

# Chain reaction

The intensive mixing performance of a twin-screw extrusion system and the ability the technology provides to optimise thermal and mechanical exposure of the polymer in the barrel makes it a good choice for reactive extrusion processing. Key applications include the chemical integration of bonding agents to improve adhesion between the polymer matrix and fibre or particulate fillers, and more recently the direct polymerisation of thermoplastic polyurethane (TPU) elastomers from liquid components.

**KraussMaffei Berstorff** has developed systems for the production of impact modifiers and bonding agents for used in applications such as WPC extrusion and highly filled compounds. The company says a prime consideration for this type of reactive extrusion application is the use of screws and barrels with a corrosion resistant coating. Typical screw configurations include LD ratios of up to 50, with the installed drives selected according to the specific melting and dwell times required for the individual processing requirements.

The company has also developed systems for the production of TPUs, comprising a twin-screw extrusion unit which is fed with the liquid components and catalysts. The reacted TPU polymer is extruded via an underwater pelletizing system.

The TPU production lines require high precision gravimetric or mass flow metering systems to ensure the liquid components are delivered to the extruder throat in the correct ratio. LD ratios of up to 60 are typical for such applications.

The polymer modification potential of reactive extrusion is being used in a variety of applications ranging from polymerisation and polymer modification to the production of novel bio-based blends. **Compounding World** reports

According to KraussMaffei Berstorff, dynamic regulation of melt temperature is a critical consideration in any reactive extrusion process. Its systems use direct heating of the barrel elements in combination with liquid cooling. Heating is performed using high power cartridge heaters or heater bands; cooling is achieved with either high pressure water or oil circulated through a network of cooling bores.

French technology company **Setup Performance** provides reactive extrusion technology support to a wide range of clients. Earlier this year, it commissioned a new 43 mm diameter LD 60 twin-screw extruder in its laboratory at Frontonas near Lyon to handle pre-industrial pilot volumes.

Aside from expertise in TPU production and the grafting of polyolefins with maleic anhydride, it has also



The abrasion resistance of TPU is exploited in Andaluz Accessibilidade's tactile pedestrian surfaces, produced in Bayer Material-Science's Desmopan

worked on projects such as the development of bio-based polyamide by polycondensation. Setup specialists have been involved in a wide range of reactive extrusion projects, including Evonik's process for the production of TPUs using fumed silica and the development of its Aerobatch processing aids. The company also has a technique for the production of a polypropylene homopolymer that can be crosslinked in a secondary process, which it markets as PPX.

Most recently, Setup worked with French agricultural products company **Roquette** in the development of its Gaiylene biopolymers, which are based on grafted starch blends and are claimed to offer performance considerably improved on current starch blends.

Roquette's patent details a reactive extrusion process that brings together starch, plasticizer, polyolefin, compatibilizers and a variety of bonding agents to create a durable starch/polyolefin blend suitable for processing using conventional techniques such as injection moulding or extrusion.

Roquette commissioned a 25,000 tonnes/year production scale plant to manufacture Gaiylene

biopolymer blends at its site at Lestrem in northern France at the end of last year.

Meanwhile, Switzerland-based **List** has developed a kneader reactor that provides an alternative to solvent-based polymerisation. It is claimed to have found applications in a variety of polymer reaction and compounding applications. Aside from eliminating the additional costs involved in handling solvents, the kneader technology also provides improved thermal control compared to stirred tank systems due to the incorporation of thermal regulation circuits within the mixing shafts and elements as well as the reactor jacket.

According to List, the benefits of using its technology – which is available in both single-shaft and twin-shaft variants – include higher outputs from smaller production systems, simple scalability, reduced product handling, and lower energy consumption.

List has a wide range of kneader reactors available for project development at its technology centre at Arisdorf in Switzerland. The company also works closely with the Fraunhofer Institute, which has a semi-commercial scale kneader reactor installed at its Polymer Pilot Plant Centre at Schkopau in Germany.

KraussMaffei Berstorff twin-screw extruder configured for production of polymer bonding agents



Click on the links for more information:

- | [www.kraussmaffei.com](http://www.kraussmaffei.com)
- | [www.setupperformance.com](http://www.setupperformance.com)
- | [www.roquette.com](http://www.roquette.com)
- | [www.list.ch](http://www.list.ch)

# AMI Strategy Seminars

These one-day seminars are given by an AMI director and provide invaluable insights into market trends and industry strategies. They are held in small groups and provide ample opportunities for questions and discussions.



**16 October 2012: Cologne, Germany**  
**5 November 2012: Philadelphia, USA**  
**12th November 2012: Dubai**



[Click here to download our 2012 brochure](http://www2.amiplastics.com/Seminars)  
[www2.amiplastics.com/Seminars](http://www2.amiplastics.com/Seminars)

