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Separation of radioiodine by dry distillation process from irradiated elemental Te target

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Abstract –The yield of release of radioiodine from pressed elemental tellurium target and both sublimation and evaporation rate of target material were investigated under different experimental conditions.

Keywords –elemental tellurium target, dry distillation

I. Introduction

A separation of radioiodine by a dry distillation from irradiated TeO₂ target is widely used^[1-6]. Until now, one work on studies on the separation of radioiodine by dry distillation from irradiated elemental tellurium target was published by Acerbi et. al.^[7] in the seventies. In recent years the separation of radioiodine by anion-exchange and solvent extraction from metallic tellurium target was also investigated^[8]. In the present work the dry distillation method of radioiodine from irradiated elemental tellurium target was studied.

II. Experimental

The thickness of pressed tellurium powder with a natural isotopic composition was about 320 mg/cm². Some of the targets were initially heated at a temperature 713 K and pressure 0.7 Pa by 10 minutes before an irradiation. The irradiation condition was 20 nA as proton of energy 60 MeV for 2-3 h at the Cracow AIC-144 cyclotron. Target after irradiation was placed in a quartz tube of 10 mm diameter. Performed two series of experiments: under reduced pressure –0.7 Pa and at a flow of Ar - 15 cm³/min. The duration of each experiment was 40 minutes after reaching a given temperature.

III. Results and discussion

The yield of release of radioiodine from target matrix and evaporation rate of target material were investigated under reduced pressure –0.7 Pa for temperatures from 713 K to 823 K. The yield of release of radioiodine was about 65% for 713 K and reached the value 95% for 823 K. The tellurium loss in the separation conditions was 4% for temperature 713 K and increasing to 44% for 823 K. In the second series of experiments initially heated targets and Ar gas flux of 15 cm³/min were used for temperatures lower then the melting point – 723 K of tellurium from 623 K to 713 K. A low yield of separation radioiodine was observed in the temperature range 623 K to 673 K. With the increase of process temperature to 713 K a significant increase of yield of dry distillation of iodine took place and reached the value about 65%. The tellurium losses in this temperature were from 3 to 4%. Comparing the obtained results of yield of release of radioiodine for targets with and without initially heating showed that the yield was higher by 12% at 698 K and about 17% at 713 K for targets without heating. There was no significant differences between the target material losses for a given temperatures. The sublimated tellurium condensed from 656 K to 575 K but the adsorption zone of radioiodine starting from 575 K to 320 K at the flow conditions. Due to overlapping the peaks the loss of radioiodine was 1,5%.

IV. Conclusion

The studies allowed to obtain the following conditions for the separation process: yield of release of radioiodine 85% (target without initially heating) and 65% (target with initially heating) at temperature 713 K. It follows that to achieve 85% efficiency of release will be required to reestablish the original properties of the tellurium powder. The sublimation of tellurium was 3-4% from initial mass. In comparison with TeO₂ target the yield of separation of radioiodine is lower then 14% (for the 40 minutes experiment). Taking into account the adsorption temperature of radioiodine it is possible to transport radioiodine

to attached trapping device by heating the part of quartz tube beetwen end of furnace and attached trapping device at temperature above 385 K. Based on the results further tests are planned.

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