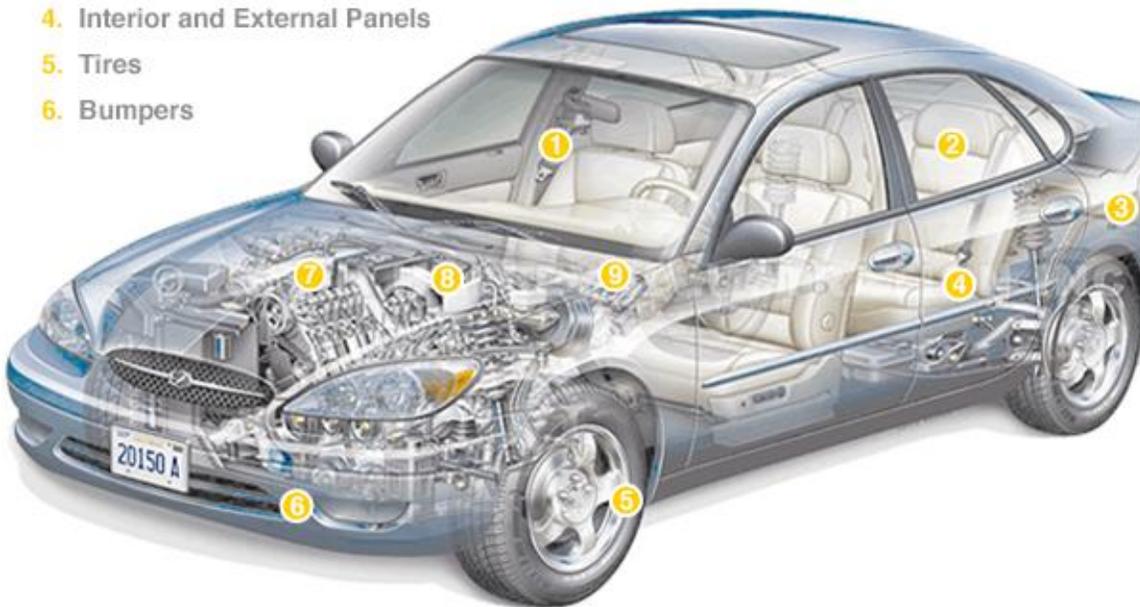


Petrochemical Use in Transportation: The Automobile

Petrochemical-derived plastics, composites, rubber, coating and textile products are used in the average vehicle accounting for about 600 pounds or 15% of the total vehicle weight.

1. Seat Belts
2. Seating Cushions and Padding
3. Gas Tanks
4. Interior and External Panels
5. Tires
6. Bumpers
7. Gear Housing
8. Wires and Cables
9. Instrument Panel



Petrochemicals and Fuel Efficiency: Plastics in vehicles play a prominent role in fuel efficiency. One pound of petrochemical-based plastics in a modern car replaces approximately 2 to 3 pounds of traditional materials. This helps minimize environmental impact and saves non-renewable resources by cutting fuel consumption. For every 10 percent of weight eliminated from a vehicle's total weight, fuel economy improves by 7 percent. The more than 330 pounds of plastic/composites used in the average vehicle reduce its weight by 330 to 660 pounds, improving an average fuel economy by 6 to 11 percent. The following petrochemical-based plastics not only improve fuel efficiency, but improve safety in the automobile.

Seat Belts: Approximately 90 million seat belt units are sold in the United States annually and are estimated to save close to 10,000 lives a year. Automotive seat belts are made of polyester or nylon with a specialty chemical – which uses propylene as a raw material – added to make the polyester and nylon stronger. Polyester is made using the petrochemicals para-

xylene (aromatic) and ethylene (olefin). The production of nylon starts with benzene and propylene as fundamental building blocks.

Seating Cushions and Padding: Polyurethane foam is used for automotive seat cushions and padding, but the polyurethane foam of today is high tech material that can be custom molded to precise specifications. Polyurethane is a complex mixture of different polymers that include a polyol and diisocyanate in a two-part system. The polyols are derived from a mixture of ethylene oxide and propylene oxide, and the diisocyanates typically use benzene or toluene as building blocks.

Gas Tank: Polyethylene is mainly used in gas tank applications, as the high-density polyethylene (HDPE) tanks are inert to the corrosive environments inside and outside of the tank. Polyethylene is also lighter in weight and its use reduces the overall weight of the vehicle.

Interior Panels: Interior door panels require a certain degree of functionality because they house window operating units, locks, door handles and other necessary items. Electronics must be kept dry, so most door panels are now made of a hybrid polymer called acrylonitrile-butadiene-styrene plastic. Many people are familiar with this material through its acronym, ABS. Acrylonitrile uses propylene as a building block. Butadiene is a base petrochemical obtained by steam cracking. Styrene is made using ethylene and benzene as starting materials. Modern door panels last longer and are lighter in weight than their predecessors.

Tires: Around the world, over one billion tires are manufactured each year. Modern tires are carefully crafted and require the use of petrochemical building blocks to achieve the expected high level of performance. The inner liner, which must be water-resistant, is usually chloro- or bromo-butyl rubber, which uses the petrochemicals isobutylene and isoprene as starting materials. Many tires still use natural rubber; however, styrene-butadiene rubber is also used a great deal of the time. Butadiene is a base petrochemical that can easily be converted to polybutadiene. Styrene is made using ethylene and benzene as starting materials. The body ply is a layer of polyester or Kevlar[®] sandwiched between two layers of rubber. This allows for increased strength, longevity and enhanced performance.

Bumpers: The main function of a vehicle bumper is to absorb energy from a low speed crash. To achieve overall weight goals for cars, modern bumpers are made from plastic. Polypropylene, derived from the petrochemical building block propylene, is used in a honeycomb pattern to maximize energy absorption while minimizing weight. The outer face of a bumper can be made from a variety of plastic, such as polycarbonate, polyester, polyurethane and polypropylene. All of these materials use petrochemicals as building blocks, including ethylene and propylene.

Wires and Cables: The material used in automotive wires and cables largely depends on the desired thermal properties. The most common materials are polyvinyl chloride (PVC) and polyethylene, which both depend on ethylene as a building block. High temperature environments use specialty fluoropolymers such as polyvinylidene fluoride, which is also derived from ethylene.

Instrument Panel: Polycarbonate is used as a substitute for glass in dashboard instrument covers and other applications because it is shatter resistant, heat resistant and has superior optical properties. Polycarbonates typically use phenol and acetone as raw materials. Phenol is made using the petrochemical building blocks propylene and benzene through a type of chemistry known as the cumene process. Acetone is a byproduct of the cumene process and can be used as a starting material (along with the phenol) to make polycarbonate.

Petrochemicals in goods Critical to the United States Economy, July 2010, Chemical Market Associates, Inc., commissioned by American Fuel & Petrochemical Manufacturers

Automotive Cushioning Through the Ages, September 2008, The Molded Polyurethane Foam Industry Panel