Lummus Technology
a CB&I company

ALMA Maleic Anhydride

Overview

The ALMA process produces high purity, superior quality maleic anhydride from n-butane. Jointly developed and licensed by Lummus Technology and Polynt SpA, the ALMA process combines the unique features of a fluid-bed reactor with that of a non-aqueous recovery system. This modern processing combination results in savings in capital investment and a product that can surpass the rigorous performance specifications of various end-use markets.

The ALMA joint development program began in 1981 and a semi-commercial unit started up in1984. The first full-scale commercial plant, located in Yokkaichi, Japan, successfully started up in 1989. Six additional plants in Korea, Taiwan, Japan, Austria, Italy, and China have come on stream since 1991. Polynt is operating the largest ALMA unit in Ravenna, Italy, and continues to operate the semi-commercial unit, which is used for technology advancement and testing.

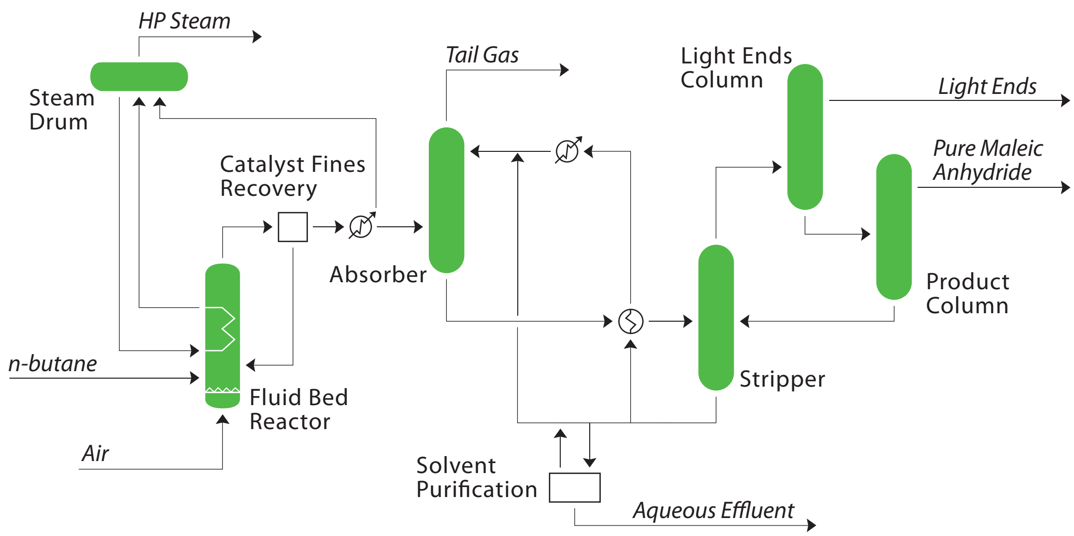
Advantages

Process Features	Process Benefits
Fluid-bed reactor system	Lower investment • Reduces downtime • Greater energy efficiency • Large capacity in single train
Patented catalyst	Excellent performance • Negligible attrition and activity decline • Low replacement rate
Anhydrous recovery using patented solvent	Superior quality product • Completely continuous • Lower investment • Reduces steam consumption • Improves operability • Reduces by-products, product loss and waste streams • Good economy of scale

Performance Characteristics

Typical Feedstocks		Typical Products	
	wt %		
n-Butane	96 min	Purity	99.9 wt % min
iso-Butane	balance	Solidification point	52.7°C
Propane or lighter saturates	0.5 max	Color in molten state	10 ° Hazen
Pentane or heavier saturates	0.5 max	Ash content	10 wppm max
Unsaturated hydrocarbons	1.0 max	Fe content	2 wppm max

Block Flow Diagram



Process Description

Feed n-butane and air are fed separately into the fluid-bed catalytic reactor to produce maleic anhydride. The exothermic heat of reaction is removed by generating high pressure steam. After cyclone separation of the elutriated solids, the reactor effluent is cooled, filtered and fed to the absorber.

In the absorber, a proprietary, patented solvent is used to selectively remove maleic anhydride from the cooled reactor effluent. The offgas is exhausted to an incinerator for recovery of its heating value. The bottoms are fed to the stripper where crude maleic anhydride is separated as distillate from recirculated solvent.

The crude maleic anhydride is fed to the light ends column where a small quantity of by-product light ends is separated as distillate and sent to the incinerator. The bottoms are fed to the product column where maleic anhydride product is recovered as distillate and the bottoms are recycled back to the stripper.

A small slipstream of the circulating solvent is purified to remove solvent degradation products in order to prevent the build up of impurities in the solvent recycle loop.

The absorber offgas is combined with the light ends column distillate and vacuum system exhausts and fed to the incinerator, where unreacted butanes and reaction by-products (carbon monoxide, acetic and acrylic acids) are combusted. The waste heat is recovered as high pressure steam, which is combined with the steam from the reactor and superheated. A portion of this steam can be used to drive the air compressor, with the excess exported or used to generate electric power.

Process Chemistry

Principal Reaction

C_4H_{10}	+	3.5 O_2	$\longrightarrow$	$C_4H_2O_3$	+	4 H_2O
n-Butane		Phenol		Maleic Anhydride		

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