Energy-saving Urea Synthesis Process

**Features**

- ACES21® (Advanced process for Cost and Energy Saving 21) is a simplified urea synthesis process that allows reducing the plant construction cost. The operating cost is also reduced because the optimized process condition in ACES21® realizes low synthesis pressure and significantly reduces the energy consumption.

**Basic Concept or Summary**

ACES21® has the advantages as follows:

1. Reduction of the construction cost by lowering the equipment elevation and making the layout more compact:
   - Reactor on Ground Level;
   - Vertical submerged carbamate condenser (VSCC);
   - Simple synthesis loop and no gravity flow (VSCC).
2. Reduction of the equipment cost by making the design more compact:
   - Small reactor by two stage reaction (VSCC);
   - Less number of equipment in the synthesis loop (VSCC).
3. Energy saving by adopting the optimum process condition:
   - Realization of low synthesis pressure and energy saving by adopting the optimum process condition.
4. Easy and stable plant operation:
   - Easy and stable plant operation realized by forced circulation in the high-pressure loop using a high-pressure ejector (no gravity flow).
5. Reduction of the maintenance cost:
   - Reduction of risks of corrosion problems by adopting lower synthesis system temperatures and more reliable materials.

**ACES21® synthesis loop**

**ACES21® process overall flow diagram**

Source: JASE-W Japanese Smart Energy Products & Technologies

https://www.jase-w.eccj.or.jp/technologies/index.html
Effects or Remarks

As a result of energy saving, utility consumption was reduced to the levels as follows (per ton of large granular urea).

<table>
<thead>
<tr>
<th>Unit</th>
<th>All Motor Driven Case</th>
<th>Steam Turbine Driven Case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steam Export</td>
<td>Steam Self Balance</td>
</tr>
<tr>
<td>Steam Import</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 bar, 300°C</td>
<td>ton 0.67</td>
<td>0.58</td>
</tr>
<tr>
<td>42 bar, 380°C</td>
<td>ton</td>
<td></td>
</tr>
<tr>
<td>110 bar, 510°C</td>
<td>ton</td>
<td></td>
</tr>
<tr>
<td>Steam Export</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 bar, Saturated</td>
<td>ton 0.24</td>
<td>--</td>
</tr>
<tr>
<td>Cooling Water (Δt=10°C)</td>
<td>m³ 52</td>
<td>52</td>
</tr>
</tbody>
</table>

Electricity

<table>
<thead>
<tr>
<th></th>
<th>Process kWh</th>
<th>105</th>
<th>105</th>
<th>21</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Granulation kWh</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

Further, with regard to urea granulation technology, TOYO established a large granular urea production technology named Spout Fluid Bed Granulation Process by combining the spouted bed and fluidized bed. This technology can significantly reduce the power consumption and equipment cost, and has been introduced to urea plants in many countries around the world.

Installation in Practice or Schedule

Overseas  The ACES21® process was adopted by urea plants in China, Indonesia, Trinidad and Tobago, Venezuela, Iran, Bolivia and Nigeria. The original ACES process before it was improved as ACES21® was adopted in Indonesia, India, Bangladesh, Pakistan, Korea, Spain, etc.

Indonesian urea plant with ACES21® process (1,750 t/d)

Further, TOYO’s energy-saving large granular urea production technology was introduced to Indonesia, China, New Zealand, Iran, Brazil, Venezuela, Ukraine, Germany, etc.

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