Experimental study on hydrogen isotope separation using twin-bed periodically counter-current flow technique

WU Wenqing[a,*] WEI Yongjun[a]

[a] *China Academy of Engineering and Physics,P.O Box:919-71,Mianyang,Sichuan,621900 China*

Deuterium and tritium of hydrogen isotopes have been separated or concentrated by several methods such as cryogenic distillation,laser and a thermal diffusion column.In th present study,protium-deuterium isotope separation experiment was carried out under the condition of reflux cycle using continuous twin-bed hydrogen isotope separation technique,i.e.twin-bed periodically counter-current flow technique.The two beds were packed with Pd and $LaNi_{4.7}Al_{0.3}$ which showed positive and inverse isotope effects,respectively.The experimental results showed that the separation efficiency mainly depended on the saturation of hydrogen adsorbents,cycle time and extraction proportion,over 90% deuterium extraction gas from 10% deuterium raw material gas could be obtained at unsaturated condition with 3 cycle times and 10% extraction proportion.

Tritium enrichment efficiency was also studied using this method at the optimized condition.The content of tritium in extraction gas was between 33.6%~46.7% with the raw gas of protium (8.4%),deuterium (82.8%) and tritium (8.8%).The enrichment efficiency was outstanding when extraction proportion was small.Thus, it can be concluded that hydrogen isotope separation under the condition of full cycle was feasible when absorption,desorption for Pd bed and desorption for $LaNi_{4.7}Al_{0.3}$ bed were operated at room temperature,100℃ and 200℃,respectively.A satisfied distribution of hydrogen isotope along axial direction was obtained within a operating periodic with 2~3 cycles under the condition of full reflux and the technique could meet the requirements of hydrogen isotope separation.

Keywords: Palladium; $LaNi_{4.7}Al_{0.3}$; Twin-bed; Hydrogen isotopes separation