Engineering solutions for people, by people

CONSER helps organizations achieve the highest standards of manufacturing excellence with an integrated comprehensive approach to process design and safety.

With over 45 years of experience in the industrial sector, CONSER is able to deliver innovative and creative solutions tailored to the client needs.

Some of the services provided by CONSER process department are basic design, Operation analysis, de-bottlenecking, revamping and I&M.

In addition to a unique portfolio of petrochemical licenses and technologies, CONSER is now able to provide additional industrial consulting services like HSE, Energy Saving opportunities, and solution for the mitigation of the environmental impact of plant operations.

Leading the change in the process engineering design

CONSER, as an independent process engineering design company, is devoted to the build up and license of advanced technologies. We focus on processes development, driving forward to meet customer requirements.

CONSER stands out in the scene of Italian process engineering companies for its faith in research, shown by its ceaseless investments in this field. The company reputation and success is confirmed by the excellent performances of the plants brought on stream following its design and the satisfaction of the clients that have chosen CONSER.

With the aim to provide a service with optimum quality characteristics, all the project phases are managed. Starting with feasibility studies, process development, licensing of processes and know-how transfer, process design package preparation, supervision of detailed engineering and construction, we follow our client up to and including assistance to initial start-up. This is valid both for new plants and for existing plants which require debottlenecking to improve performances and enhance profitability.
### Maleic Anhydride - Process introduction

Maleic anhydride is a highly reactive colourless solid widely used in the petrochemical industries for:
- Unsaturated polyester resins (UPR)
- Fiberglass enriched resins
- 4,4 Butanoldiol or BDO
- Lubricating oil additives
- Artificial sweeteners
- Reagent in food and pharmaceuticals

MAK market is in continuous expansion, presenting a healthy and constant growth over the last 30 years due to its inherent application flexibility, supply constraints, exacerbated by a number of plant outages, and higher consumption as consumers rebuild inventories.

### Maleic Anhydride - Process features

The maleic anhydride process offered by CONSER is a gas phase catalytic oxidation process using normal butane as feedstock. Thanks to an advanced reaction system integrated with a patented process of recovery and purification, the technology can be regarded as highly advanced compared to the usual commercial technology available.

The technology of reaction has been substantially improved, compared to the previous generation technology, resulting in a higher yield and excellent productivity. The recovery and purification system employs a readily available solvent and adopts unique features, which result in high yield of recovery, low energy requirements, extremely low frequency shutdown and clean-outs operations, minimum environmental impact and high and consistent quality of the product.

### Maleic Anhydride - Product specification

- Purity (wt%): 99.8 min
- Final Maleic Acid (wt%): 100 max
- Colour (Molten MAN – Hazen): 15

*Additional information available upon request*

### Maleic Anhydride - Experiences

With its improved Maleic Anhydride process, CONSER has secured a leading position in the maleic anhydride market proven by the experience of the following references:

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Capacity (MTPY)</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technopol</td>
<td>Belgium</td>
<td>20,000</td>
<td>Expansion</td>
</tr>
<tr>
<td>Portolunch</td>
<td>Belgium</td>
<td>25,000</td>
<td>Expansion</td>
</tr>
<tr>
<td>Miles - Bayer</td>
<td>Belgium</td>
<td>25,000</td>
<td>Expansion</td>
</tr>
<tr>
<td>Europol</td>
<td>Belgium</td>
<td>30,000</td>
<td>Expansion</td>
</tr>
<tr>
<td>Tubiplast</td>
<td>China</td>
<td>50,000</td>
<td>From Benzone</td>
</tr>
<tr>
<td>Sanwei</td>
<td>China</td>
<td>100,000</td>
<td>From Benzone</td>
</tr>
<tr>
<td>YPPC</td>
<td>China</td>
<td>200,000</td>
<td>From Benzone</td>
</tr>
<tr>
<td>Workull</td>
<td>China</td>
<td>50,000</td>
<td>From Benzone</td>
</tr>
<tr>
<td>ENOC-RC</td>
<td>Russia</td>
<td>45,000</td>
<td>From Benzone</td>
</tr>
<tr>
<td>Sibur</td>
<td>Russia</td>
<td>45,000</td>
<td>From Benzone</td>
</tr>
<tr>
<td>Workull</td>
<td>Russia</td>
<td>50,000</td>
<td>From Benzone</td>
</tr>
<tr>
<td>Talneft</td>
<td>Russia</td>
<td>60,000</td>
<td>From Benzone</td>
</tr>
</tbody>
</table>

### Process description

**CONSER maleic anhydride process consists in the following main steps:**
- **Reaction**
  - Maleic anhydride recovery and puriﬁcation
  - Solvent Puriﬁcation
  - Effluent disposal

**Reaction**

This Maleic Anhydride technology offered by CONSER is a gas phase, catalytic partial oxidation process, where normal butane or benzene reacts with the oxygen contained in a compressed air stream, passing through a fixed bed reactor. The primary reaction is:

Starting from n-butane

\[ C_4H_{10} + 3.5O_2 = C_4H_6O_3 + H_2O \]

Starting from benzene

\[ C_6H_6 + 4.5O_2 = C_6H_5O_3 + 2CO_2 + 3H_2O \]

The main side reactions are the total oxidation of the raw material to carbon dioxide, carbon monoxide and water. Other by-products are formed in a small amount, such as acetic and acetic acid. In case of benzene feedstock also benzonic acid and phthalic anhydride are produced.

The reactor conditions are optimized to maximize the MAK production, feedstock conversion and selectivity, minimizing the presence of by-products in the exit stream.

Due to the reaction thermodynamics, the generated heat is recovered to produce high pressure steam, which is used in the plant and can be also exported to other users.

CONSER offers a high performance integrated process with key improvements over conventional technology; such as the patented partial off-gas recycle concept which allows a substantial saving when n-butane is used as feedstock, increasing the overall reaction yield and minimize the energy losses.

**Maleic anhydride recovery and puriﬁcation**

The maleic anhydride contained in the reactor offgas is recovered by selective absorption using an organic solvent, through a patented system with high recovery efficiency. The solvent proposed in CONSER technology is non-proprietary, easily available on the market and economically convenient.

Maleic anhydride is then recovered from the solvent through a stripping unit. The crude product is further puriﬁed in a fully continuous distillation unit, leading to a product with consistently high quality, avoiding high variability in the utility consumptions.

**Soluvent Puriﬁcation**

The solvent used to absorb the maleic anhydride is circulating in a closed loop, reducing its consumption to a minimum. To minimize fouling problems of the plant and to remove high boiling impurities, a portion of the solvent is treated in a simple solvents puriﬁcation system. The regenerated solvent is then recycled internally to the process.

**Effluent disposal**

After that the Maleic Anhydride has been removed, the off-gas coming from the MAK recovery section, is treated in an incineration system, the heat produced is used to produce steam and the flue gas are released to the atmosphere with a negligible amount of residual pollutants, below the emission limits of the most stringent international regulations.

When n-butane is used as feedstock, a fraction of the off-gases may be recycled to the reactor, leading to additional beneﬁt besides the improvement of overall yield of butane conversion reduced incinerator waste gas load and consequent reduction of CO2 emissions.

The environmental impact has been strongly reduced - CONSER process produces zero liquid organic efﬂuents zero outside bafﬁy limits - avoiding the installation of a Wastewater Treatment unit with a considerable reduction of the initial investment and operational costs.