PRISM™ O_2/O_3 Short Loop Recycle (SLR) technology

For ozonolysis chemistry and other advanced ozone applications

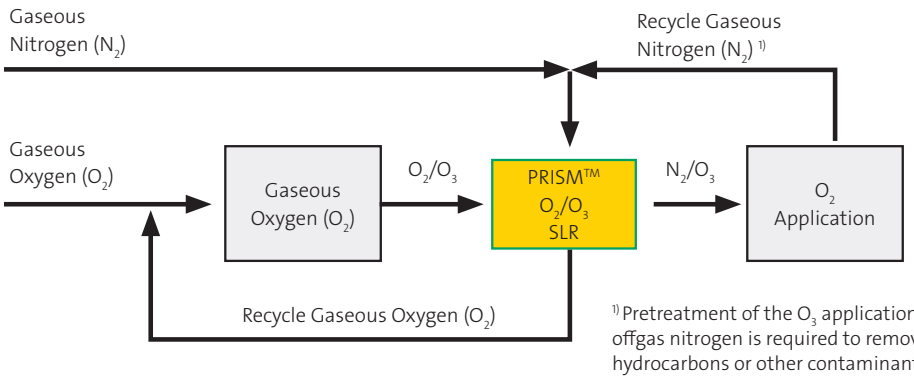
A need has emerged in the specialty chemical industry to optimize the overall ozone supply system for industrial gas usage, capital expenditure and power consumption, including process equipment for ozone generation, oxygen supply and heat management, all while focused on the safe use of oxidants in an ozonolysis reactor.

Pictured above is a large scale ozone generator which generates ozone at 6 to 15 wt% from an oxygen feed gas. The generated ozone stream is directed to the O_2/O_3 SLR process for separation of oxygen and creation of an ozone containing nitrogen gas.

The use of ozone in the specialty chemical industry has become more widely cited due to innovation in the synthetic organic chemistry field and the reduction in capital cost and efficiency gains for commercial, large scale ozone generation equipment. Proprietary ozonolysis know-how has led to full scale, commercial projects since the chemistry developed is economically attractive and more environmentally friendly arising from improvements in product yield, fewer by products, less complicated separations or elimination of costly, toxic reagents such as osmium tetroxide.

Meeting the Need—PRISM™ O_2/O_3 Short Loop Recycle (SLR) technology

PRISM™ O_2/O_3 SLR technology is a pressure swing adsorption (PSA) process that uses a proprietary adsorbent to adsorb ozone from an ozone containing oxygen gas produced in ozone generation equipment. As shown below, adsorbed ozone is removed from an adsorber vessel in the PSA process with a stream of gaseous nitrogen, therein creating a reactive process gas containing principally ozone and nitrogen. Oxygen in the PRISM N_2/O_3 product gas can be designed to a low concentration level, thereby creating an ideal gas for ozonolysis chemistry given safety concerns associated with the addition of oxidants to hydrocarbon mixtures. Concurrently, separated oxygen is recycled back to ozone generation equipment to minimize the need for make-up oxygen to the ozone generation process.



1) Pretreatment of the O_3 application offgas nitrogen is required to remove hydrocarbons or other contaminants

Prism O_2/O_3 SLR technology and engineering support available from Air Products

Features and Benefits

Feature: Enables generation of ozone at low concentration while specifying/controlling ozone at a higher concentration in the SLR product gas

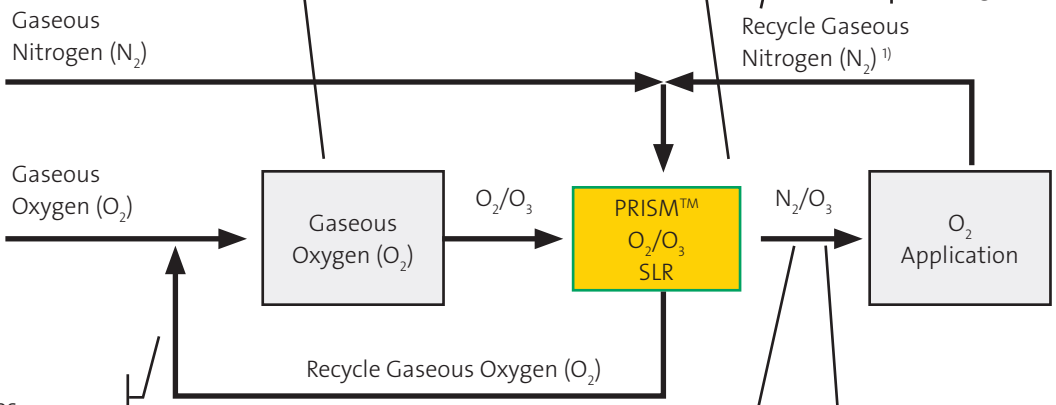
Benefit: Significantly reduces power usage for ozone generation and heat mitigation

Feature: High ozone recovery in SLR process

Benefit: Reduces CAPEX and power usage for ozone generation and heat mitigation

Feature: Amenable to recycle of offgas nitrogen from an ozonolysis reactor or other ozone consuming application to the SLR absorber vessel

Benefit: Minimizes operating expense for nitrogen



Feature: Separates oxygen from ozone enabling recycle of oxygen to ozone generation equipment

Benefit: Reduces operating expense for oxygen generation

Feature: Separates oxygen from ozone

Benefit: Enables control of oxygen concentration in the SLR product gas over a wide specification range including a product gas virtually free of oxygen

Feature: Separates oxygen from ozone

Benefit: Enables the creation of a reactive ozone process gas at a specified ozone concentration in an inert nitrogen carrier gas

About Air Products

Air Products (NYSE:APD) provides atmospheric, process and specialty gases; performance materials; equipment; and technology. For over 75 years, the company has enabled customers to become more productive, energy efficient and sustainable. Recognized as one of the world's most innovative companies by both Thomson Reuters and Forbes magazine,

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