

Product Utilization Information

Astra Green Gum Technologies

Rubber Granules Manufacturing Technology

Nov 2017

1. Background Information (Source: I.M.)

Product: Rubber granules manufactured with a patented process which is able to produce fine granules of 200 & 300 microns and superfine granules 180 microns to 150 microns. The production has a small carbon footprint as no freezing or other energy intensive processes are used. The current production level in Europe is 15,000 tons of low grade rubber granules grossly ***inferior in quality to the Green Gum produced granules***. The need for road building and road maintenance alone is expected to be in excess of 35,000 tons per year over the next five years.

Key

Advantage: There are very few manufacturers, if any, who are able to produce fine rubber granules less than 250-300 microns in diameter. The product manufactured by the Green Gum method is extremely fine and the size can be as low as 150 microns. In addition to greatly enhancing the general bonding properties, it also makes it an extremely cost effective and profitable to use the granules in the manufacturing of plastics, Synthetic Rubber and other similar materials.

Bitumen: The standards vary from country to country but in general, there are no major differences. The mixture consists of bitumen base with crushed stone granules, and other materials. Approximately 20% of rubber fine granules are added to the mixture thus producing a cohesive effect and an eminently usable product. These mixture technologies are in some instances proprietary, but they all use fine granules. A liquid bitumen form is also in use and is being further developed for the repairs of road surfaces which suffered smaller damage such as cracks, breaks and potholes. This process is possible only with the use of *high grade rubber granules*, and the savings produced in road repairs are extremely high.

Potential: Most Synthetic Rubber is created from two materials, styrene and butadiene. Both are currently obtained from petroleum. Over 454,000 tons of this type of rubber was manufactured in the United States in during the 1990-s increasing to over 600,000 tons during the early 2000-s. Other Synthetic Rubbers are made from specialty materials for chemical and temperature resistant applications. Tires account for 60%-70% of all natural and Synthetic Rubber used. Other products containing rubber include footwear, industrial conveyor belts, car fan belts, hoses, flooring, and cables. *High quality, fine rubber granules as produced by the Green Gum process* can decrease the requirement for the petroleum based materials in the manufacture of Synthetic Rubber.

Green

Industry: The use of recycled rubber in plastics manufacturing processes is only possible with very high quality granules which are extremely fine and have special bonding properties due to their shape. The recycling of rubber products is currently limited by the quality of the recycled product. The Green Gum process makes it possible to greatly increase the clean and environment friendly utilization of scrapped rubber.

2. Marketing Information Notes (Source IRSG)

The International Rubber Study Group (IRSG) is an intergovernmental organisation recognised as an international body located in Singapore, formally established by a Headquarters Agreement with the Government of Singapore. The purpose of the organisation is to prepare current estimates and analyse future supply and demand trends, while undertaking statistical and economic studies on specific aspects of the industry.

Global rubber consumption reached 24.6 million tons in 2010, 15.3% higher than in 2009, reflecting a strong recovery in the demand for vehicles and tyres. Global Synthetic Rubber production was 14.1% higher than in 2009, in line with the strong recovery seen in Synthetic Rubber consumption, while global Natural Rubber supply was 7.2% higher than in 2009.

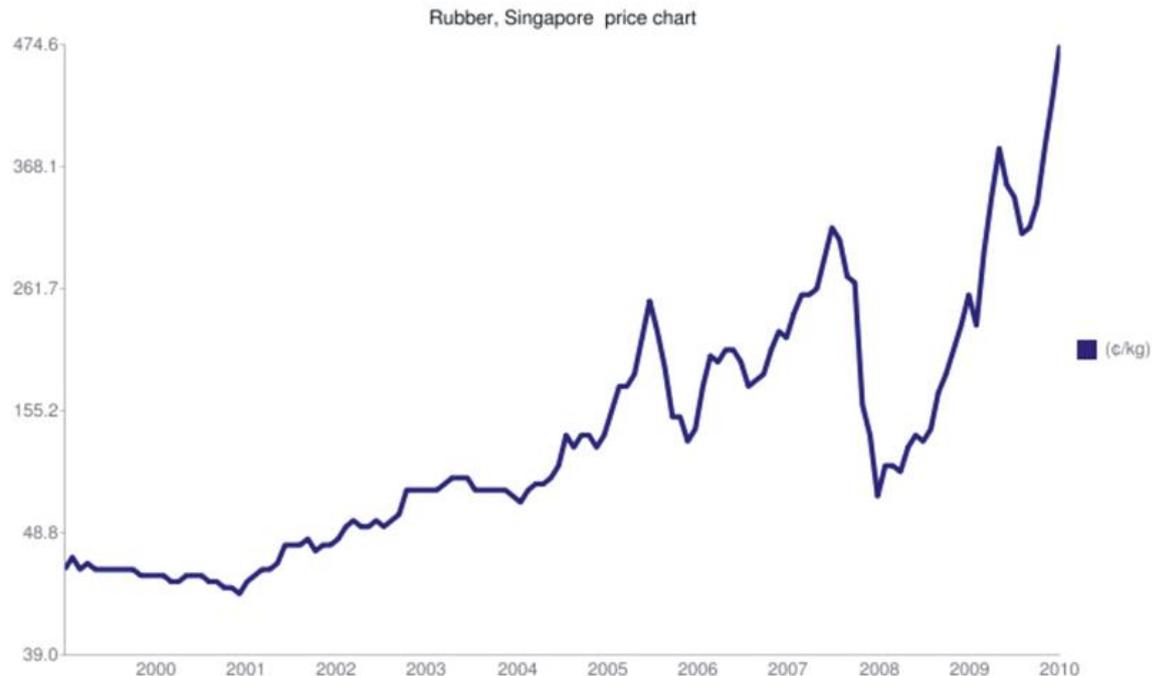
Global rubber demand is forecast to reach 25.7 million tons in 2011 and 27.6 million tons in 2012.

Global Synthetic Rubber demand is expected to grow by 5.0% in 2011 and 9.0% in 2012, while global Natural Rubber demand is forecast to rise by 3.8% in 2011 and 5.4% in 2012.

Partly due to the impact of higher prices, and assuming normal growing conditions, global Natural Rubber production is forecast to rise by 5.6% in 2011 and 8.2% in 2012.

In the short term, following the rapid recovery and growth seen in 2010, global rubber consumption (both Natural Rubber and Synthetic Rubber) is forecast to reach 25.7 million tons in 2011, with Natural Rubber consumption of 11.2 million tons.

In the longer term, global rubber consumption is forecast to reach 35.9 million tons by 2020, with Natural Rubber consumption of 16.5 million tons.



It should be noted that the international average price of rubber is subject to the normal commodity market fluctuations.

3. Utilization of Rubber Granules

In simple terms, the production of styrene butadiene rubber (SBR), which is the major general purpose Synthetic Rubber accounting for around 37% of world solid Synthetic Rubber.

Butyl rubber is a synthetic rubber, a copolymer of isobutylene with isoprene polyisobutylene. Butyl rubber has excellent impermeability and the long polyisobutylene segments of its polymer chains give it good flex properties.

Synthetic rubber or elastomer butyl rubber is impermeable to air and used in many applications requiring an airtight rubber.

Polyisobutylene and butyl rubber are used in the manufacture of:

- ✓ Adhesives
- ✓ Agricultural chemicals
- ✓ Fibre optic compounds
- ✓ Ball bladders
- ✓ Sealants
- ✓ Base and sealer for paint products (external, internal, heavy duty)
- ✓ Personal care products
- ✓ Gasoline & fuel additive
- ✓ Pigment concentrates for rubber and polymer modification
- ✓ Butyl rubber can also be used for protecting and sealing and in certain equipment for areas where chemical weapons may be present.

1.2.1 Product Features

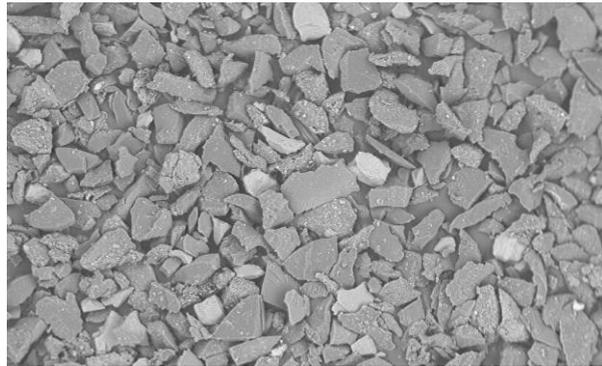
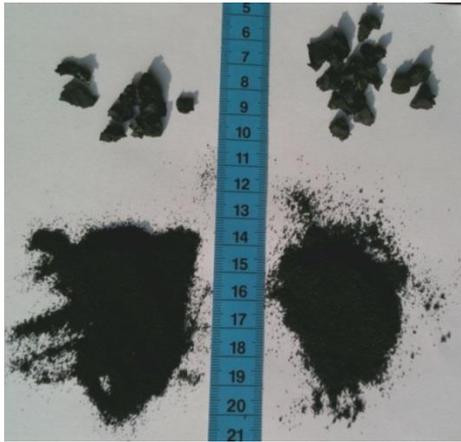
The *Green Gum patented technology* utilises the de-vulcanisation of scrap or waste rubber (e.g. automotive tyres) by converting rubber base material (rough grind 8-10mm) via a grinding technology into high quality and consistent sized end products of fine and super fine rubber granules 200 to 300 and 150 to 180 microns in size respectively.

The resulting rubber granules are of a flour-like consistency and are available in industrial quantities. This material is suitable for the substitution of expensive industrial base materials and it may be applied for the substitution of a part of caoutchouc in certain industries, for example as filler in the paint industry or for the substitution of plasticisers in the plastic industry.

Global demand for bitumen has generally remained constant at around 100 million metric tons per year. However, according to the Freedonia Group, between 2009 and 2014 global annual demand rose by from 101 million tons to 107 million. By 2019 the annual demand is expected to grow to 122.5 million tons. The bitumen market was valued at around \$75 billion in 2014 and is expected to reach \$94 billion by 2020.

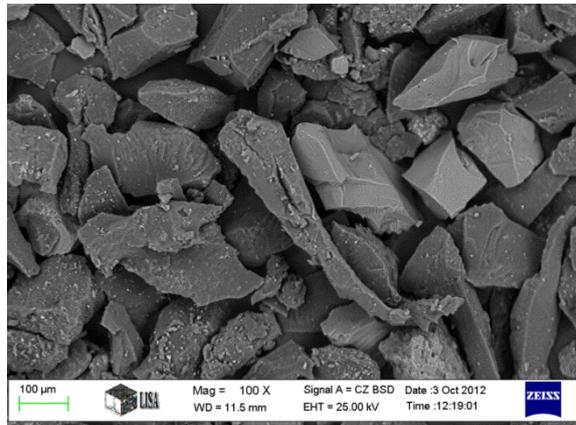
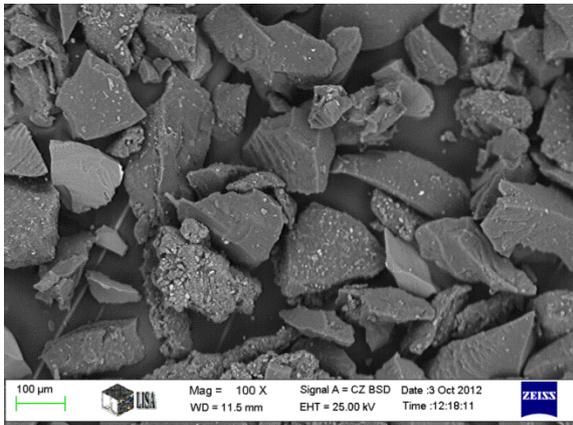
The rubber granules are used in road building in the colder climates, because of their inherent flexibility and are mixed into the road building materials such as bitumen. The sale price is directly related to bitumen whose price is tied to the price of crude oil. Bitumen prices are volatile and for the purposes of general calculations, €500 per ton could be used for indicative calculations.

There are also possible opportunities in the long term for the use of rubber components in the manufacturing of automotive cabin components, which include dashboards.



Comparison between the “normal” size granules and the ultrafine

(200 microns) granules produced by the Green Gum Kft process produced from the above particles. The raw material particle size determines the size (i.e. the particle size distribution) of the final product.



Electron Microscope tests conducted during initial machinery setup

Not resistant to most oils, fuels, solvents and acids

EPDM rubber exhibits average to good resistance to fireproof hydraulic fluids, ketones, hot and cold water and alkalis. EPDM rubber has poor resistance to most oils (petroleum, mineral, di-ester lubricants), fuel (gasoline, kerosene), aromatic and aliphatic hydrocarbons, halogenated solvents and concentrated acids.

Used for weather sealing applications on all vehicles, glass run channels and tubing

EPDM rubber is frequently used for weather sealing applications on all vehicles: door, window, trunk and hood seals. EPDM rubber is also used in glass-run channels, radiator hoses, garden and appliance hoses, tubing, washers, belts, solar panels, gas masks (instead of silicone) and electrical insulation.

Applications	Market Segments								
	Automotive	HeavyTruck	Construction	Off-Road	Recreational	Medical	Rail / Bus	Industrial	Agricultural
	Tier 1	OEMs	Equipment	Vehicles	Vehicles			Customers	
Door Seals		■	■	■	■	■	■	■	■
Dynamic Window Seals	■	■	■	■	■				■
Static Window Seals	■	■	■	■	■	■	■		■
Compartment Seals	■	■	■	■	■		■	■	■
Under Hood Seals	■	■	■	■	■				■
Body Fascia Seals	■	■							
NVH Isolators	■	■	■	■	■			■	■
AC Insulators	■	■							
Engine Seals		■	■	■			■		■
Industrial Seals								■	
Tubing	■	■						■	
Molded Parts	■	■	■	■				■	■