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Cryogenic Grinding of Rubber to produce Micronized Powder

Superfine rubber powder can be manufactured efficiently using a cryogenic process. Liquid nitrogen is employed to cool the feed granules below their glass transition temperature before they are pulverized with counter-rotating pin mills. The fineness and throughput are determined by the impact speed from the pin mill and nitrogen metering. A specialized rubber granulate and liquid nitrogen feeding system in combination with specially designed screw cooler are important for the efficiency of the system.

Cryogenic processing refers to the use of liquid nitrogen to freeze rubber chips prior to size reduction. Most rubber becomes brittle or "glass-like" at temperatures below minus 80°C. Typically, the size of the feed material is around 1 to 5 mm chips derived by ambient grinding from end-of-life tyres. This process can be used to produce fine micronized rubber powder ranging from 40 mesh size (420 microns) to 200 mesh size (74 microns).

Why micronized rubber is used in new rubber compound?

- Micronized rubber produced by cryogenic process behaves like reinforcing filler in a rubber compound (no prior de-vulcanization is required). It is easily dispersed in the compound without lump formation and is again cross-linked during vulcanization.
- The high specific surface area of micronized rubber substantially improves mechanical properties of compound unlike when crumb rubber or reclaimed rubber is used.
- Incorporation of micronized rubber does not impair dynamic character (flexibility) of the product.
- Micronized rubber powder price is much lower than virgin rubber and hence improves economics of the compound without sacrificing product performance and reducing carbon footprint.

Usage in tyre and rubber products: Fine rubber powder ranging from 80 mesh size (177 microns) to 120 mesh size (120 microns) can be directly incorporated in new rubber compounds along with virgin rubber without sacrificing end product performance. The micronized rubber powder does not require any de-vulcanization prior to use in new rubber compounds, reducing energy cost, processing time & carbon footprint.

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Usage in other rubber products like – recyclate for thermoplastic elastomers (TPEs) and thermoplastic vulcanizates (TPVs), waterproof roofing membranes, brake pad lining, antivibration mounts, bridge bearing pads, railway rubber products, dock fenders etc.

Other Usage – micronized rubber powder is used in epoxy coatings, acrylic / asphalt sealings for driveways, improve mechanical properties and impact resistance of polypropylene and polyurethane compounds etc.

Typical Particle Size Distribution after Cryogenic Grinding of 5 mm rubber chips

31 %	**<**	**100 µ** (lower than 140 mesh)
41 %	**<**	**125 µ** (lower than 120 mesh)
60 %	**<**	**160 µ** (lower than 100 mesh)
70 %	**<**	**180 µ** (lower than 80 mesh)
76 %	**<**	**200 µ** (lower than 70 mesh)
91 %	**<**	**300 µ** (lower than 50 mesh)
96 %	**<**	**425 µ** (lower than 40 mesh)

Approximate Fractions distribution from output of cryogenic grinding process

Fraction 1 (140 to 200 mesh size)	Less than < 100 µm 31%
Fraction 2 (80 to 120 mesh size)	Less than < 125 µm (120 mesh) 41%
	Less than < 160 µm 60%
	Less than < 180 µm (80 mesh) 68%
Fraction 3 (40 to 70 mesh size)	Less than < 200 µm 76%
	Less than < 300 µm 91%
	Less than < 425 µm (40 mesh) 96%

(It should be noted that reclaimed rubber is made from 20 mesh or 840 micron particle size rubber powder)

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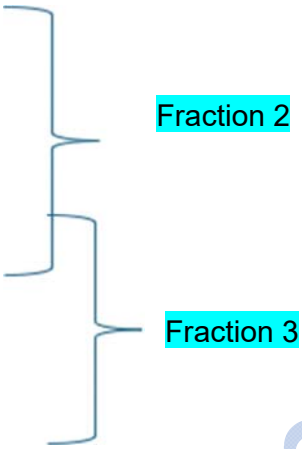
Market Segments

1) **Tyre & Rubber products**

- Automotive tyre
- Off the Road (OTR) tyre
- Agricultural tyre (tractor tyres)
- Solid implement tyres
- Bicycle tyre & tube
- Tyre Retreading Material
- Conveyor belts, Dock Fenders
- Flooring Sheet & Tiles
- Footwear and shoe soles



2) Brake pad lining (Fraction 1 & 2)
3) Water-proof roofing membranes (Fraction 2 & 3)
4) Paint primers & coatings (Fraction 1 & 2)
5) Epoxy coatings, acrylic / asphalt sealings for driveways (Fraction 2 & 3)
6) Thermoplastic elastomers (TPEs) – Fraction 3
7) Impact modifier in polypropylene and polyurethane compounds – Fraction 3

What are the advantages of superfine powder in rubber compounds / products

- Cryogenic Micronized Rubber can be directly added to virgin rubber compound (without any further processing)
- Cryogenic Micronized Rubber does not need to be de-vulcanized like reclaimed rubber (reducing energy, processing cost and time)
- Due to its low particle size & high specific surface area Cryogenic Micronized Rubber behaves like a reinforcing filler in rubber compound.
- Cryogenic Micronized Rubber improves mechanical properties and dynamic properties (flexibility) of the end-product.
- Cryogenic Micronized Rubber is easily dispersed in the compound without lump formation and is again cross-linked during vulcanization.
- Cryogenic Micronized Rubber price is lower than virgin rubber and hence it improves economics of end product without sacrificing product performance
- Cryogenic Micronized Rubber reduces carbon footprint / processing cost / energy cost & will help to meet company EPR targets

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Indicative Project Cost

Plant & Machinery	~ 1.50 million euro
Land	~ 3,000 to 4,000 sq. meters
Building	~ 15 m X 15 m (3 floor levels)

LN_2 tanks with safety measures & parking bays for tanker trucks

Utilities, Factory support infrastructure, Testing & Quality Control Laboratory

Total connected power around ~ 150 kW

Indicative production output 600 to 900 kg per hour (average ~ 750 kg / hr)

Annual output (750 X 24 hrs. X 300 days) = 5,400 metric tons

Input raw material – 2 mm to 5 mm chips free of steel & fiber from end-of-life tyres or other waste rubber products

As a first step we can prepare a Techno Economic Project Feasibility Study that will provide a realistic picture and help you to take an informed business decision, approach banks for project finance and government departments for statutory approvals. Typical contents of the project feasibility report are given below.

1.0 End-of-life tyre recycling- different processes and end applications
2.0 Why micronized rubber powder provides the best results?
3.0 Suggested production volume & project parameters
4.0 Production process & technology
5.0 Production flow diagram
6.0 Main plant & machinery with basic specifications and indicative price
7.0 Utilities & Support facility with basic specifications and indicative price
8.0 Quality Control & Testing Lab with indicative prices
9.0 Estimated Project Cost
10.0 Manpower requirement & cost
11.0 Estimated Product Cost (raw material, additives, production, overheads)
12.0 Estimated Turnover, Profitability & Project Payback Period
13.0 Working Capital requirement
14.0 Factory Layout
15.0 Product guiding specifications & test standards
15.1 Product pricing vis-à-vis reclaimed rubber & recycled rubber granulate
15.2 Advantages vis-à-vis reclaimed rubber & recycled rubber granulate

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15.3 Key market segments and end applications

16.0 Global Market Scenario

16.1 Present production & consumption, main players

16.2 Market potential and growth prospects

One you decide to go ahead with the project we can provide complete assistance for the project implementation i.e. selection and sourcing of plant & machinery, plant layout and factory design, selection & sourcing of utilities and support equipment, recruiting technical manpower, commissioning of plant, sourcing of additives, process know-how, quality control and testing systems, product technical qualification, target market segments, end application know-how, market intelligence, REACH compliance

Best regards,

Dr. Anomitra Chakravarty
KPS Consultants & Impex Pvt. Ltd.
812 Devika Tower, 6 Nehru Place, New Delhi - 110019, India
(M): +91 98993 59661 , (T) : +91-11 4161 6899
(e) : kpspltd@gmail.com anomitra@kpsimpex.com (w) : www.kpsimpex.com
www.linkedin.com/in/anomitra-chakravarty-5a4b1414