International Process Plants

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220,000 MTPY
Spheripol
Polypropylene Plant

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Brief Overview

- The Spheripol technology and catalyst is an industry leader and is the most widely used polypropylene technology in the world.

- The “Additive Injection Process” Unit provides a method for direct, topical application of commercially available additives to the Spheripol product. This process can eliminate the need for an extrusion compounding stage.

- This “Additive Injection Process” was operated indoors for only 5 years and has some very attractive equipment.

- The Process Control is the latest Honeywell TDC version with 50” flat screen monitors. Virtually all of the process area is monitored and controlled by this system including start-ups, shut-down, and product type changes.

- Facility is laid out very logically and has been well maintained. Its operability is the best of all plants in north america at 98% on-stream time. It is being shut down only because of its smaller size and inability to expand due to the local cracker limitations.

- Access to the site is excellent by road or rail and the closest sea port is about 30 km away.
## Brief Overview

- **Capacity:**
  - 220,000 MTPY *Spheripol Unit*
  - 100,000 MTPY *Extrusion Unit*

- **Production:**
  Homopolymer and Copolymer (w/ethylene) polypropylene at various melt index density and additive packages
  
  Cross-linked polypropylene (with peroxide in re-extrusion)

- **Built:**
  - 1986 *Spheripol Unit*
  - 1990 *Additive Injection Process Unit*

- **Shut Down:**
  - April 2008

- **Raw Materials:**
  Propylene, Ethylene, Steam and Process Water (all supplied by pipeline)

- **Documentation:**
  Excellent with equipment files, maintenance files and electronic auto-CAD P&IDs
Major Equipment

- (2) Loop Reactors: SA-537 steel, 650 psig @ -45°-+150°F, 24” ED x 75’ h x 1,100 cu. ft. vol, loops are 350 ft. in length including the 180° bends.
- (2) Gas Phase Reactors: 200 psig, 301SS, 3 modes
- (1) Flash Drum (homopolymer)
- (1) Fluid Bed Dryer: B-625 steel, 900 cu. ft. capacity
- (1) Steamer Vessel: 400 cu. ft., 17 psig, SA-515 grade 60 steel
- (1) Baker Perkins Ko-Kneader: Mdl UP-250-UMMM
- (1) Baker Perkins Extruder: Size 12, 8:1 L/D
- Silos: 15,000 cu. ft., aluminum B-209-6061-T6
The Spheripol PP plant was built in 1986. Two Additive Injection Process units were constructed in the 1990’s. Buildings include an office building, warehouses, powerhouse, electrical substations, maintenance workshops, and control building (including laboratory). The site is completely fenced. Significant structures include the Spheripol PP plant, a flare stack, and storage tanks.

The site manufactures polypropylene (PP) using the Spheripol process (Unit 2) and has a capacity of 220,000 mtpy. Propylene, ethylene, steam, and process water are all supplied by pipeline to the site. The site has a single propylene storage bullet and railcar unloading facilities as well. The original steam boilers and related equipment are still in place but are no longer utilized. Electricity comes from the local utility while hydrogen and nitrogen are from Air Liquide. Finished product leaves the site by railcars.

Access to the site is excellent by road or rail. The closest sea port is about 30 km away.

The Spheripol process for manufacturing polypropylene produces a virgin flake material which is actually small spherical particles. This unit was added in 1986. Half of the sales from this facility are the virgin flake. The other half of the production is processed through the extruder building to add stabilizers and other additives. Ethylene is used as a copolymer and hydrogen is used as a chain terminator to control overall molecular weight of the polymer molecules (measured as “melt index”). The catalyst is a proprietary Ziegler type catalyst using aluminum and titanium. It is ultra-high efficiency and produces 30,000 kg of PP per gram of catalyst.
This facility is laid out very logically and has been well maintained. Its operability is at 98% on-stream time. It is being shut down only because of its smaller size and inability to expand. The majority of this process is constructed of low-temperature carbon steel due to the -40°F potential with flashing propylene.

The main raw material, propylene, is supplied by pipeline. However, there are also propylene railcar unloading and storage facilities on the property. The 90,600 gal storage bullet tank is rated for 350 psig and is constructed of SA-299 normalized steel (low-temp carbon steel).

The titanium portion (solid powder) of the catalyst described earlier is added to a grease compound in the catalyst preparation area, cooled to 4°C, and injected into the loop reactors using large, stainless steel syringes with accurate metering systems. The aluminum portion of the catalyst is the pyrophoric compound tri-ethyl aluminum alkyl. It is supplied as a liquid and is injected directly into the loop reactor. Water and carbon monoxide are catalyst poisons and must be removed from all incoming raw materials. The main raw material concern is propylene, where the specifications are set to less than 30 ppm for both water and carbon monoxide. In this facility, the water and carbon monoxide are removed from the propylene by the supplier using molecular sieve beds.

The loop reactors run at approximately 600 psig and 70°C. The reactors are 24” ID and 75’ tall with volume of approximately 1,100 cu. ft.. Each reactor has two loops which give an overall length of about 350’ including the 180° bends. The reactors are constructed from SA-537 steel and are rated for 650 psig at -45 to 150°F. The reactors are jacketed for cooling since the reaction is exothermic.
Process Description

Large pumps with propellers are used at the bottom of the loop reactors for circulation. They are rated for 31,000 gpm with 46’ of suction head. The discharge pressure is rated for a maximum of 730 psig, but they typically ride the reactor pressure. They are constructed of 316 SS and driven with 400 hp motors. Hydrogen is injected as a chain terminator to control the length of the polymer chains which determines the overall molecular weight of the product. This is measured by melt index. Product density is control primarily by the loop reactor temperature. Addition of ethylene to the copolymer product also affects the density. Density is measured using on-line radioactive source (Cs 136) densitometers.

Product from the loop reactors then proceeds through a bag filter and a flash drum running at about 250 psig for removal of propylene. The propylene goes through the monomer recovery section of the plant where it is separated from the ethylene, washed with clean liquid propylene, cooled, and recycled back to the storage tank. The separator column is 32” diameter by 13’ tall and is rated for 425 psig pressure. It is constructed of SA-516 grade 70 steel. The two propylene recycle compressors are rated at 3,300 kg/hr each with 22 psig inlet pressure and 300 psig discharge pressure. They are driven by 300 hp motors. Recycle ethylene is purified at a rate of 4,100 kg/hr in a small column with 64 cu. ft. volume. The ethylene dryer is rated for the same flow and is 3’ diameter by 12’ tall. Both columns are constructed of SA-516 grade 70 steel and are rated for 325 psig. A propylene purge stream is recycled back for removal of unreacted propane and other impurities.
Two gas phase reactors running at approximately 200 psig are used for copolymer production. Polypropylene from the flash drum, which still contains active catalyst, is fed into two gas phase reactors along with ethylene. These reactors are made of 304 stainless steel and have the unique ability to be aligned in three modes; single, series, or parallel. They can also be bypassed for homopolymer production. They each have a volume of 1,300 cu. ft. and are rated for 285 psig pressure. They are 8’ diameter by 30’ tall and have a wall thickness of 0.9”. They have an internal wall scraper driven by a 4 hp external motor to keep polymer from sticking to the walls of the reactor.

There are emergency systems to dump carbon monoxide into the reactors in case of a runaway reaction. There are also emergency dump vessels which vent to the flare.

Product from either the flash drum (homopolymer) or the gas phase reactors (copolymer) is then fed to the steamer vessel where live steam is injected counter-currently to deactivate the catalyst. This vessel holds 400 cu. ft. and is rated for 17 psig pressure. It is made of SA-515 grade 60 steel. The product then flows through a 900 cu. ft. fluid bed dryer using hot nitrogen to dry the flake polymer product. The dryer is constructed of B-625 steel. Product is then pneumatically conveyed (dilute phase) to storage silos with nitrogen.

Approximately half of the production is sold at this point as virgin flake. The other half is sent to the extruder building for additive and stabilizer addition.

All products leave this facility by railcar as there is no truck or smaller packaging facilities. The rail spurs and railcar facilities at this site are quite extensive, including an indoor wash rack.
Process Description

Process control in this facility is absolutely state-of-the-art. It is the latest Honeywell TDC version with 50” flat screen monitors. Virtually all of the polypropylene process area is monitored and controlled by this system, including start-ups, shut-downs, and even product type changes. This system is also used as a predictive controller for quality properties such as density and melt index due to the lag time in the process and quality testing procedures. The control room has reinforced walls for blast protection. The control room and input/output rooms have raised flooring for under-floor wiring. There is a UPS system for emergency control power.

This building houses the two, large Baker Perkins Ko-kneader extruders for incorporating additives, stabilizers, and peroxides into the virgin flake product. Additives are typically antioxidants and UV stabilizers. Some stearate stabilizers can also be added to assure catalyst neutralization. Peroxides are added to further cross-link the polymer and achieve lower melt index (higher molecular weight). The two lines together have a capacity of 100,000 mta. This facility does not do any color compounding.

Additives and stabilizers are metered using two Con-Mix loss-in-weight feeders rated for 350 kg/hr each. The material is then dry blended with the virgin flake PP using two “zig-zag” blenders which each have 460 cu. ft. capacity and are constructed of 304 stainless steel.
Process Description

The Baker Perkins equipment is specifically designed for this application and for each other (Ko-kneader and extruder). There are two separate lines, each with a Ko-kneader mated to an extruder. The Ko-kneader is a Baker Perkins model UP-250-UMMM which uses a gimble box to make a rotating shaft also move back and forth for additional mixing. The Ko-kneader has a 1,250 hp drive and the extruder has a 600 hp drive. The extruder is a Baker Perkins size 12 with an 8:1 L/D. Material of construction is SA-216 gr.WCB and it is rated for 300 psig discharge pressure. It feeds a hot cut pelletizer and then the pellets fall into a water trough which carries them to a spin drier and Cason classifier. Each line can process 6 mt/hr of material so that the two lines together produce 100 kmta.

Product is pneumatically conveyed (dilute phase) with nitrogen to six blender silos. The silos hold 15,000 cu. ft. each and are constructed of aluminum B-209-6061-T6.

This building has six floors and is constructed of steel beams with a double layer of metal siding with insulation between the layers. Floors are all poured concrete and cinder blocks are used for internal walls and for the first floor exterior walls. The footprint is approximately 130’ by 110’, but the higher floors are only 110’ by 40’.
Spheripol Technology

Process Flow

HOMOPOLYMER SECTION

COPOLYMER SECTION

MONOMER RECOVERY SECTION

POLYMER RECOVERY SECTION

FLASH DRUM

1st COPOLYMER REACTOR

2nd COPOLYMER REACTOR

PROPYLENE + ETHYLENE GAS

EXCHANGER

DRYER

FINAL PRODUCT to EXTRUSION or LOADING

CATALYST

PIPEDLINE

TANK CAR

FLAKE (POLYMER)

FLAKE AND MONOMER

MONOMER

LIQUID PURGING TO PETROMONT

P-302 PUMP

GAS PURGING

C2=

C3= AND C3+

SEPARATOR C2+ C3+

COMPRESSOR

BAG FILTER

WASHING TOWER

STEAMER

STEAM

WASHING TOWER

COMPRESSOR

NITROGEN
Photos
Photos
Photos
Photos
Contact IPP Today!

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