

Recovering Xenon — and Costs

A Special Report to Cryogas International

by Gene Karwacki, Commercial Development Manager, Air Products

A range of new uses for the noble gas xenon has boosted its profile along with its demand at a time when supplies have been crimped thanks to the ongoing economic recession. With that in mind, users are paying more attention to how they use xenon.

Xenon is a heavy, colorless, odorless rare gas that is present within the atmosphere at 87 parts-per-billion. It is collected as a byproduct from very large air separation plants. Current world-wide production capacity is estimated to be 14 million liters per year. However, because of the global economic recession and curtailment in demand for oxygen and nitrogen, the available volume of xenon is now estimated to be less than 10 million liters per year.

Because of its place within the periodic table, xenon possesses a number of physical and chemical properties that make it useful within a wide variety of applications such as integrated circuit (IC) manufacturing, plasma displays, excimer lasers, lighting, and aerospace. In the future, there are expectations that

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xenon will also be employed as an anesthetic and blanketing gas to reduce brain trauma.

Xenon is also used to manufacture xenon difluoride (XeF_2). This material is emerging as a dry etchant for fabricating many types of MEMS (microelectromechanical systems) devices. Though xenon usage for many of these applications has declined from their peaks in early 2008, demand for xenon continues to outpace production. This is reflected in the pricing of xenon which remains near historical highs.

As a means to stabilize the supply and pricing of xenon there has been growing interest within the market for ways to recover xenon from processes that employ it. To address this demand, Air Products introduced its XeCoveySM: Xenon Recovery Service in 2008. The service employs vacuum swing adsorption (VSA) technology to selectively capture and concentrate xenon from process waste gas streams. For example, in the waste gas from plasma etching processes, xenon is present at concentrations of less than 0.5 percent. There are many challenges to seamlessly integrate a recovery system into such a process. These include extracting and diverting the waste gas from the process to the recovery system, mitigating the presence of reactive and/or toxic species that may be accompanying the xenon, and being able to balance wide swings in the volumes of waste gas as processes are ramped up as well as down.

The Air Products Mark I and II VSA-based units were developed to enable efficient xenon recovery from processes that employ 10,000 liters per year to more than 150,000 liters of xenon per year. Recovery efficiencies of greater than 98 percent have been achieved using this methodology. The “crude” xenon collected is concentrated and compressed into cylinders by the units. This material is then transported to Air Products for distillation back to a purity of 99.999 percent.

The benefit to customers of the XeCovey service is a reduction of 50 percent or more in the cost of xenon. Air Products owns, operates, and maintains the recovery equipment at a site. The customer is responsible for installing the unit and the utilities to operate the equipment.

For processes which emit higher concentrations of xenon (> 5%), there is less of a need for VSA-based technology to recover xenon. To address these market segments, Air Products has recently introduced the Mark III XeCovey system. This unit is more compact and is designed to capture the entire waste effluent stream. The Mark III is flexibly designed to recover xenon from processes that may only employ a few thousand liters to very large (>100,000 liters) volumes. This system is also capable of recovering other gases of value such as krypton and neon.

The XeCovey service is now expanding into the MEMS manufacturing segment to recover xenon from etching processes that employ XeF_2 . A major impediment to wider utilization is the high cost for this material. The escalating price for xenon has made this material more expensive over the past two years. Xenon, released as XeF_2 , is consumed during the isotropic etching of materials such as silicon. Recovery of xenon from the waste gas is a means for substantially lowering the price of the xenon feedstock for manufacturing XeF_2 . This has motivated Air Products to begin leveraging its XeCovey service to enter the market as a supplier of XeF_2 . Customers employing the XeCovey service will now be able to significantly reduce their XeF_2 cost.

For more information on XeCovey go to www.airproducts.com/xecovey

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Air Products' XeCovey xenon recovery unit, which can enable customers to save as much as 50 percent on their cost of xenon.