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RESEARCH OF $KBrF_4$ PRODUCTION BY FLUORINATION METHODS OF POTASSIUM BROMIDE

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At present, fluoride processes play important role in the technology of rare elements, especially attention is attended of oxidative fluorination for the purpose of ores and technologic materials revelation is important branch of the fluorine application in the rare metals technology [1, 2].

Pure fluorine is the most widespread fruorinating reagent. But, fluorine is not always applicable. If it is necessary to carry out the oxidative fluorination, in other words, not only to obtain fluoric compounds of elements, but also to oxidize them during the fluorination process, then metal fluorides in the highest oxidation level, fluorides of noble gases or halogen compounds of fluorine are applied.

ClF, ClF_3, BrF_3, BrF_5, IF_5 and IF_7 are well-known among halogen compounds. This group of compounds differs in big spread of boiling temperatures from minus 100 °C till plus 128 °C [3]. BrF_3 and IF_5 are especially marked out the raw of halogen fluorides. They are liquids with strongly marked oxidative properties under normal conditions.

Bromine trifluoride is capable to oxidize whole sum of noble metals quantitatively. However, in this case, it is possible to distinguish two groups according to relative kinetic inclination to the oxidation with bromine trifluoride [2]:

- quick-dissolving metals Ag, Au, Ru, Ir, Os;
- slow-dissolving metals Pt, Pd, Rh

The metals of the first group interact by complex many-stage mechanism through the formation of coordinating fluorides. Next schemes of reactions are represented in general view [2]:

$$Ag + 2\,BrF_3 \rightarrow Ag[BrF_4] + 2\,Br_2, \quad (1)$$

$$Au + 2\,BrF_3 \rightarrow [BrF^{2+}][AuF^{4-}] + ½\,Br_2, \quad (2)$$

$$Me + 3\,BrF_3 \rightarrow [BrF^{2+}][MeF^{6-}] + ½\,Br_2, \quad (3)$$

where Me is Ru, Os, Ir.

The interaction between BrF3 and the second group metals is accompanied by the formation of well-dissolving complexes $[BrF^{2+}]_2[PtF^{6-}]$, $[BrF^{2+}]_2[RhF^{6-}]$ and inclusion complex $PdF_3{\cdot}BrF_3$ [2].

Besides bromine trifluoride application in fluoride oxidation of noble metals, it is possible to use this compound for the irradiated fuel fluorination with subsequent separation of uranium from plutonium and fission products fluorination by the distillation methods. Bromine trifluoride and uranium form uranium hexafluoride [4, 5] according to the reaction:

$$UO_2+BrF_3 \rightarrow UF_6\uparrow+O_2\uparrow+Br_2\uparrow\ (BrF) \quad (4)$$

Bromine trifluoride with plutonium forms non-volatile plutonium trifluoride:

$$PuO_2+BrF_3 \rightarrow PuF_4+O_2\uparrow+Br_2\uparrow\ (BrF). \quad (5)$$

So, we have the gaseous mixture and non-volatile excess. The gas contains uranium and volatile fluorides of fission products. Non-volatile excess contains plutonium and non-volatile fluorides of fission products.

In spite of all above-mentioned facilities, wide application of bromine trifluoride in a laboratorial practice is yet complicated. The reason of this is high chemical and corrosive activity of this reagent, and besides, the necessity of some specific skills use, the providing of safety engineering in BrF_3 use [2, 10]. As alternative for analytical aims, it is suggested the use of bromine trifluoride complex compound with potassium fluoride, in other words, potassium tetrafluorobromate $K[BrF_4]$, which is the powder and possesses much less chemical and corrosive activity. And that's why it is more appropriate for the use and storage. It is considerably safe in the use than liquid bromine trifluoride [2, 11, 13]. When this reagent is in the molten state at elevated temperatures (above 330 °C), it shows its excellent fluorinating properties. The processes with its participation are absolutely safe and can be fulfilled in any analytical laboratory [2, 11, 13]. That's why it is sure that any powdery tetrafluorobromates of alkaline and alkaline-earth metals will be safe forms of bromine trifluoride storage.

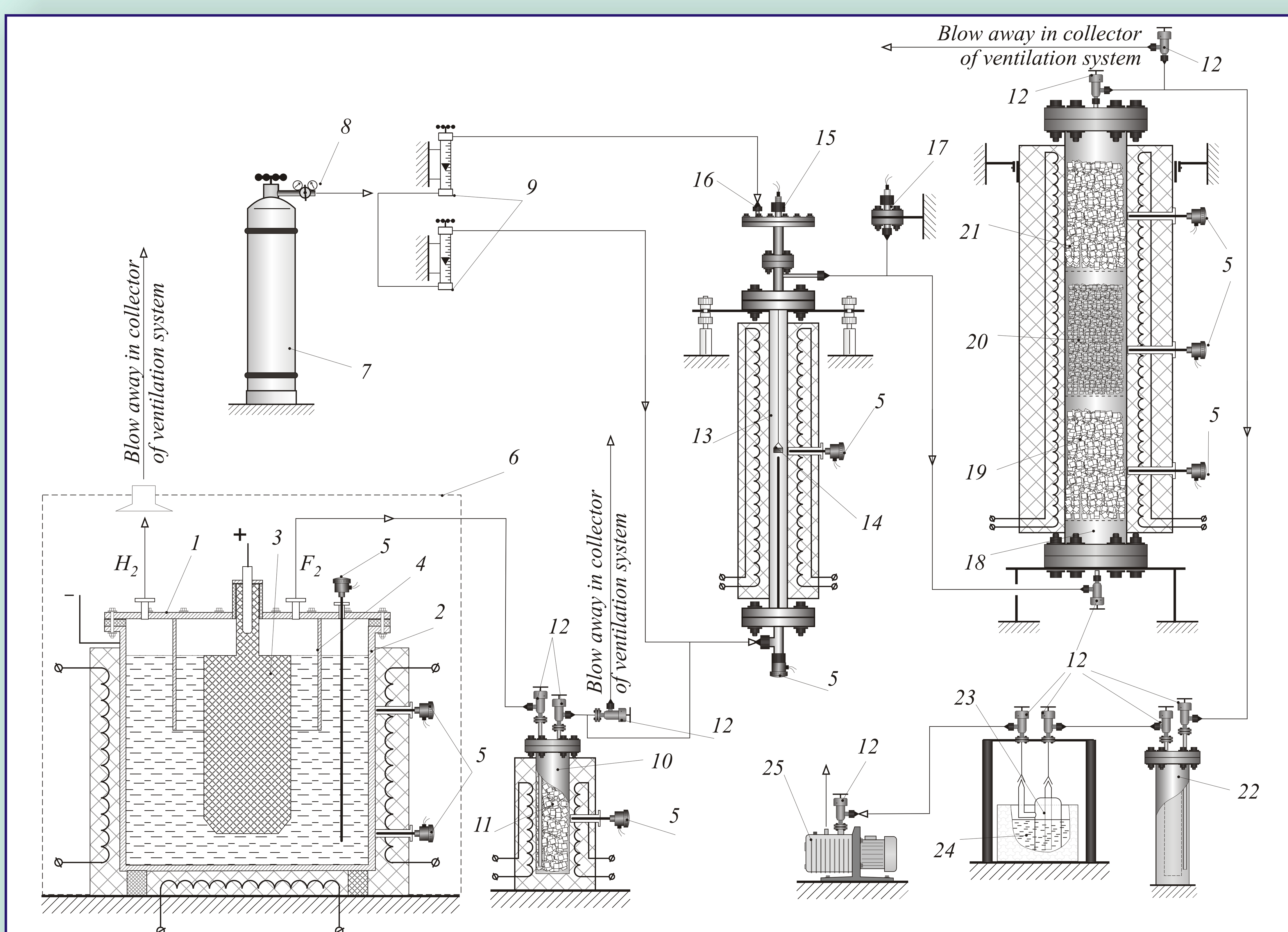
Barium tetrafluorobromate is the most stable one among alkaline-earth elements, the rest of alkaline-earth elements form the compounds of indefinite composition, or simple fluorides form [6]. Barium tetrafluorobromate forms according to the next reaction:

$$BaCl_2 + BrF_3 \rightarrow Ba[BrF_4]_2 + Cl_2 + Br_2. \quad (6)$$

High thermal stability of $Ba[BrF_4]_2$ complicates its application for bromine trifluoride production by the thermal decomposition under laboratorial conditions. But $Ba[BrF_4]_2$ can be prospective for synthesis fluorine organic compounds in the production of fluorine derivatives for pharmacological industry and for other preparative aims.

Using of alkali metals tetrafluorobromates is more perspective in case oxidative fluotination inorganic substances and in analytical chemistry. One of that complex compounds is tetrafluorobromate of potassium - $KBrF_4$. Research of interaction potassium bromide with fluorine to formation $KBrF_4$ is sown in this work.

The process of fluorination was produces on standard methodic base in nickel reactor vertical type. The scheme of experimental installation is sown on ***picture 1***.



1. Electrolytic cell for fluorine production; 2. Nickel cathode, shell of electrolytic cell; 3. Graphite anode; 4. Globe of anode; 5. Temperature detector; 6. Box for electrolytic cell; 7. Argon tank; 8. Gaseous reducer; 9. Gas flow meter; 10. Sorption column for anode gas purification; 11. NaF sorbent for anode gas purification; 12. Valve with sylphon sealing; 13. Reactor to fluorination; 14. Nickel vessel with a sample; 15. Mass measurement detector; 16. Pipe of gas-buffer security; 17. Absolute pressure detector; 18. Three-layered sorption column; 19. Sorbent NaF; 20. Zeolite layer; 21. Lime layer for control chemical sorption; 22. Metal-pore filter; 23. Freezing collector; 24. Liquid nitrogen; 25. Vacuum pumper.

Picture. 1. *The scheme of experimental installation for fluorination solid samples by gaseous fluorine research*