

**Biosilico®**

Bio-based Silica/Nano Silica  
for the Rubber Industry

Multifunctional additives & Reinforcing fillers

Better products. Better prices. Better life.





# About BSB Nanotech

Biosilico is the world's first commercially produced bio-based amorphous silica manufactured with the highest degree of purity and synthesized for a wide range of applications. Manufactured by BSB Nanotech in Vietnam, this silica is derived from Rice Husk (RH), a common agricultural waste in rice producing countries in Asia. The production of Biosilico offers strong environmental, technical and commercial advantages in comparison with conventional methods of producing silica from sand & quartz.

The vision of BSB Nanotech is to become a global producer and developer of premium industrial applications of RH silica and Nanosilica.

## Key Milestones

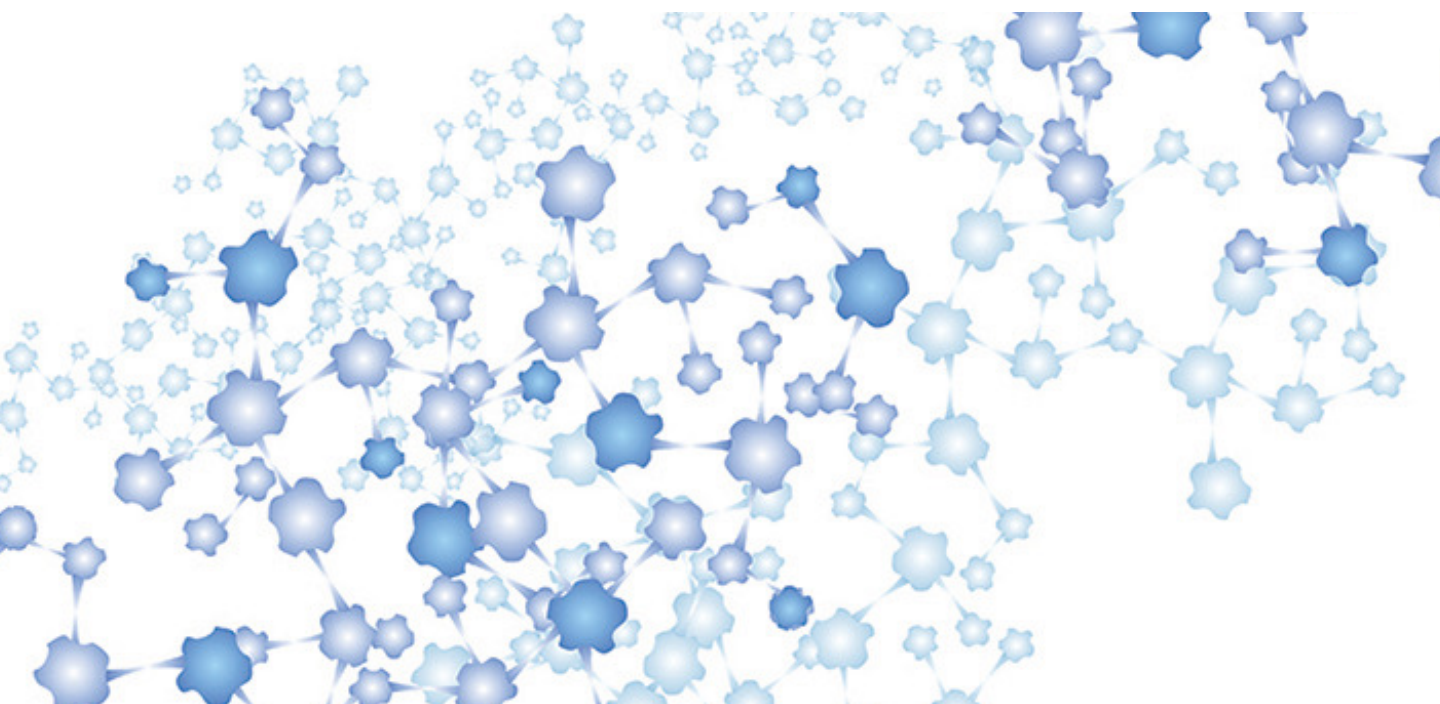
- April 2017: Investment License in Saigon Hi-Tech Park
- November 2018: Pilot Plant Completion
- December 2018: First Commercial Order
- February 2018: Nano Lab Completion
- March 2020: Plant Upgrade Completion
- Name change from BSB Development & Investment Co. Ltd to BSB Nanotechnology Joint Stock Company

## Senior Management Team

- Hung Nguyen Viet, PhD, Founder & CEO
- Christopher Do, Chief Commercial Officer & Director







## Bio-based Silica



**Nanosilica or Silicon Dioxide** ( $\text{SiO}_2$ ) is a marriage between nanotechnology and one of the most widely used and manufactured materials, silica.

**Silica** in its nano size has a range of advantages: large specific surface area and energy, strong surface absorption, high chemical purity and good dispersion. Due to its unique properties, Nanosilica has established roles in the fields of physics, chemistry and biology.

**Nanosilica** is applicable to a large and diverse range of industries, from construction to rubber and plastic additives, paints and coatings, medicine and cosmetics, and more. Nanosilica is a ubiquitous constituent in materials which are a part of our daily life.





# The Bio-based Silica Production Pioneer

**Asian countries** are predominantly rice producers with Vietnam being one of the top five in the world. The extraction of silica from this renewable resource has been endeavored by many scientists and researchers.

**Leading** this scientific race, BSB Nanotech is the first company to successfully produce rice husk based nanoporous silica on a commercial scale in the world.

**Strategically** located along the waterways of the Mekong Delta in Vietnam, BSB Nanotech has brought together the abundant access to rice husk, state-of-the-art technologies and skilled professionals to develop a cost effective nanoporous silica in its purest form.

**After four years** of extensive research, Biosilico was formulated to perfection, harnessing the highest amorphous silica content from rice husk and customised for various applications.







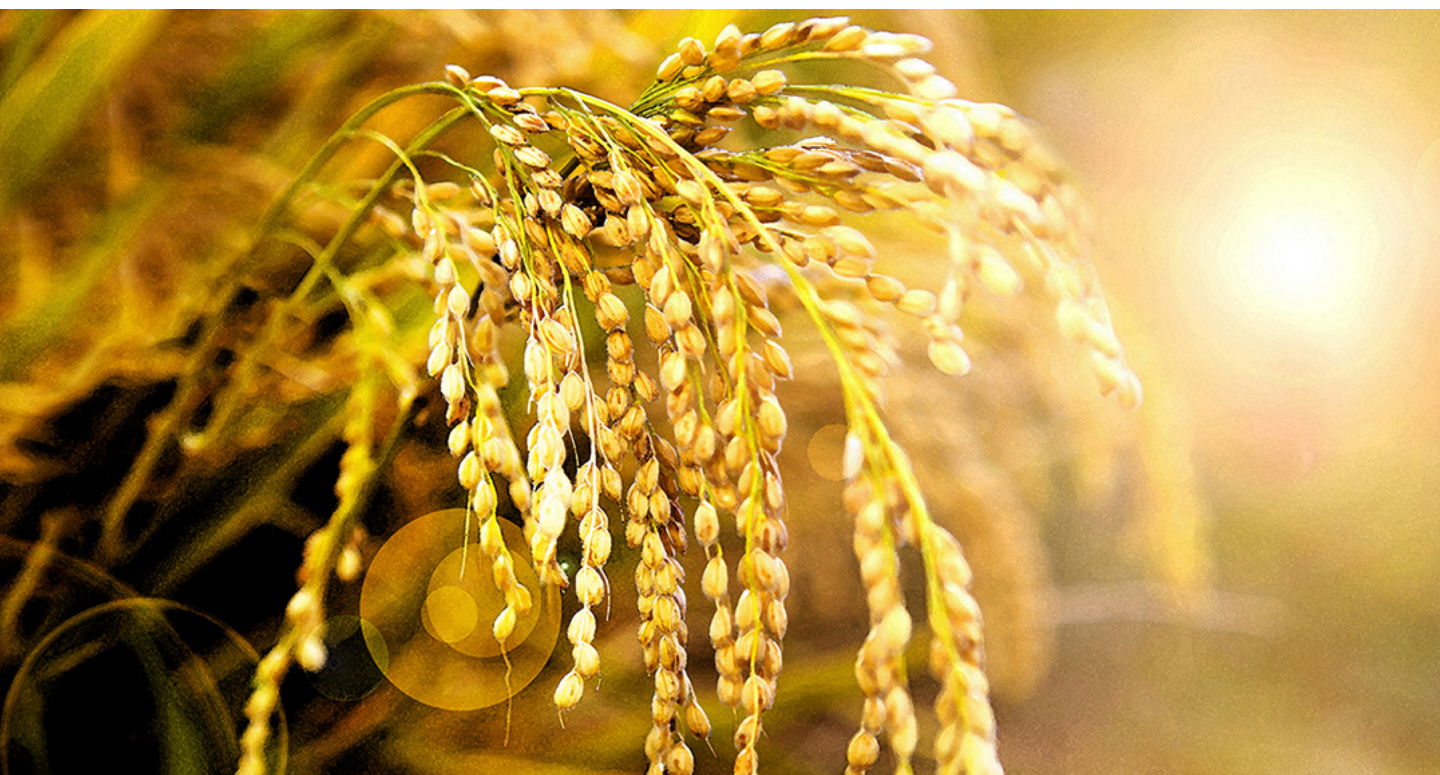
# Reinforcing Fillers in Rubber Application

**Silica has long been used as reinforcing fillers** in the rubber industry especially in the production of automobile tires, conveyor belts, gloves, shoes, hoses, just to name a few.

**Silica is shown to improve rheological properties and mechanical properties** of rubber compound in many different aspects. The four main factors that influence effectiveness of fillers are namely particle size, particle surface area, particle shape and particle surface activity. Therefore, particles of Nano Silica have larger surface area due to their smaller size within the 1-100 nm range and it can be surface modified to further change its role in rubber as a filler.

**The addition of Silica nanoparticles results in a homogenous mixture within the Natural Rubber matrix forming a stable filler-rubber composite.** Nano silica introduction in Natural Rubber improves its tensile strength, modulus and tear strength, abrasion resistance and hardness among many others. When used in polymer nanocomposite, Nano Silica migrates to surface at elevated temperatures and therefore providing better thermal ageing resistance to the rubber-filler composite.





## BIOSILICO vs Conventional Silica

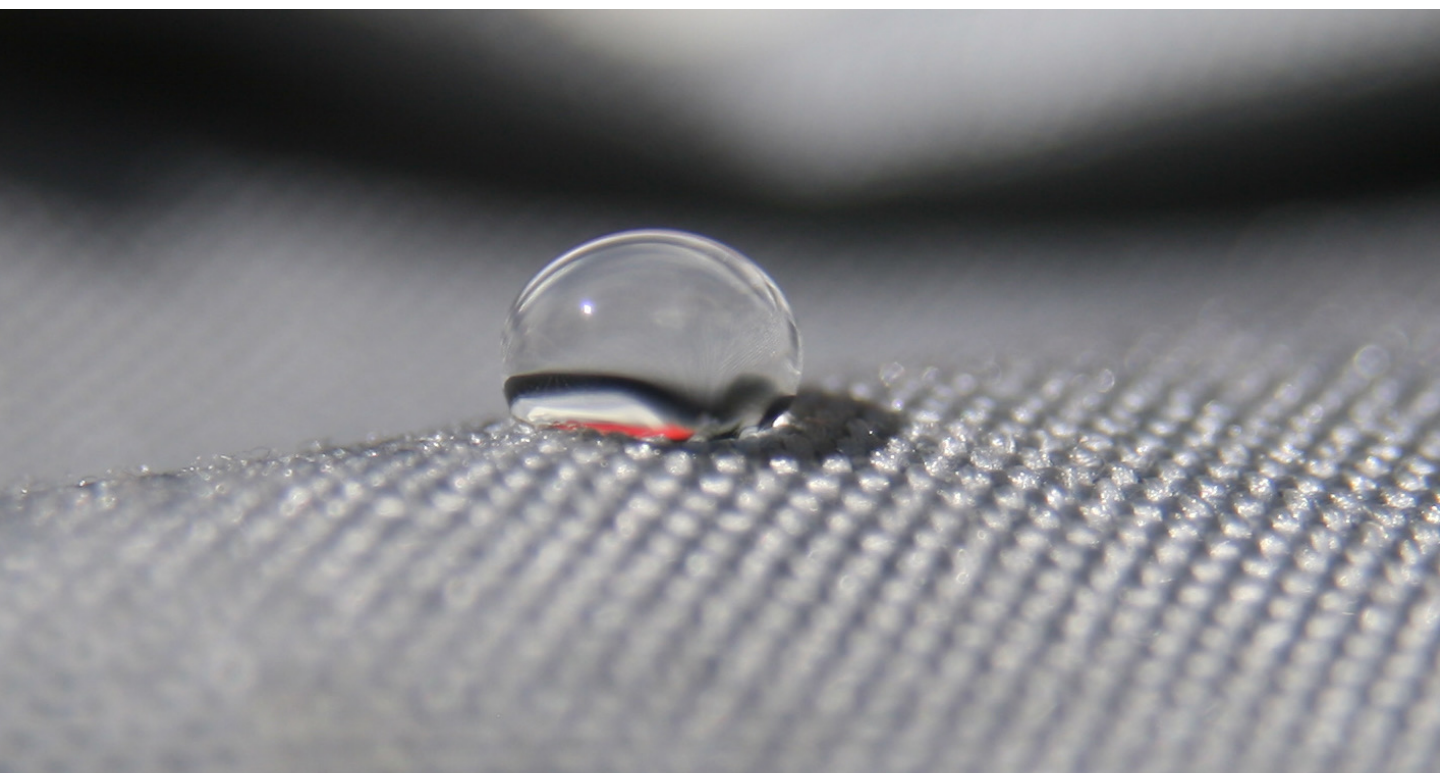
**Particle size** is inversely related to surface area, and both are important factors that determine the effectiveness of a filler. Essentially the smaller the particle size, the higher the effective surface area that the particles can cover which in turn leads to better reinforcing capabilities within the rubber matrix. **Truly reinforcing fillers range from sizes of 10 nm to 100 nm** and is able to significantly improve rubber properties.

Studies have shown that **surface area** of rice-husk based Nano Silica is found to be 252 m<sup>2</sup>/g, which is significantly better than conventional silica. However, this is not a fixed value as different methods in production can produce better surface area coverage by the Silica nanoparticles. Higher purity of silica within the husk also results in better overall mechanical properties.

Biosilico products are available in the range of **150 to 600 m<sup>2</sup>/g, a bigger and broader coverage** without compromising the strength and quality as well as providing with the highest purity percentage of silica. Besides hydrophilic silica, Biosil is also available in hydrophobic and superhydrophobic form, offering a new range of multifunctional properties for rubber applications.







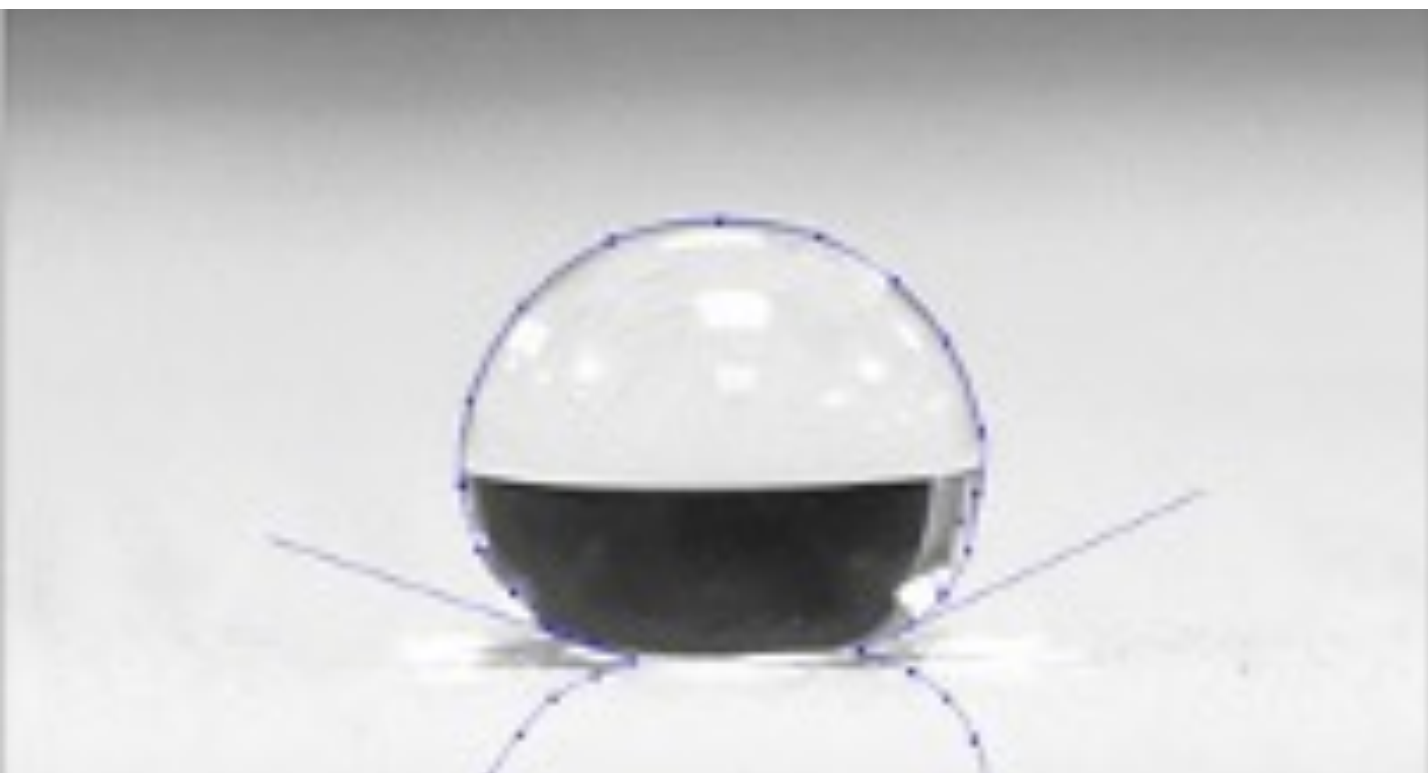
# Hydrophobic Silica for Rubber

The most commonly used application of hydrophobic Silica is in **Silicone Rubber** applications especially in **outdoor insulators** and long-distance power transmission. Hydrophobicity plays an important role in these **high voltage insulators** and the major drawbacks from using Silicone Rubber material with low hydrophobicity is the potential increase in leakage current activity, reduction in electrical insulation, formation of contaminant layer on the outdoor insulator due to humidity and accelerated ageing of the insulator.

The introduction of hydrophobic Silica as a filler provides an array of benefits for these high voltage insulators including but not limited to:

- **Homogeneous dispersion** in the rubber matrix and better optical properties
- **Improved processability** of rubber/silica composites
- **Non-wetting surface** properties (hydrophobic/oleophilic)
- **Enhanced surface appearance** of final products
- **Superior mechanical properties** in terms of tensile & tear strength, modulus, hardness, durability and many more
- **Self-cleaning properties** which negate the formation of contaminant layer on the outdoor insulator





## Superhydrophobic Silica for Rubber

Superhydrophobic material also exhibits water repellent properties like its hydrophobic version but with a Water contact angle of  $> 150^\circ$  on its surface. Superhydrophobic Silica is widely used in Silicone Rubber outdoor insulators and even **as spray coatings on rubber gloves** to induce the superhydrophobic characteristics on its surface. Water droplets can bounce off these superhydrophobic coated gloves which can eventually delay the transmission of pathogens.

It is noteworthy that Silicone Rubber although having hydrophobicity, its addition tends to produce inferior mechanical properties in the product. Hence, the introduction of silica as a filler can combat this reduction in mechanical property whilst providing a nanostructured hydrophobic surface on the Silicone rubber. The benefits of Superhydrophobic Silica in Rubber applications:

- **Provides self-cleaning capacity and antimicrobial properties** to the surface of finished product
- **Anti-corrosion, Anti-fouling and Anti-fogging**
- **Non-wetting on surface** – even if product is immersed in water
- **Delayed icing characteristics** – Icephobic surface properties
- **Superior mechanical properties** in terms of tensile & tear strength, modulus, hardness, durability and many more







## Typical Applications & Benefits

### **Silicone Rubber Products**

- Overall improvement in mechanical properties
- Prevents micro-agglomeration in SiO<sub>2</sub> particles

### **EPDM Rubber Products**

- Increased modulus up to 135%
- Better tensile strength over conventional silica by up to 398%
- Enhanced dynamic mechanical thermal analysis

### **Tires**

- Improves tensile strength, abrasion/tear resistance
- Improved processability and better hardness
- Better rolling resistance in the tires, which leads to efficient fuel consumption

### **Rubber gloves**

- Produce superhydrophobic or “dry” gloves that repel any liquid droplets on its surface
- Antimicrobial gloves that can prevent pathogens from spreading

### **Footwear**

- Improve wear and tear resistance in shoe soles
- Produce water-proof and slip-resistant shoe soles
- Provides superior durability, resilience and modulus

### **Industrial Rubber Products**

- Enhanced heat build-up resistance, wear resistance and abrasion
- Increase in stiffness and reinforcing strength
- Increased tensile strength and modulus by over 300%



PR00.0299

Multifunctional Additives for Rubber

**PR00.0299** is a bio-based hydrophilic silica powder, synthesized from Rice Husk, used as Multifunctional Additives for Rubber products.

Offers Multi-functional Benefits

- High reinforcing filler effect
- Increased stiffness and reinforcing strength
- Better tensive strength, tear & abrasion resistance
- Suitable for anti-settling agent formulation
- Good incorporation in different solutions
- Improved process-ability
- Enhanced resistance to heat build-up
- Extended product life in high-temperature environments.

General Properties

PROPERTIES	UNIT	SPECIFICATION
State		Amorphous – Micron powder
Appearance		White
Loss on Drying (2h in 105 °C)	%	Max 8.0
Bulk density	g/cm <sup>3</sup>	0.02 – 0.07

Specifications

PROPERTIES	UNIT	SPECIFICATION
Particle size (D50)	µm	3.0 – 10.0
Surface area	m <sup>2</sup> /g	150 – 350

Product Information



Packaging

Product is supplied in 9-kg paper bag.

Storage and Handling

- Store in dry place and handle sensibly to minimize dust generation.
- This product should be used within 12 months from production date.

Safety Data

Warning

- Product together with air may develop ignitable and explosive mixtures.
- Keep away from ignition source.
- Drying and abrasive properties may cause skin, eye or respiratory irritation.
- Avoid inhalation or prolonged contact with skin.
- If dusty conditions prevail, use gloves and adequate respirator.
- Dispose of in accordance with state and local requirement.
- See MSDS for more information.

First Aid

- Follow the rules of personal hygiene on dust inhalation and/or eye contact.

After eye contact

- Remove contact lens if have.
- Flush open eyes with large quantity running water for at least 15 minutes.
- Call for medical care if symptoms persist.

After skin contact

- Flush skin with water at least 15 minutes
- Call for medical care if symptoms persist.

After inhalation

- Supply fresh air
- Call for medical care if complaints
- Do CPR if stop breathing.

After swallowing

- Call for medical care
- Do not induce vomiting.





## PR00.0399

### Reinforcing Filler for Rubber

**PR00.0399** is hydrophilic bio-based nano porous silica powder, synthesized from Rice Husk, used as Multifunctional Additives for Plastics & Rubber.

#### Offers Multi-functional Benefits

- High reinforcing filler effect
- Increased stiffness and reinforcing strength
- Better tensile strength, tear & abrasion resistance
- Suitable for anti-settling agent formulation
- Good incorporation in different solutions
- Improved process-ability
- Enhanced resistance to heat build-up
- Extended product life in high-temperature environments.

#### General Properties

PROPERTIES	UNIT	SPECIFICATION
State		Amorphous – Micron powder
Appearance		White
Loss on Drying (2h in 105 °C)	%	Max 8.0
Bulk density	g/cm <sup>3</sup>	0.12 – 0.18

#### Specifications

PROPERTIES	UNIT	SPECIFICATION
Particle size (D50)	µm	20.0 – 35.0
Surface area	m <sup>2</sup> /g	150 – 350

#### Product Information



UNICERT  
ISO 9001



ISO 9001:2015

QMS granted by Universal GmbH



#### Packaging

Product is supplied in 14-kg paper bag.

#### Storage and Handling

- Store in dry place and handle sensibly to minimize dust generation.
- This product should be used within 12 months from production date.

#### Safety Data

##### Warning

- Product together with air may develop ignitable and explosive mixtures.
- Keep away from ignition source.
- Drying and abrasive properties may cause skin, eye or respiratory irritation.
- Avoid inhalation or prolonged contact with skin.
- If dusty conditions prevail, use gloves and adequate respirator.
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##### After inhalation

- Supply fresh air
- Call for medical care if complaints
- Do CPR if stop breathing.

##### After swallowing

- Call for medical care
- Do not induce vomiting.



ARE YOU  
DRIVING  
**CHANGE**

**OR** ARE YOU  
BEING **DRIVEN**  
BY IT

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