

YULEX® PRIME Natural Rubber Solid

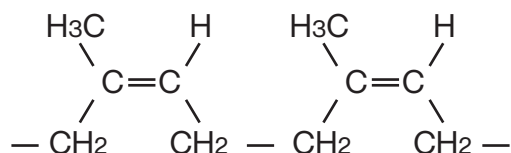
FOR MOLDED PRODUCTS

YULEX® PRIME Natural Rubber solid (YNRS) is a stable plant-based, thermoset elastomeric polymer of cis, 1-4 Polyisoprene used primarily in compound molding production methods. Curative or vulcanization systems are typically sulfur or peroxide in combination with activators and accelerators. A broad range of ingredient systems are typically used such calcium carbonate, clays and carbon black fillers, process oils, protectants, pigments, activators, and accelerators, to impart specific physical properties in finished products as well as a dilutant for cost management. YNRS may also be used in solvent-based adhesives and glues and as gum base in candies and drug delivery.

TYPICAL USES:

- Molded products such as gaskets, tires, shoe soles, and pet toys.
- Foamed products such as yoga mats, wetsuit foams, and footwear products
- Additives such as adhesives and glue.
- Gum Base products such as candies and drug delivery products.
- Molding methods include compression molding, injection molding, extrusion molding, rotational molding and transfer molding.

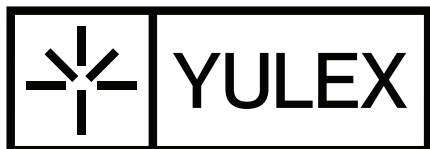
CHEMICAL STRUCTURE



Yulex Pure Natural Rubber Latex is a nonpolar elastomeric polymer.

The physical properties of the vulcanized product are totally dependent upon the compound formula, process methods and curing cycle parameters.

ITEM	TYPICAL CHARACTERISTIC
Dry Rubber Content, wt.%	100
Ash Content, wt.%	<0.5
Volatile Matter, wt.%	<0.5
Color, Lovibond	1-4
Viscosity @Mooney ML (1+4), 100C	60-75
Dirt, wt.%	ND-0.05
Elongation, EB%	>1,000
Density, g/cm ²	0.92-0.96
CAS#	9006-04-6
Molecular Weight	68.12g/mol
MW Distribution	Multimodal
Curative System	Sulfur or Peroxide
Certified Sourcing	FSC/PEFC
Harmonizing Code	4001.22.0000
REACH	Exempt
RoSH	Exempt
California Prop 65	NA
Chemically Modified Polymer	No
GRAS Approval	Listed
FDA Approved Material	Yes



STORAGE OF YNRS

It is important that the material be kept wrapped, in a cool, dry location away from high heat, humidity, and sunlight. If material is cold (<18C) the material should be placed in a hot room (>35C) for 24-48 hours allowed to warm completely before using.

SHELF LIFE

Under proper conditions is one (1) year from production date.

Note: Always use correct and proper Personal Protection Equipment (PPE).

Yulex Natural Rubber Solid is available in 30-35kg bales wrapped in low melt plastic.

DISPOSAL

Since country and local guidelines vary on regulations for disposal of various materials, it is extremely important that a local waste service provider be consulted on the proper disposal of any material.

It is the responsibility of the disposer to contact a local waste service to help determine if the material is considered potentially hazardous .

Working with Yulex Natural Rubber Solid

Proper compounding is critical to ensuring consistency of the material and achievement of optimal physical properties. Care and patience are necessary to allow for proper incorporation of all components used in the compound. Failure to take these precautions may result in inconsistencies in the compound and thus abnormalities or defects in finished parts.

COMPOUND MIXING

There are many types of equipment and machines used to mix rubber and chemical ingredients. The more common ones are noted below:

- Internal mixers such as Banbury and Kneaders
- External mixers such as two roll open mills
- Extruders are used to remove air pockets and shape slabs
- Calendars are used to sheet the compounded rubber into thin sheets and pieces used as preforms for molding.

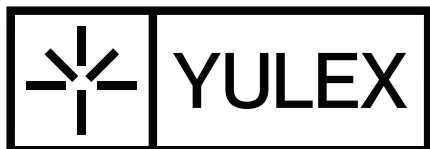
Compound mixing is by far the most important process in making rubber products, next to the selection of ingredients (formula) and in some cases more important. The variety of mixing equipment is extensive as is the choice of ingredients, but there are common issues regardless of the equipment used or the ingredients selected:

Overloading the mixer - Meaning is trying to mix too much material for the equipment size, which may be volume or weight. Typical rule of thumb is 60%-80% of the equipment capacity. Overloading causes incomplete ingredient dispersion, excess heat build-up in certain areas of the compound.

Excessive mix time - Meaning the operator continues to run the equipment well past the optimal time cycle thinking that more is always better, it is not. Excessive mixing causes the polymer to breakdown and oxidize, reduce viscosity and causes the compound to become very sticky. It is better to dump the compound and allow it to cool, then remix if necessary.

Not using Split Mix Techniques - Depending on the type of product being produced some compounds require high levels of fillers and/or process oil. When trying to mix in large amounts of fillers or fillers of different types it is best to add half the amount, mix, then add the remaining amounts. Mixing of fillers and certain types of blowing agents are difficult to do and require high shear forces to help incorporation and dispersal. By stopping the mix and allowing the compound to cool, then remixing when the viscosity is higher allows for better mixing.

Split Batch - When two or more different polymers are mixed together it might be helpful to mix each polymer separately.



ORDER OF ADDITION

Ideally, materials should be of the highest quality obtained, fresh (well before "Use By Date", be kept and stored properly.

In general, ingredient order of addition for a basic compound should follow an order such as follows:

1. Yulex NR Solid
2. Activators
4. Fillers
5. Process Oils
6. Antioxidants
7. Accelerators
8. Blowing Agents (if used)
9. Curatives

The order of addition can and should be changed depending on the ingredients, if other polymers are used, type of mixing equipment and required thermal input needed. The above order is general and used as guidance only. Remember there is no one right way in rubber compounding.

MATERIALS

YULEX® PURE Natural Rubber Solid, is the base material for compounding and ingredient calculations are based on the actual amount of rubber as Parts per Hundred Rubber (PHR). There are many other materials used to impart or enhance specific properties, some that are critical to the system to ensure basic desired physical properties are achieved. The primary basic ingredients in a typical compound are discussed below.

Activators - Typical activators such as zinc oxide and stearic acid are used to help the curative system like sulfur develop crosslinking of the polymer chains. They also help with filler incorporation and can have an impact on other physical properties such as elongation, hardness, tensile and tear strength.

Process Oils - Plant based such as soy or palm oils, or petroleum-based oils such as aromatic, paraffinic and naphthenic are used to:

1. Soften the product as a plasticizer,
2. Help in adding higher amounts of fillers,
3. Extending the compound mix as a dilutant for cost management,
4. Physical properties such as elongation, hardness and surface finish.

Filler Systems - These are classified as white or black. White fillers are generally clays, calcium carbonate, silica and certain plant based fillers. Blacks are carbon black which is produced in a wide variety of types to impart a range of physical properties. Fillers are also used to extend the compound volume/mass to manage cost of the end product.

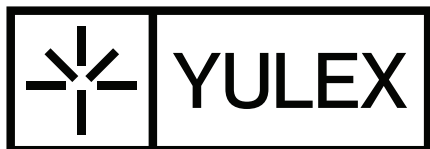
Protectants - There is a wide range of protectants in the rubber industry to protect the product from UV radiation, ozone damage, heat damage and oxidation. Typically, they fall into two (2) categories: Staining and Non-Staining. Depending on the product and the protectant, some migrate or bloom to the surface where they act to protect the rubber while others remain in the polymer matrix. Excessive amounts will tend to surface or bloom and cause discoloration of the product.

Process aids - These exist to help the compound mix together ingredients, reduce energy needed for mixing and produce specific product characteristics. Waxes, oils, peptizes and others fall into this category.

Blowing agents - These are used to form open or closed cells in the cured rubber products. When the compound is molded and reaches a specific temperature the blowing agent decomposes and turns into a gas that creates a small bubble or cell in the rubber as it cures.

Curatives or vulcanizing ingredients - There are two (2) basic types: Sulfur or peroxide. Each has its own performance and characteristics and are used with accelerators to speed and control how the rubber cures or vulcanizes.

Accelerators - As the name implies these chemicals speed up, modify and slow down the rate of cure and the temperature the cure happens. They are often used in pairs as a primary and secondary accelerants. This is a large class of chemicals and very important in the product's physical properties. The ratio of sulfur to accelerator will have a profound effect on the properties of the product.



Pigments and Colorants - These are exactly what their name implies, they color the product. There are two (2) basic categories: Organic and Inorganic. This has to do with carbon content and is a scientific term unrelated to how vegetables are grown. Titanium dioxide (TiO₂) is often used to establish a base color (white or light color) so certain types of pigments can be used such as bright colors like pure white, yellows, tans, blues and reds to name a few. Darker colored pigments often do not use TiO₂. Pigments are often concentrates mixed with a similar base polymer.

Others - There are thousands of different chemical ingredients used in rubber compounding and depends on the product being produced. Some of these include:

- Odor modifier
- Surface gloss enhancement
- Fragrances
- Biodegradability promoters

About Biodegradation or biodegradability. We all want to feel good about throwing away our used products, knowing they will degrade properly and not affect the environment.

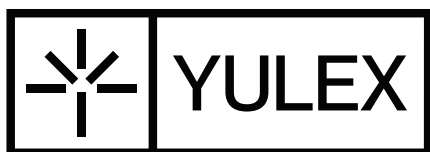
Raw, unvulcanized natural rubber will easily degrade in landfills, compost pits and even when left outside in the garden or first floor. Unfortunately in order to turn natural rubber into a useable product with function, utility and durability the rubber is compounded or mixed with other essential ingredients to help crosslink the polymer chains,

add tensile strength, protect from UV, ozone and thermal oxidation, improve abrasion and tear resistance, improve wet grip, allow it to stretch and return, to name a few physical properties. Some products you simply do not want to degrade like vehicle tires. Unfortunately, industry produces tires that are very durable and safe while they are on our cars or trucks, but because they are so durable they do not degrade in less than 200 years. That's a big problem as we throw away hundreds of millions of tires every year, and for these incredibly durable products, recycling is the best approach.

Depending on the environment the product is disposed in to, several forces will begin working to degrade and disassemble the elastomeric polymer compound by means of aerobic and anaerobic microbes that consume the ingredients, breaking apart the structures into the base components. Depending on how your product was designed (formula) will determine how long it takes to break down and in which environment.

There is a class of ingredients that can be added to the compound that help to promote biodegradability under certain conditions and environments. However, many of these have been shown not to work in most landfills due to lack of intense heat, moisture, too much moisture or microbial species.

Depending on how you compound Yulex Natural Rubber Solid will determine how easily, fast and where the product will biodegrade.



Contact Yulex Technology & Engineering Group
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