

# International Process Plants

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Stock #600496

## Triacetin Plant

***15,000 MTPY***



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# Brief Overview

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- Capacity: 15,000 metric tons/year
- Technology: Free and Clear to Practice Worldwide
- Utilities: Electricity, Steam, Water and Fuel Gas
- Shutdown: 2009
- Product: Triacetin
- Raw Materials: Glycerine, Acetic Acid, Acetic Anhydride
- Process control systems and programming are completely up-to-date and are available for sale with the facility. They are Siemens PCS7 and Fisher-Provox systems



# Process Overview

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- The triglyceride triacetin, also known as 1,2,3-triacetoxypropane or glycerine triacetate, is used for imparting plasticity and flow to laminating resins, particularly at low temperatures. It is mainly used as a plasticizer for the bonding of cellulose triacetate fibers in cigarette filters, as a hardening agent in brick manufacturing, and as a solvent in textile dyes, antibiotics, adhesives, and perfumes.
- Triacetin is produced from a multi-stage reaction sequence involving glycerine, acetic acid, and acetic anhydride as raw materials. In the first reaction, glycerine is esterified with acetic acid. In this first stage, the conversion is to mono1 di-acetin. Water is also formed and is removed from the reaction system by azeotropic distillation of the acetic acid/water mixture during the reaction. In the second stage, the products from the first reaction, namely mono1 di-acetin, are further esterified in an exothermic reaction with acetic anhydride. Triacetin and acetic acid are formed, the latter returning to the reaction system to be used as the reactant in the first reaction.

# Process Overview - Reaction

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- The Triacetin plant is a highly automated and dedicated continuous plant. Glycerine is reacted with acetic acid and acetic anhydride in the bubble column and cascading reactor vessels. The overheads from the bubble column go to an azeotrope column where butyl acetate is added to help break the azeotrope so that acetic acid can be fully recovered. The crude Triacetin leaving the reactor train is then further refined in two distillation units and a deodorizer column which basically strips impurities with nitrogen. Unreacted acetic acid is recovered and recycled back to the reaction section of the plant.
- Glycerine is fed to the top of the bubble column reactor (sold) and acetic acid vapor boils up from the base of the column and the No. 1 reactor. The base section of the column contains three helical steam coils, each with 4 m<sup>2</sup> surface area. The column base section also contains two sparger pipes that dip down below the coils, turn 90 degrees, and run across the column diameter. One sparger is used for acetic acid addition, and the other is for column boil-outs in the wash sequence. The bubble column reactor has a tundish that overflows into reactor No. 1 and a drain which flows to the containment tank.

# Process Overview - Reaction

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- No. 1 reactor has steam coils with restricting orifices built in via 3 separate circuits so that in the event of a coil burst, the maximum steam flow is minimized. Liquid overflow from No. 1 is level controlled to No. 2 reactor.
- No. 2 reactor operates at atmospheric pressure and has a large heating coil. About 20 - 30% of the total new anhydride is fed to the No. 2 reactor. The No. 3 reactor is identical to the No. 2 reactor. It operates at atmospheric pressure with a cascade overflow into the intermediate storage tank. As in the design of No. 2 reactor, the steam input is via two separate coil banks with fixed orifices to minimize the leakage rate in the event of a steam coil burst.
- No. 4 reactor is typically bypassed and out of service. The No. 5 reactor is a tubular (pipe) design which ensures that the triacetin has been fully converted before allowing the material to pass from the reactor to the distillation sections. Some acetic anhydride is injected into the reactor just upstream of a static mixer to provide thorough mixing of the anhydride in the partially converted triacetin.

# Process Overview - Distillation

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- Material from No. 5 reactor is preheated and pumped to the No. 1 still venturi. The acetic acid and anhydride flashes off and the vapor expands down the pipe (which is under vacuum) until it enters the venturi unit. The venturi acts as a centrifugal separator, preventing carry over of liquid. The No. 1 still column contains an upper and lower bed of Sulzer type 452 Y stainless steel packing, which has low pressure drop and high surface area. The main condenser on the No. 1 still is constructed of 904L stainless steel and has 25.4 m<sup>2</sup> surface area. The vent condenser is manufactured of 904L stainless steel and duplex 2205 stainless steel water boxes. The area of the vent condenser is 7 m<sup>2</sup>. The No. 1 still reboiler V0396 has a coil area of 15.5 m<sup>2</sup> and is manufactured out of 904 L stainless steel.
- The No. 2 still (sold) is designed to provide the best possible distillation conditions to achieve high purity triacetin. It is comprised of three main units: a thermosiphon reboiler, a separation and black triacetin removal unit, and a condensing column split into 3 sections. The thermosiphon reboiler is an external shell and tube vertical reboiler made of 316 stainless steel. Triacetin vapor rises up the condensing column through the demister. It passes through a bed of structured packing which is wetted by 50 kg/hr of triacetin. The scrubbed vapor then rises via a distributor into the base of condensing section, which is comprised of a shell and tube calandria area made of 316 stainless steel.

# Process Overview - Distillation

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Condensed liquid from this section drops into a collection ring at the base of the calandria, which passes outside the column. The uncondensed vapors then pass upward into a second calandria section supplied with tower water. The liquid falls into a similar collection ring and passes outside the column to join the stream mentioned above. Any remaining uncondensed vapor passes out of the top of calandria and into a U-tube cooler C4018 C. This cooler condenses out the remaining volatiles estimated to be around 5 kg/hr, which will be a mixture of acetic anhydride and triacetin. This material is returned to the No. 1 still reboiler.

- The deodorizer column has a cryogenic nitrogen injection supply. Cryogenic nitrogen is used because the oxygen content is much lower than PSA nitrogen. The unit is filled with structural packing and operates between 110 and 90 mbarA of pressure. The column has a 316 stainless steel condenser.

# Process Overview – Acetic Acid Recovery

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- Water is removed from the wet acetic acid by using butyl acetate to form an azeotropic mixture with the water. This azeotropic distillation column is designed to operate with both liquid and gaseous feed. There is a reflux distributor plate at the top of the upper bed.



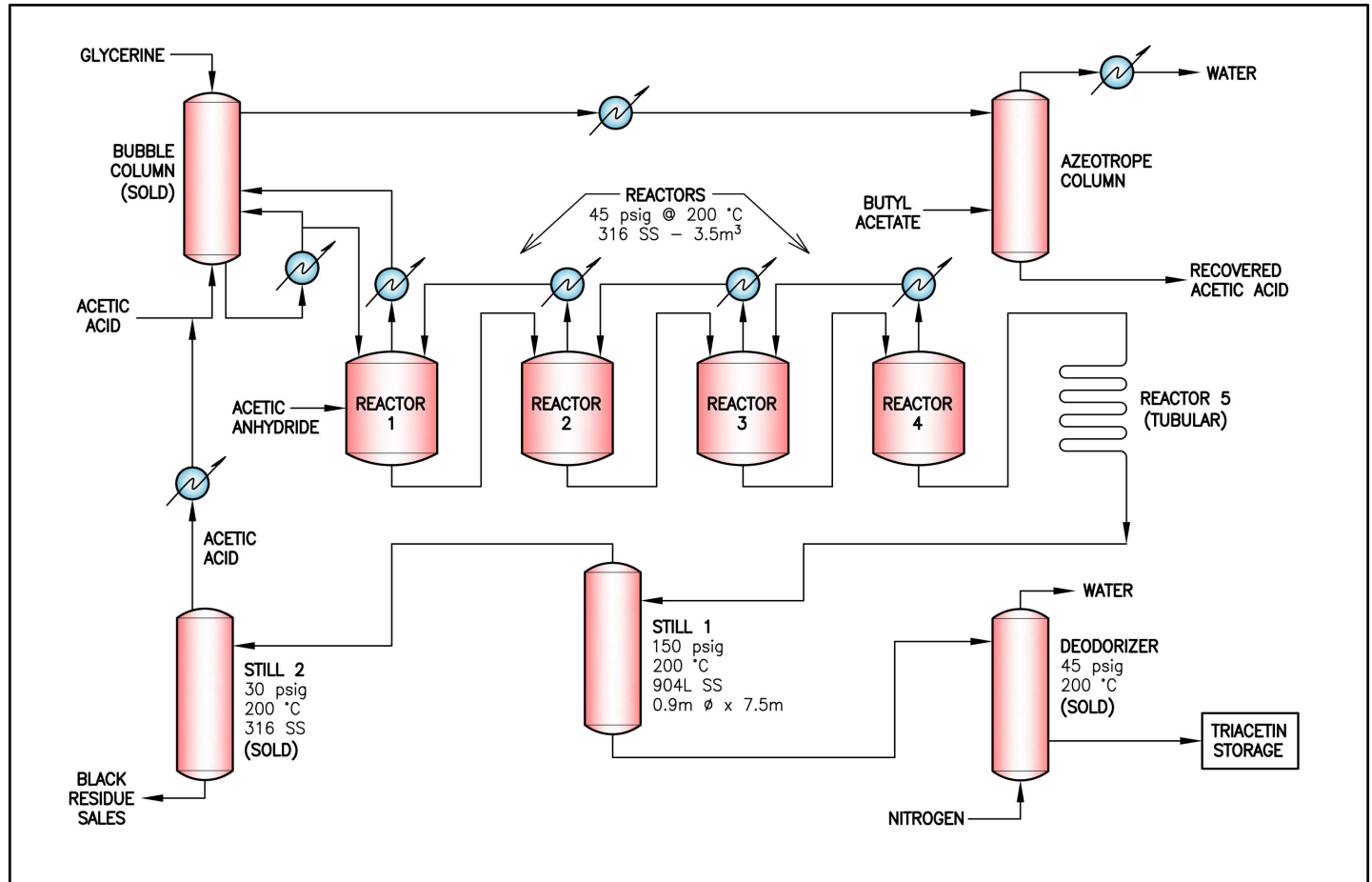
# Major Equipment

	No. 1 Still Column	No. 1 Still Reboiler	No. 2 Still Reboiler	No. 2 Still Thermosiphon	Deodorizer
Design Temp.	200°C	200°C	200°C	200°C	200°C
Design Press.	10.0 Barg	2.0 Barg	2.0 Barg	20.0 Barg	3.0 Barg
MOC	904L	316	316	316	-
Dimensions	0.85 (dia.) x 7.5m	-	1.3m <sup>3</sup> working	20m <sup>2</sup>	

*There are also (18) SS storage tanks with a total capacity of 1,100 metric tons associated with this plant.*

	Bubble Column	Reactor 1	Reactor 2
Design Temp.	150°C (shell)	250°C (shell) 250°C (tubes)	250°C (shell) 250°C (tubes)
Design Press.	4.0 Barg (shell)	3.0 Barg (shell) 20.0 Barg (tubes)	2.0 Barg (shell) 20.0 Barg (tubes)
MOC	-	316 (shell) 254 SMO (tubes)	316 (shell) 904L (tubes)
Dimensions	-	3.5m <sup>3</sup>	2.7m <sup>3</sup>

# Triacetin Flow Diagram



**INTERNATIONAL PROCESS PLANTS**  
17A Marlen Drive, Hamilton, NJ 08691  
Phone: +1 609 586 8004  
Fax: +1 609 586 0002  
www.ippe.com

**Fatty Acids, Glycerine, & Esters Plant**

**Triacetin Plant**

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PAGE 5 OF 5 SHEETS

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## **MICHAEL JOACHIM**

*DIRECTOR, PLANTS DEPT.*

Tele: 609-838-5930 (direct)

Mobile: 609-516-9107

[MichaelJ@ippe.com](mailto:MichaelJ@ippe.com)

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## **SANJEEV REGE**

*VP GLOBAL PLANT SALES*

Tele: 609-838-5938 (direct)

Mobile: 609-510-2616

[SanjeevR@ippe.com](mailto:SanjeevR@ippe.com)

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### *IPP World Headquarters*

17A Marlen Drive ♦ Hamilton, NJ 08691 ♦ USA  
Tele: +1 (609) 586 8004 ♦ Fax: +1 (609) 586 0002

Visit us at: [www.ippe.com](http://www.ippe.com)