

Direct Denitration of Uranyl Nitrate

In India the oxides of uranium (U_3O_8) is produced after treating the uranyl nitrate pure solution (UNPS) with ammonia (NH_3) and subsequently calcining the resultant ammonium diuranate (ADU). This conventional process includes several steps such as neutralization of the nitrate solution with NH_3 , precipitation, filtration, drying, and calcination. On the other hand the direct denitration process offers savings in chemical costs, since it avoids the use of ammonia and permits the recovery of nitric acid. Hence, an economical and efficient way is to decompose the uranyl nitrate solution thermally and obtain the oxides of uranium in a single step. Initial experimental investigation has been carried out in an 80 NB laboratory scale fluidized bed reactor to test the process feasibility as well as to select the optimum process parameters for continuous smooth operation. Later this process has been demonstrated in a 150 NB bench scale fluidized bed reactor. The reactor was operated using U_3O_8 (250 – 500 micron) as starting bed material and with a feed rate of 5 LPH (125 – 300 g U/ l). In campaign runs total 1000 l solution was processed and 150 kg coarse fluidizable UO_3 particles were collected. Continuous smooth operation was observed in all campaign runs. Online regeneration of filter candles using blow back air and online solid withdrawal from the reactor to the product collection vessel were successfully tested. The fine UO_3 powder (8.34 μm) obtained from filter housing during operation was reduced to UO_2 (O/ U ~ 2.06 – 2.09) at Uranium Extraction Division. The UO_2 powder was taken for both pellet production and hydro-fluorination reaction. The green pellet (10 mm dia.) density was obtained as 6.28 g/ cm^3 at 455 MPa compaction pressure. These pellets were sent to AFFF, Tarapur for sintering. The sintered pellet density was In the order of 9.05 g/ cm^3 (~90% of theoretical density). In the other route metal grade UF_4 (Moisture: 0.11%; Free Acidity: 0.45%; UO_2F_2 : 1.96%; AOI: 0.7%) was produced from UO_2 and also U metal produced from the UF_4 .

It was proposed to setup similar direct denitration denitration demonstration facility at PREFRE-2, Tarapur. Safety Clearance for this facility has been obtained from ULSC – NRB (T). Equipment installation and piping work has been completed.

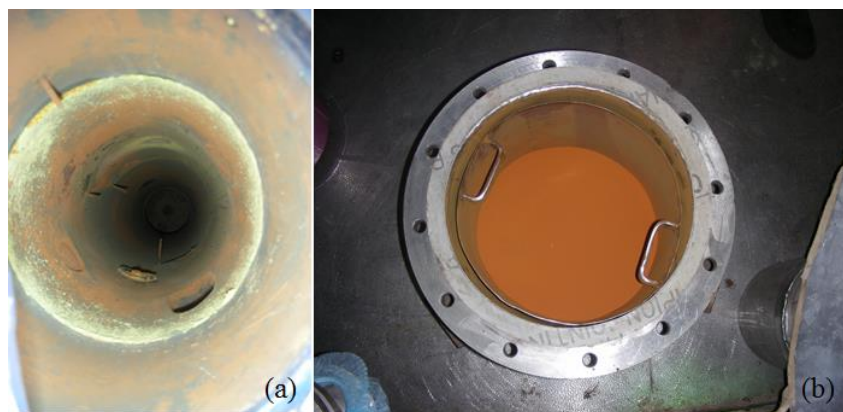


Figure 1: (a) Inside of bench scale reactor after processing 310 l (~ 125 g U/ l) solution (b) Product UO_3 discharged from the reactor to the Product Collection Vessel (PCV).