Polypropylene (PP) is a thermoplastic polymer with a very wide range of applications, from grocery bags to automotive plastics. The great aptness of PP is rightfully reflected by the global production of approximately 54 million metric tons (MMT) in 2014, which is expected to further expand to 70 MMT till 2020.

As one of the world’s top PP manufacturers, SABIC endeavors to advance promptly by building solid foundations towards more innovative and energy-efficient PP production processes.

The Achilles’ heel of the gas-phase PP production processes operated by SABIC is the formation of catalytic fines in the main polymerization reactor. These are extremely small and active catalytic particles formed upon the uncontrolled fragmentation of the process catalyst owing to exposure to intensive process conditions. Reactor fouling, loss of active material, formation of lumps and subsequent reactor clogging are some of the harmful events caused by the catalytic fines, leading in turn to increased operating and maintenance costs, and on many occasions to the emergency shutdown of the unit.

To mitigate these negative effects a pre-polymerization step is applied prior to the main polymerization, preparing the catalyst in a way that will prevent the problems described above. In this project a novel pre-polymerization reactor pilot plant was designed, modeled, scaled up and evaluated in terms of process economics. An entirely new design concept was introduced and the reactor model proved to be successful with a maximum relative error of 12% between model and experiment. In addition, the economic evaluation confirmed the project’s feasibility, with breakeven two years after the reactor installation and a minimum internal rate of return (IRR) of 29%.

Development of a Pre-polymerization Reactor for Polypropylene Manufacturing

Polypropylene (PP) is a thermoplastic polymer with a very wide range of applications, from grocery bags to automotive plastics. The great aptness of PP is rightfully reflected by the global production of approximately 54 million metric tons (MMT) in 2014, which is expected to further expand to 70 MMT till 2020.

As one of the world’s top PP manufacturers, SABIC endeavors to advance promptly by building solid foundations towards more innovative and energy-efficient PP production processes.

The Achilles’ heel of the gas-phase PP production processes operated by SABIC is the formation of catalytic fines in the main polymerization reactor. These are extremely small and active catalytic particles formed upon the uncontrolled fragmentation of the process catalyst owing to exposure to intensive process conditions. Reactor fouling, loss of active material, formation of lumps and subsequent reactor clogging are some of the harmful events caused by the catalytic fines, leading in turn to increased operating and maintenance costs, and on many occasions to the emergency shutdown of the unit.

To mitigate these negative effects a pre-polymerization step is applied prior to the main polymerization, preparing the catalyst in a way that will prevent the problems described above. In this project a novel pre-polymerization reactor pilot plant was designed, modeled, scaled up and evaluated in terms of process economics. An entirely new design concept was introduced and the reactor model proved to be successful with a maximum relative error of 12% between model and experiment. In addition, the economic evaluation confirmed the project’s feasibility, with breakeven two years after the reactor installation and a minimum internal rate of return (IRR) of 29%.