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## **Study and Characterization of potential adsorbent materials for the design of the hydrogen isotopes extraction and analysis system**

Selection of appropriate adsorbents, for the adsorption systems of Hydrogen Isotopes Recovery System (HIRS) at IPR, is of great importance for the effective functioning of the system. The two main systems of HIRS, namely Atmospheric Molecular Sieve Bed (AMSB) adsorber and Cryomolecular Sieve Bed (CMSB) adsorber removes ppm levels of water vapour, hydrogen isotopes, oxygen and nitrogen gas from Helium gas. Micro porous adsorbents like activated carbon, zeolites molecular sieves 4A, zeolites molecular sieves 5A have been considered. Studies suggest that molecular sieves 4A at room temperature effectively adsorb trace quantities of water vapour present in Helium carrier gas and molecular sieves 5A have very good selectivity and adsorption capacity for the preferential hydrogen isotopes adsorption at cryogenic temperatures. So the main aim of the present study is to understand the hydrogen gas adsorption equilibria on zeolites 4A and 5A at 77K using a BET apparatus and also to perform the characterisation of these adsorbent materials using SEM + EDAX technique.

The plan of the project work is as follows:

### **A) Literature survey of adsorption and adsorbents**

- 1) Understanding the physics and thermodynamics of adsorption.
- 2) Different types of micro porous adsorbents: activated alumina, activated carbon and zeolites. Preparation of their comparison and application chart.
- 3) Study of Zeolites and its types in detail along with specific advantages of zeolites over other adsorbents
- 4) Manufacturing process of zeolites.
- 5) Equilibrium models: Langmuir, freudlich and BET. Assumption, Theory, formula, differences and application.

### **B) Experimental activities**

1. Experimental Study of adsorption of pure component hydrogen, deuterium, at 77K on zeolites 4A, activated carbon, zeolites 5A using Volumetric adsorption apparatus at Fusion Fuel Cycle lab
  - Aim of the experiment: To determine the adsorption isotherm, BET surface area, nature of pores, adsorption capacity/g of adsorbent and energy of adsorption for the adsorption of gases on the adsorbent
  - Data interpretation and analysis of obtained results
2. SEM+EDX analysis of zeolites 4A and 5A, activated carbon at SEM Lab, FCIPT
  - Aim of the experiment: To determine the exact chemical composition of zeolites and activated carbon.
  - Data interpretation and analysis of obtained results

### **C) Modelling activities**

1. Determination of breakthrough curves using theoretical adsorption models like Rosen solution, RT Yang solution using Matlab and excel.

**Eligibility: Only students of (B.E/B.Tech) Chemical engineering (2 Nos. candidates) branch can submit their application at**

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