Labasys® Control Ex Bulk-Flow
Controls Recirculation Rate of Spherizone Process

Polypropylene (PP) Polymers are basic materials to produce every day products like pipes for housing and industry, household boxes or automotive components. LyondellBasell, one of the world's largest and leading PP producers, developed the spherizone process based on long lasting experience. It is one of the most advanced polymer processes, whose first plants are in operation since 2002.

Fig. 1 shows the scheme of the spherizone process: The heart piece of the process is the multizone reactor (MZCR), where the polymer is produced. As it consists of 2 zones, there are 2 fully controlled, but separate polymerization conditions in just one single reactor.

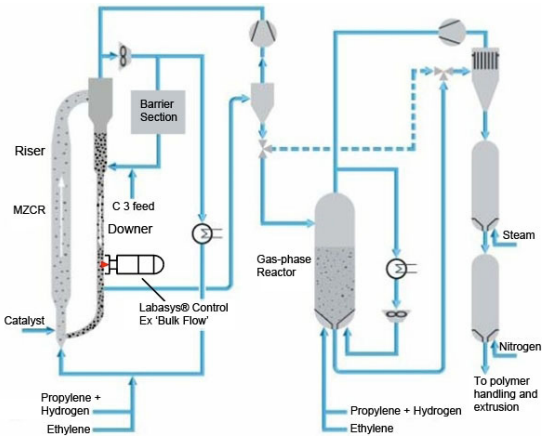

Fig. 1: Schematic drawing of the spherizone process (source: brochure Basell Polyolefins-modified)

At the top of the MZCR the polymer exit from the first polymerization zone and is separated in the cyclone from the gas. Then they enter the downer - the second polymerization - zone, where a downward, dense phase plug flow pattern occurs under gravity. At the bottom of the reactor the particles are fed to the MZCR - riser section - back again. The remaining process units (right of fig. 1) are identical to the established spheripol process technology.

As in every chemical production unit, an effective control system is fundamental. A key quantity for the spherizone process control is the solids recirculation rate, which is determined by measuring the velocity of the recirculated polymers and their concentration.

«We are happy with our 3 Labasys® Control Ex instruments. In the more than 2 years they were in operation at our plants now, they run perfectly well and delivered important in-situ information to control our processes efficiently.»

Antonio Mazzucco, Supervisor manufacturing platforms LyondellBasell

This quantity helps the operator in the control room to keep the fluid-dynamics in the downer at state conditions. Thus the Labasys® Control Ex Bulk-Flow is an important tool to run the process always at its optimum.

Measuring Task

Overview

- Task: **Velocity sensor for Spherizone process**
- Target Size: **Velocity of moving bulk polymer bed**
- Motivation: **reliable and cost effective measuring solution**
- Solids Conc.: **packed bed of PP beads**
- Pressure: **42 bar (operation, tested 65 bar)**
- Temperature: **100 °C (tested 165 °C)**
- Particle Size: **2-3 mm**

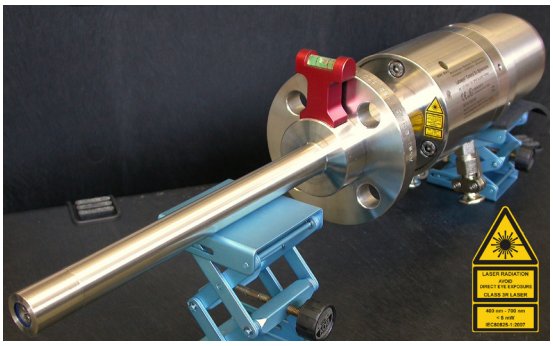

Fig. 2: Ex-protected Labasys® Control Ex Bulk-Flow instrument for velocity measurement of the moving polymer bed.

Such a system was already in use, but it was laborious and quite costly. This motivated LyondellBasell to look for an alternative solution and so they contacted MSE Meili - the specialist instrumentation company for such tasks.

The high requirements of the task made it challenging: The instrument needed to be Ex-protected and have a double sealing against the high process pressure of up to 42 barg. Other requests were that the instrument holds temperatures of up to 100 °C and that its tip has an outer diameter of no more than 25 mm.

Realisation

Key Success Factors

- Existing basis of modular Labasys® technology portfolio.
- Newly designed bulk flow tip with sapphire window and double sealing to withstand high pressure and product abrasion.

MSE Meili developped based on its existing Labasys® technology a new instrument with all features desired. In the first old system the optical fibres had to be led up over the entire path to the control building, what is expensive and risky towards cable breakage.

By contrast the optical fibres are located inside the Labasys® instrument itself now. Thus they are well protected and the costly fibres are shorter than 0.5 m. The tip of the instrument is constructed very solidly with a sapphire window at its front, a double sealing barrier against the high process pressure and is fully built of chemical grade stainless steel. So a reliable and long lasting operation without costly production interruptions is assured. The optional water cooler guarantees a save operation of the instrument in warmer regions with temperatures higher than 40 °C.

Fig. 3: Spherizone plant (left) and Labasys® Control Ex Bulk-Flow instrument at the LyondellBasell R&D center in Ferrara (right).

The design and testing phase of the new system was completed successfully with close cooperation between LyondellBasell and MSE Meili AG by the end of 2007. The first industrial Labasys® Control Ex Bulk-Flow instruments were commissioned during 2008.

Results

Products and Services used

- **Labasys®100** with special high pressure tip and EX-P protection unit during test phase
- **Labasys® Control Ex Bulk-Flow instrument** with "Labasys® Power Control" power supply
- **Labasoft** – Windows™ based (98/NT/2000/XP) data acquisition and analysis Software for analysis and reporting of elaborate data
- **Services:** instrument rental, commissioning, customer training, maintenance and analysis services

«Our Labasys instruments are an essential tool to understand the details of the process and to study the fluid-dynamics of the solid phase in the reactor.»

Dr. Tiziana Caputo, Process Engineer at R&D center in Ferrara

The instruments function to full satisfaction of the plant operators. By now LyondellBasell has a total of 4 Labasys® systems in use at their sites in Ferrara (Italy) and Frankfurt (Germany).

The measuring principle of the Labasys® Control Ex Bulk-Flow system is based on laser backscattering. In the data acquisition and analysis software LabaSoft Control the velocities are determined using advanced cross correlation techniques. So typically 17 single velocities are evaluated every 3 seconds, from which a stable mean value is derived and communicated to the control system.

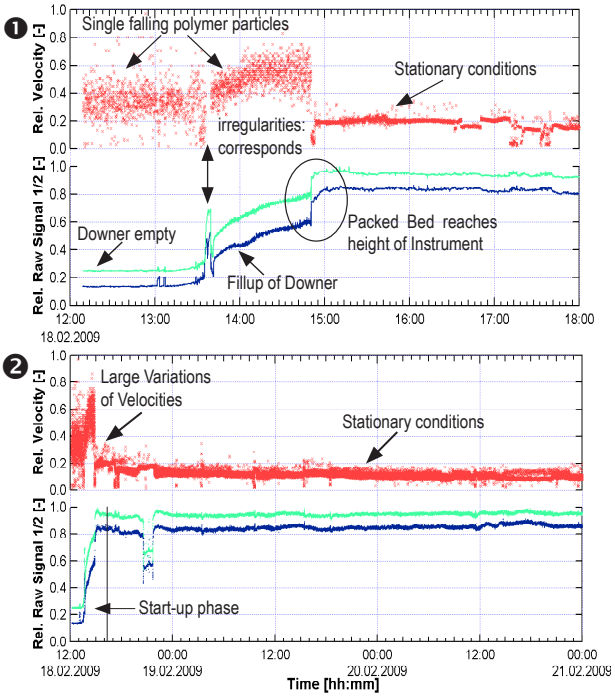

Fig. 4: Exemplary spherizone data: ❶ shows the start-up phase and ❷ the continuous operation of the running process (data courtesy of LyondellBasell).

Exemplary data is shown in the two figures, where graph ❶ illustrates an enlargement of graph ❷ of the plant start up. In both graphs the upper, red curve shows the relative velocities, whereas the lower green and blue curves show the relative raw signals of channel 1 and channel 2, which correspond to the polymer concentration in the downer. All data is drawn versus time.

During the start up phase the filling level rises and so do the relative concentration signals, which correspond well with each other. In this phase the velocities (red) fluctuate strongly and have a rising trend. The PP beads fall onto the packed particle bed which's level is below the instrument at this stage. Around 13:30h the relative solid concentrations are irregularily high, indicating a short peak of higher polymer flow. The instant of time, when the level reaches the instrument position, is at ca. 14:50h. Afterwards the plant reaches stationary conditions, as shown in graph❷. So the Labasys® instrument provides a detailled and accurate insight into the internals of the spherizone process.