World Scale
Ethylene Glycol Plant

1,009,000 tons/year
Total Capacity

Visit us at: www.ippe.com
Brief Overview

Consisting of Two Plants: G I and G II (*Capacity in MMTPY*)

<table>
<thead>
<tr>
<th>GI Production:</th>
<th>Component</th>
<th>Capacity</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG</td>
<td>242</td>
<td>227</td>
<td></td>
</tr>
<tr>
<td>DEG</td>
<td>22</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>TEG</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>266</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GII Production:</th>
<th>Component</th>
<th>Capacity</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG</td>
<td>675</td>
<td>635</td>
<td></td>
</tr>
<tr>
<td>DEG</td>
<td>61</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>TEG</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>743</td>
<td>699</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Production:</th>
<th>Component</th>
<th>Capacity</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG</td>
<td>917</td>
<td>862</td>
<td></td>
</tr>
<tr>
<td>DEG</td>
<td>83</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>TEG</td>
<td>9</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,009</td>
<td>949</td>
<td></td>
</tr>
</tbody>
</table>
Products

- The facility consists of two plants, Glycol I and Glycol II, which produces three types of Ethylene Glycols, MEG accounts for 90% of plant production, with DEG and TEG produced as co-products, representing 9% and 1% of total production respectively. All major grades of MEG, DEG and TEG are produced at the facility, with product quality considered to be top tier. This is one of a few U.S. facilities producing polyester grade DEG.

- The products consistently exceed industry standards (outlined on next slide) and are used in several high quality applications. The previous owner has also developed special analytical techniques in recent years to improve product quality sold into specific polyester markets where reduction in particulates is a competitive advantage.
Carbon Dioxide is a by-product of Ethylene Glycol production. Approximately half of the Carbon Dioxide produced is captured and sold via pipeline, which is purified for merchant sale.
Glycol I

- The designs of both Glycol I and II production units are based on process licenses from Scientific Design Technology. Glycol I has one production train with three oil-cooled reactors.
The Glycol II Unit was originally built by PPG in Ponce, Puerto Rico in 1972 and consisted of one production train (Train A). Glycol II now has two production trains with the addition of a boiling water reaction system.
Glycol II (continued)

- Glycol II Train A has four oil-cooled reactors and can rotate catalyst changes in one reactor while the other three operate; Glycol II Train B has one boiling water reactor (installed in 1991). Both Trains have the same capacity and EO from all the reactors in the Glycol II Unit processed in a shared MEG reactor/refining section.
Boiling Water Reaction System

- Installed Early 1990’s

- Can be Sold Separately

- 01-09-017 ETO Reactor: 104,790 SqFt 18’3” x 33’0” CS Shell/CS Tubes/CS Heads 943 PSI Shell/349 PSI Tubes 7,191 Sqft Tubes Mfg. Belleli Built 1989
Process Description

- In the process of making Ethylene Oxide and Ethylene Glycol, Ethylene and Oxygen react in the presence of a silver catalyst to form Ethylene Oxide and CO₂. The reaction takes place in a tubular reactor which contains the silver catalyst. The Ethylene and Oxygen are added to a Cycle Gas which uses Nitrogen or Methane as the ballast. The Ethylene Oxide formed is removed from the Cycle Gas by passing the gas through water scrubbers to absorb the Ethylene Oxide.

- The effluent gases are returned where more Ethylene and Oxygen are added after passing through two recycle compressors. A portion of the Cycle Gas is passed through a Potassium Carbonate Contactor to remove the CO₂ from the Cycle Gas. The Carbonate is converted to the Bicarbonate by absorbing CO₂. The Bicarbonate is sent to a regenerator where it removes the CO₂ by converting the Bicarbonate back to Carbonate. The outlet gases from the contactor returns to the Cycle Gas Stream. The CO₂ is vented to the atmosphere.
When in service, a portion of the Cycle Gas is also sent to the Argon Removal System to remove Argon which is an impurity that come sin with the Oxygen feed. Argon is removed by passing Cycle Gas through Separators filled with thousands of tiny hollow plastic fibers. Different elements in the Cycle Gas Stream pass through the fiber walls, down the center of the fiber, and are collected in the bottom of the vessel. This stream is called the Permeate Stream and is sent to the Incinerator to be burned.

The Rich Cycle Water containing the absorbed Ethylene Oxide is sent to a Stripping Column where the Ethylene Oxide is stripped from the Rich Cycle Water using heat from a re-boiler. The Ethylene Oxide passes overhead and the Lean Cycle Water is cooled and returned to the scrubbers to absorb more Ethylene Oxide.

The Ethylene Oxide vapors are condensed and reabsorbed in cool water in a Re-absorber Column. The re-absorber bottoms contain approximately 10% Ethylene Oxide and are sent to the Glycol Feed Stripper Column to remove dissolved CO₂ from the Water-Oxide Stream. Steam is injected into the Glycol Feed Stripper Column to flash off the CO₂. The Glycol Feed Stripper bottoms are sent to the Glycol Reactor to form Ethylene Glycol.
Process Description (continued)

- The Glycol Feed Stripper bottoms going to the Glycol Reactor is preheated and flows through a 24” pipe reactor 633’ long. The reaction of the Ethylene Oxide and Water to form Ethylene Glycol is a non-catalytic reaction. The effluent from the Glycol Reactor goes to the Evaporator section to remove the water.

- The Evaporators are five columns in series with each operating at a lower pressure. The overhead vapor is used to provide heat for the succeeding evaporator re-boilers. There are five evaporators in the section. Vent streams from the 2nd, 3rd, and 4th Effect Condensate pots are sent to the Aldehyde Purge Condenser where the steam purge is condensed containing dissolved aldehydes. This stream is then sewered to the waste water system. The non-condensed steam and aldehyde stream is sent to the Incinerator/Flare.
The Fifth Effect bottoms contains approximately 15% water and the remaining 85% Ethylene Glycols. The remaining water is removed in a Drying Column. The water is driven overhead and the Glycols are removed from the bottom of the column. The MEG is separated from the heavier glycols in the MEG Refiner Column. The MEG is taken overhead and the bottoms which contains an appreciable amount of MEG is sent to a Splitter Column. In the Splitter Column, the remaining MEG is removed overhead and mixed with the feed to the Refiner Column. The heavy glycols are removed from the Splitter bottoms and sent to the DEG Column where the DEG is taken overhead. The DEG Column bottoms are sent to the TEG Column where the TEG is distilled overhead. The TEG bottoms are stored and sold as scrap.
Contact IPP Today!

MICHAEL JOACHIM  
DIRECTOR, PLANTS DEPT.  
Tele: 609-838-5930 (direct)  
Mobile: 609-516-9107  
MichaelJ@ippe.com

SANJEEV REGE  
VP GLOBAL PLANT SALES  
Tele: 609-838-5938 (direct)  
Mobile: 609-510-2616  
SanjeevR@ippe.com

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