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Reduction in variation in refrigeration temperature for a sorption compressor based J-T cooler

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The requirement of a cryocooler with practically zero vibration and no electromagnetic interference has led to development of sorption compressor based Joule-Thomson (J-T) coolers. The adsorption is carried out at near room temperature and desorption process at an elevated temperature. High pressure is generated due to accumulation of desorbed gases inside the adsorber cell on providing heat input. The rate of desorption depends on the adsorbent loading level, the heat input rate and the time before the flow from desorption cell is started. Therefore, the rate of gases desorbed varies during the discharge phase as gas is continuously discharged after opening of the discharge valve. This affects the flow rate of the desorbed gases through the throttling device and results in the variation in the cold temperature desired At the beginning of the throttling process, the gas mass flow rate is maximum due to maximum pressure difference between desorption and the adsorption cells. The adsorption rate within the cell does not match with the gas flow rate entering the adsorption cell. This causes increase in the pressure in the adsorption cell. As the pressure increases, the lowering of the temperature is affected. The variation in refrigeration temperature can be reduced by allowing the large flow rate through the throttling valve but not allowing simultaneously, the same to enter the adsorption cell. To achieve this simple insertion of a buffer chamber has been tried. In the present work, activated carbon is used as the adsorbent, with a mixture of nitrogen, methane, ethane and R134a acting as adsorbate. A buffer chamber of volume 9.75 l is used while the heat input is 990 W for a cycle time of 1500 seconds. A maximum variation of 8 ⊠C is observed by using a buffer chamber against 11 ⊠C without it.

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