

Chemistry - PI 24

HEAVY WATER LEAKAGE - RECOVERY BY MOLECULAR SIEVES

Objectives:

1. Briefly describe the action of a molecular sieve in the recovery of heavy water from atmospheres containing moisture.
 2. Draw a diagram to show the service, regeneration cycle of molecular sieves and in a sentence or two, explain the diagram.
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Heavy water leaked from CANDU systems is recovered by two basic methods:

- (1) Liquid Recovery (Collection) systems which are discussed in the PI-33 course.
- (2) Vapour recovery systems to remove heavy water from the air leaving the plant and areas such as reactor vault atmospheres.

Heavy water vapour is recovered by Molecular Sieves.

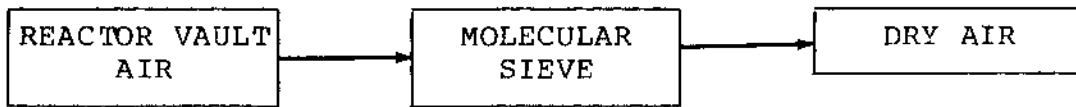
All air leaving the plant and air from areas which are likely to contain heavy water vapour is passed through filters, commonly called molecular sieves.

The packing material of these filters is an inorganic polymer in granular form. The infrastructure of the polymer has cavities or holes such that linear molecules are able to line themselves up and pass through but non-linear molecules are trapped. The significance of this is that Nitrogen and Oxygen (ie, air) may pass through the sieve but water or nitrogen oxides from radiolysis of air are trapped. Thus all water vapour is removed from the air, both heavy water and light water, as well as the small amount of nitrogen oxides present. At some point in time the sieve becomes saturated and will no longer function. For this reason sieves are run in pairs, one in service, the other being regenerated (having the water removed) or on stand-by.

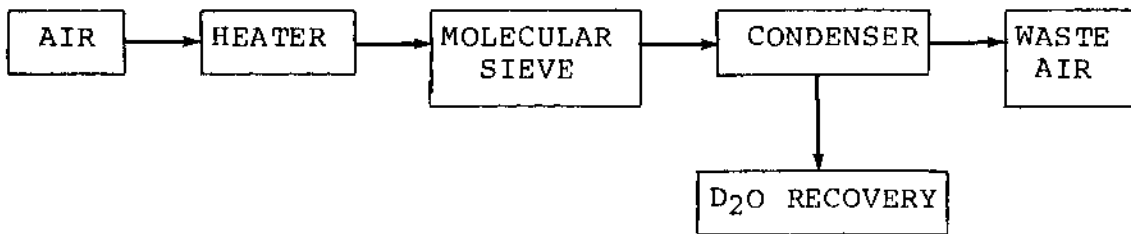
Regeneration is done with a stream of preheated air which expands the cavities allowing the water to escape. The resulting warm moist air is passed through a condenser for D₂O recovery. The condensate will be downgraded from the normal atmospheric humidity which was also trapped on the sieve.

The service/regeneration cycles may be depicted schematically.

SERVICE



REGENERATION



Practice Exercise:

Consider the two objectives at the front of this module as if they were check-out questions. Draft out your answers and review your work with a colleague.

Additional Reading:

You will not be tested on anything other than the stated objectives for this module but if you want to know more about molecular sieve materials and operation you are referred to:

- (1) An Assessment of Molecular Sieve Dryers for Heavy Water Vapour Recovery; CRNL-182; A.H. Dombra; 1969.
- (2) How NPD Driers Work; Ontario Hydro Technical Note No. 20; NPD File 00230, J. Burnham; July 1974.

The Course Manager should have a copy of these to lend you.

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