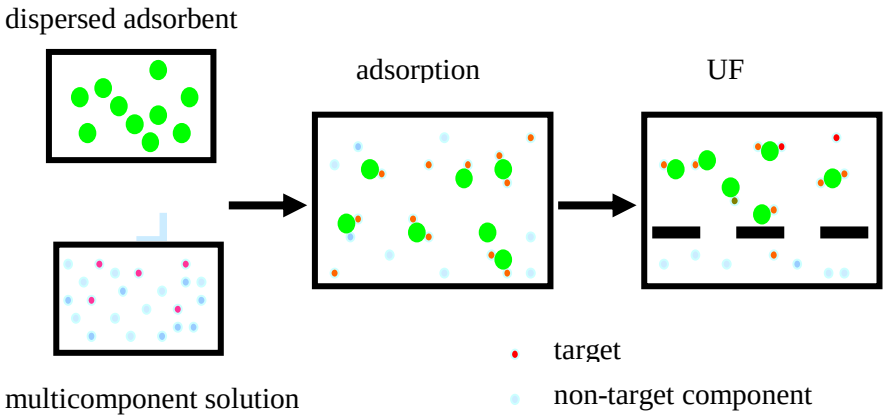
Radioactive wastwater processing by complexation/ultrafiltration hybrid method

Ultrafiltration can be applied in nuclear industry as the pre-treatment stage before reverse osmosis that needs removal of potential foulants from feed streams. To remove efficiently radioactive substances very often ultrafiltration is combined with precipitation or complexation. Small ions bound by macromolecular chelating agent form complexes, which are retained by UF membrane. Such an "enhanced" ultrafiltration becomes an efficient separation process with high decontamination factors, sometimes compared with those obtained by reverse osmosis. Radioactive cations can be removed in precipitation process by formation of less soluble particles (carbonates, phosphates, oxalates or hydroxides) which are later filtered with UF membrane. These hybrid methods are effectively used around the world in plants processing alpha bearing radioactive waste streams. One of the current research devoted to membrane treatment of radioactive waste is directed towards seeded ultrafiltration and all the methods, which combined with ultrafiltration, give considerable enhancement of separation.



Ultrafiltration combined with process of sorption

The processes of UF and enhanced UF for low and intermediate level radioactive waste treatment were studied at Institute of Nuclear Chemistry and Technology, *Department of Nuclear Methods in Process Engineering* [1-5]. Liquid radioactive wastes originating mainly from application of radioisotopes are collected from all of Poland at Institute of Atomic Energy in Świerk. They contain various radioactive substances (total specific activity $<10^7$ kBq/m^3) and ballast non-active salts (concentration < 5g/dcm^3), as well. In the solution small radioactive ions as $^{51}Cr^{3+}$, $H^{51}CrO_4^-$, $^{60}Co^{2+}$ and $^{137}Cs^+$ are present; most of them can easily pass through the membrane of cut-off value ~2,000 MW. Ultrafiltration membranes that are permeable to small ions retain the macromolecules or particles formed in the processes of complexation and sorption.

The selection of appropriate complexant is very important to remove the radioisotopes with high efficiency. Each ion needs specific ligand that has to fulfil special requirements:

- high molecular weight, selected for each UF membrane cut-off,
- good solubility in water
- ability of selective binding the ions and molecules,
- stability of complexes in the process conditions
- non-toxic, not causing potential hazard,
- low-price and market availability.

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