Energy-saving Urea Synthesis Process

Features

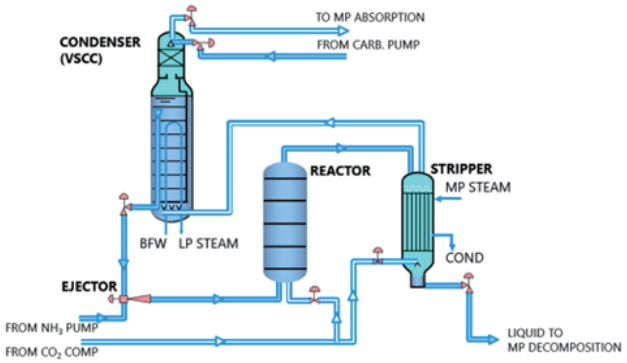
◆ ACES21® (Advanced process for Cost and Energy Saving 21) is a simplified urea synthesis process that allows reducing the plant construction cost. The operating cost is also reduced because the optimized process condition in ACES21® realizes low synthesis pressure and significantly reduces the energy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

Basic Concept or Summary

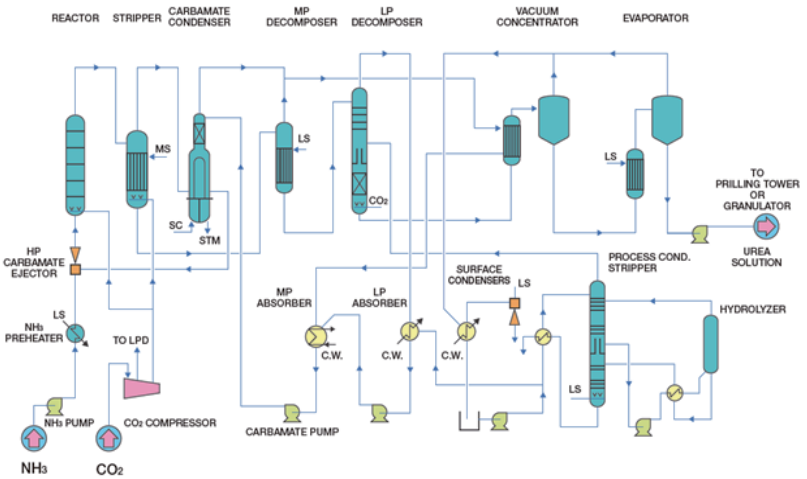
ACES21® has the advantages as follows:

1. Reduction of the construction cost by lowering the equipment elevation and making the layout more compact:
   - Reactor on ground level by applying a high-pressure ejector;
   - Vertical submerged carbamate condenser (VSCC);
   - Simple synthesis loop.
2. Reduction of the equipment cost by making the design more compact:
   - Small reactor by two stage reaction;
   - Less number of equipment in the synthesis loop.
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



Effects or Remarks

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

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.

	Unit	All Motor Driven Case		Steam Turbine Driven Case	
		Steam Export	Steam Self Balance	42 bar	110 bar
Steam Import					
22 bar, 300℃	ton	0.67	0.58		
42 bar, 380℃	ton			0.80	
110 bar, 510℃	ton				0.69
Steam Export					
5 bar, Saturated	ton	0.24	–	–	–
Cooling Water (⊿t=10℃)	m^3	52	52	81	75
Electricity					
Process	kWh	105	105	21	21
Granulation	kWh	24	24	24	24

In 2022, TOYO announced the innovative next-generation urea process, "ACES21-LP®". ACES21-LP® is the most advanced urea process which realizes the lowest synthesis pressure together with the highest CO_2 conversion among any modern urea processes, maintaining salient features of current ACES21®. ACES21-LP®, thanks to the sophisticated combination of the excellent process concept of ACES21® and the state-of-the-art low-pressure urea synthesis technology, further reduces energy consumption by reducing power requirements in pressurizing raw materials and reduces plant cost by trimming weight of synthesis equipment, and contributes to low-cost production of urea and global environmental protection.

Installation in Practice or Schedule

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

Urea plant with ACES21® process in Nigeria (4,000 t/d)

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

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