
I ❤ Amtuf

Bumper harvest

We may take the production of modern polymers for granted, but as *Tom Seslar* discovers, there's more to creating plastic auto parts than meets the eye

A lot has evolved between BP and the auto industry since 1997, but Aaron Ford was already feeling confident when he flew from Detroit to Oklahoma in the autumn of that year. He was armed with valuable details about a significant chemical breakthrough for the manufacture of automobile bumpers.

Ford, a scientist by university education and a salesman by years of experience, was going to the American southwest to call on Camrose Technologies, known as a 'Tier 1' company in the auto business. That means it makes and paints auto bumpers and other components according to the strict specifications of the industry's original equipment manufacturers – the big automakers.

Ford, who heads the Detroit-based BP automotive group, scheduled that initial meeting with Camrose to tell its engineers about a new patented polymer material named Amtuf. Initially developed by Amoco about five years ago, today Amtuf is BP's highly engineered and specialised automotive-grade polypropylene, identified in chemical industry circles as RxTPO, or reactor thermoplastic polyolefin. It was a breakthrough as a primary material for making bumpers and other car and truck components because in addition to having the right structural properties, it excels in accepting and holding paint and readily withstands the ravages of weather.

RxTPO is a tough, mouldable material produced by catalyst-induced polymerisation of propylene and ethylene. The Amtuf versions of these resins have become a key force in the auto business since 1997, when Ford first made his convincing case for their superior predictability and controllability. He explained to the Oklahoma engineers that those attributes are due largely to the proprietary process for producing these resins. And Ford commercially launched Amtuf by landing a major contract from Camrose Technologies.

Although Amtuf RxTPO has been on the market for less than five years, it has >>

>> already captured about a third of the RxTPO market in the US. According to Barry Dean, product development manager for BP's polypropylene business unit based in Naperville, Illinois, it has quickly become 'a highly strategic part of BP's chemical portfolio.'

The majority of Amtuf applications are for interiors and exteriors of passenger cars and trucks. The material has notched up success with many of the US auto industry's familiar names – the Chevy Trailblazer, Buick Regal, Buick Century, Pontiac Grand Am, GMC Envoy, Chevy Malibu, GM Express, Pontiac Bonneville and the Chrysler Neon have exterior Amtuf components, while interior hard trim applications can be found on door panels for the Ford Escape, Ford Mustang, Ford Taurus, Mercury Sable, Ford Windstar, Saturn and Ford F-250.

Gas phase consistency

So far, BP's marketing of Amtuf is limited to the US auto and truck businesses, but the company is exploring other market possibilities. All of the product is currently produced in a unit at BP's Chocolate Bayou polypropylene plant near Alvin, Texas. The RxTPO leaves the plant in pellet form and is shipped to the factories of Tier 1 manufacturers, where it is melted and injected into moulds to form auto components, and subsequently painted.

'In one sense,' explains Aaron Ford, 'you could say that we really don't sell RxTPO pellets. We sell our process. It's the process that makes us different and gives us a big competitive edge over other suppliers.'

Dean adds: 'The unique features of Amtuf that give it low temperature impact resistance, paintability and overall structural performance, are the result of the combination of the catalyst and the horizontal reactor bed at the heart of BP's proprietary Innovene gas phase process for making polymers such as polyethylene and polypropylene (*Frontiers*, September 2001). Our competitors use a bulk loop, fluid bed process, whereas with the Innovene horizontal gas phase reactor process we have two reactors connected in series, allowing BP to tailor the unique properties of its RxTPO. This advantage translates to a patented technology that our competitors cannot match.'

The BP-patented catalyst is classed as a Ziegler-Natta catalyst variety, named after Karl Ziegler and Giulio Natta, who shared 1963's Nobel Prize in chemistry for their discoveries in the field of the chemistry and technology of high polymers.

The catalyst and propylene gas feedstock – the latter obtained by cracking petroleum hydrocarbons – enter the front end of the first reactor (see figure opposite) where turbine blades resembling huge window fans revolve and propel the material through the vessel at a continuous rate. The molecules progress through the reactor in a controlled manner, each molecule spending exactly the same amount of time in the reactor to achieve a uniform growth rate as the molecules polymerise to form polypropylene.

In the second reactor, ethylene gas is introduced into the feedstock, and grows within each polypropylene molecule to endow rubbery properties to the polymer product, which at this point looks like flakes of detergent laundry soap.

BP converts the RxTPO into pellets purely for the convenience of shipping, Ford points out, whereas competitors produce pellets as a necessary step to increase dispersal of the rubber into their product.

'Typically, these conventional processes are like big stirred tanks that deliver uneven results,' he explains. 'It's not guaranteed that all molecules will spend the same amount of time in the process, and that means you might not get the best morphology. The rubber sometimes will grow on the outside of the RxTPO molecule, sometimes on the inside, sometimes both on the inside and the outside. It raises the real possibility that in use, the paint will soon begin to come off, for example when a car goes through a power wash.'

It's the process that makes us different and gives us a big competitive edge over other suppliers

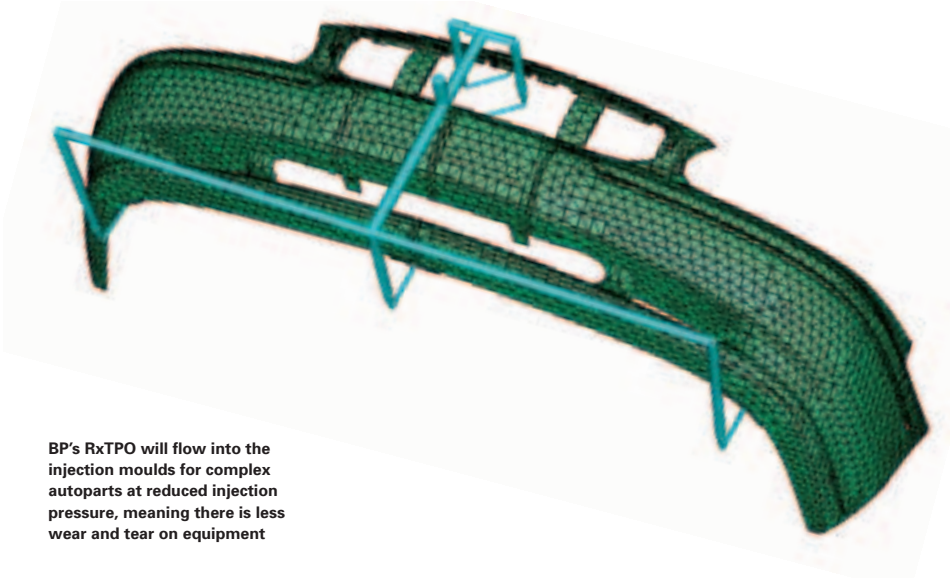
BP's RxTPO brings a number of benefits and advantages to Tier 1 companies that use it. In addition to product consistency and quality-controlled paint adhesion, the manufacturing cycle time is shortened, translating into increased profits for the users as they can make parts faster with their same capital equipment. There is less material wasted as scrap, and as the RxTPO will flow into injection moulds at reduced injection pressure, there is less wear and tear on equipment.

'Overall, the biggest advantage is lot-to-lot consistency,' notes Dean. 'The same quality product that we deliver today will show up tomorrow, and the day after tomorrow, and next month and next year.'

Prize polymers

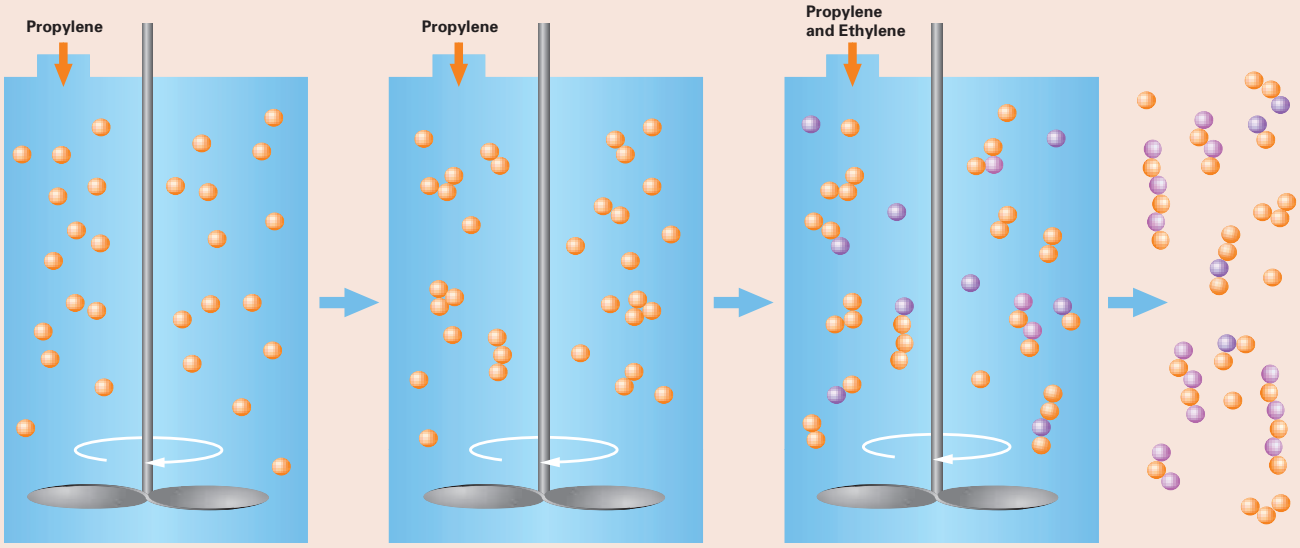
Amtuf RxTPO also is aligned to address the trends and changing performance requirements of today's automotive industry. These include escalating cost pressures among original equipment manufacturers, consolidation among Tier 1 companies and general movement toward larger, thinner and lighter auto parts.

BP is particularly well-positioned to continue growing its RxTPO and other polypropylene businesses. In addition to Chocolate Bayou, the company has long had US polypropylene manufacturing in the Texas community of Cedar Bayou, plus Geel in Belgium, Grangemouth in Scotland, and at Lavéra in France, a 50% joint venture with TotalFinaElf. BP also holds majority

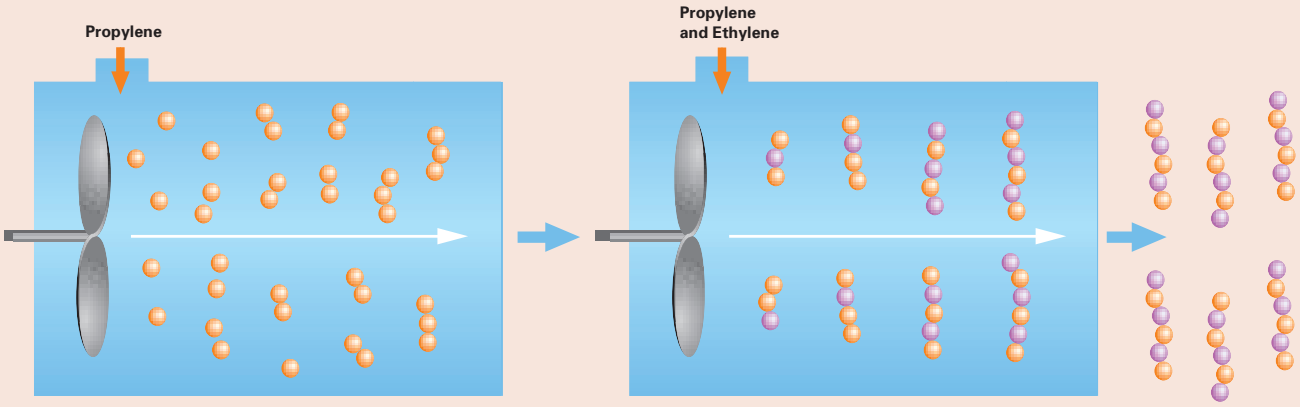


BP's RxTPO will flow into the injection moulds for complex autoparts at reduced injection pressure, meaning there is less wear and tear on equipment

Conventional RxTPO production process



BP's improved RxTPO production process



Top diagram: Conventional stirred tank reactors used for RxTPO manufacture deliver a product which can exhibit uneven properties.
Bottom diagram: BP's two-stage horizontal gas phase process achieves uniform growth and properties of the polypropylene product.
(Both of the above process diagrams are simplified for clarity)

ownership in a polypropylene operation at a refining complex in Carson, California.

This picture improved even further late last year when the company completed a deal with Solvay to strengthen BP's core polyolefins businesses significantly in Europe and the US. As a result of that deal, BP acquired Solvay's global polypropylene manufacturing base, while the two companies combined their high-density polyethylene businesses in Europe and the US into two joint ventures. BP has also transferred its non-core engineering polymers operations to Solvay.

BP's worldwide annual capacity for producing polypropylene is now around 3.1 million tonnes, making it the largest producer in North America and the second-largest worldwide after Basell, jointly owned by BASF and Shell. Polypropylene is the fastest-growing thermoplastic market, with an average annual growth rate of around 6%. As a tough yet lightweight thermoplastic resin, the polymer is noted for its high melting point of 121°C and its resistance to moisture, oils and solvents, making it a prime ingredient for many products in addition to automobile parts, including fabrics, luggage, buoyant rope, packaging material and dishwasher-safe food containers.

'The Solvay agreement was a significant step in repositioning and upgrading our chemicals portfolio,' observes Byron Grote, chief executive of BP's chemicals businesses. 'The deal expands BP's worldwide reach in our core petrochemicals businesses, while exiting a non-core business. Our priority will now be to integrate fully the polypropylene businesses and operate the high density polyethylene partnership to access maximum synergies from these combinations.' ■