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Production of ^{15}N for nitride type nuclear fuels

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Nitride type nuclear fuel is the obvious choice for advanced nuclear reactors and accelerator driven system (ADS) because of the favorable properties: high melting point, excellent thermal conductivity, high fissile density, lower fission gas release and good radiation tolerance.The application of nitride fuels in nuclear reactors and ADS requires use of ^{15}N enriched nitrogen instead of ^{14}N to suppress ^{14}C production due to (n, p) reaction of ^{14}N. For an industrial plant producing 10 t /y ^{15}N, using present technology of isotopic exchange in Nitrox system ($\alpha = 1.055$ at 25°C), the first separation stage of the separation cascade would be fed with 10M HNO_3 solution of 60 m3/h flow-rate. If conversion of HNO_3 into NO, NO_2, at the enriching end of the separation columns, would be done with gaseous SO_2, for a production plant of 10 t/y ^{15}N a consumption of 4x105 t/y SO_2 and a production of 65 – 70% H_2SO_4 waste solution of 4.5x105 m3/y are estimated. In the present there is no alternative technology for ^{15}N production, the ion exchange NH4 – R / NH_3(aq) on cation exchange resin being inefficient for large scale production, according to the small flor-rate accepted in the separation columns. The cryogenic distillation of nitric oxide having a good single stage separation factor for ^{15}N ($\alpha = 1.037$ at -152°C) can't be taken into consideration for industrial production of that isotope because nitric oxide, in liquid and solid form, is an unpredictable, highly shock-sensitive explosive.

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