

# Products from Specialty Natural Rubber as an Alternative Material to Synthetic Rubber towards application of Naturally Sustainable Resources

<sup>1</sup>Fatimah Rubaizah, M.R., <sup>2</sup>Zameri, M., <sup>3</sup>Siti Salina, S., <sup>4</sup>Nik Intan N.I., <sup>5</sup>Nurul Hayati, Y., <sup>6</sup>Roslim, R., <sup>7</sup>Rohani A.B., <sup>8</sup>Dazylah, D., <sup>9</sup>Manroshan, S., <sup>10</sup>Mohamad Asri, A., and <sup>11</sup>Amir Hashim, M.Y.

<sup>1, 2, 3, 4, 5, 6, 7, 8, 9</sup> Technology and Engineering Division, Malaysian Rubber Board, Malaysia

<sup>10</sup> Quality and Technical Services Division, Malaysian Rubber Board, Malaysia

<sup>11</sup> Directorate Office, Malaysian Rubber Board, Malaysia

Wednesday, 24 June 2020

# TREND OF THE MALAYSIAN RUBBER INDUSTRY

## PRODUCTION

CAGR **-2.7%**  
**2018: 603,329**  
 tonnes  
**1990: 1,291,499**  
 tonnes

## PRODUCTIVITY

CAGR **+1.4%**  
**2018: 1,420e**  
 kg/ha/yr  
**1990: 967**  
 kg/ha/yr

## PLANTED AREA

CAGR **-1.4%**  
**2018: 1,009.53**  
 '000 hectares  
**1990: 1,488.00**  
 '000 hectares

Smallholding

CAGR **-5.4%**  
**2018: 73.46**  
 '000 hectares  
**1990: 348.70**  
 '000 hectares

Estate

### UPSTREAM

## Imports of NR (dependency on foreign rawmaterial)

**136,220**  
 tonnes  
 1990  
**1,082,700**  
 tonnes  
 2019

## Exports of NR

**1,321,778**  
 tonnes  
 1990  
**1,033,712**  
 tonnes  
 2019

## EXPORT CONTRIBUTION TO RUBBER INDUSTRY

1990 **65%** ↓ **19%** 2018

### MIDSTREAM

## Exports of Rubber Products

1990: RM 1.44B 2019: **RM 23.34 B**

CAGR **+10.1%**

## Rubber Consumption

1990: **36,290**  
 tonnes

2018: **986,043**  
 tonnes

CAGR **+6.1%**



## Employment

1990: **36,290**

2018: **77,353**

CAGR **+2.7%**

## Export Contribution to Rubber Industry

1990 **34%** ↑ **75%** 2018

### DOWNSTREAM

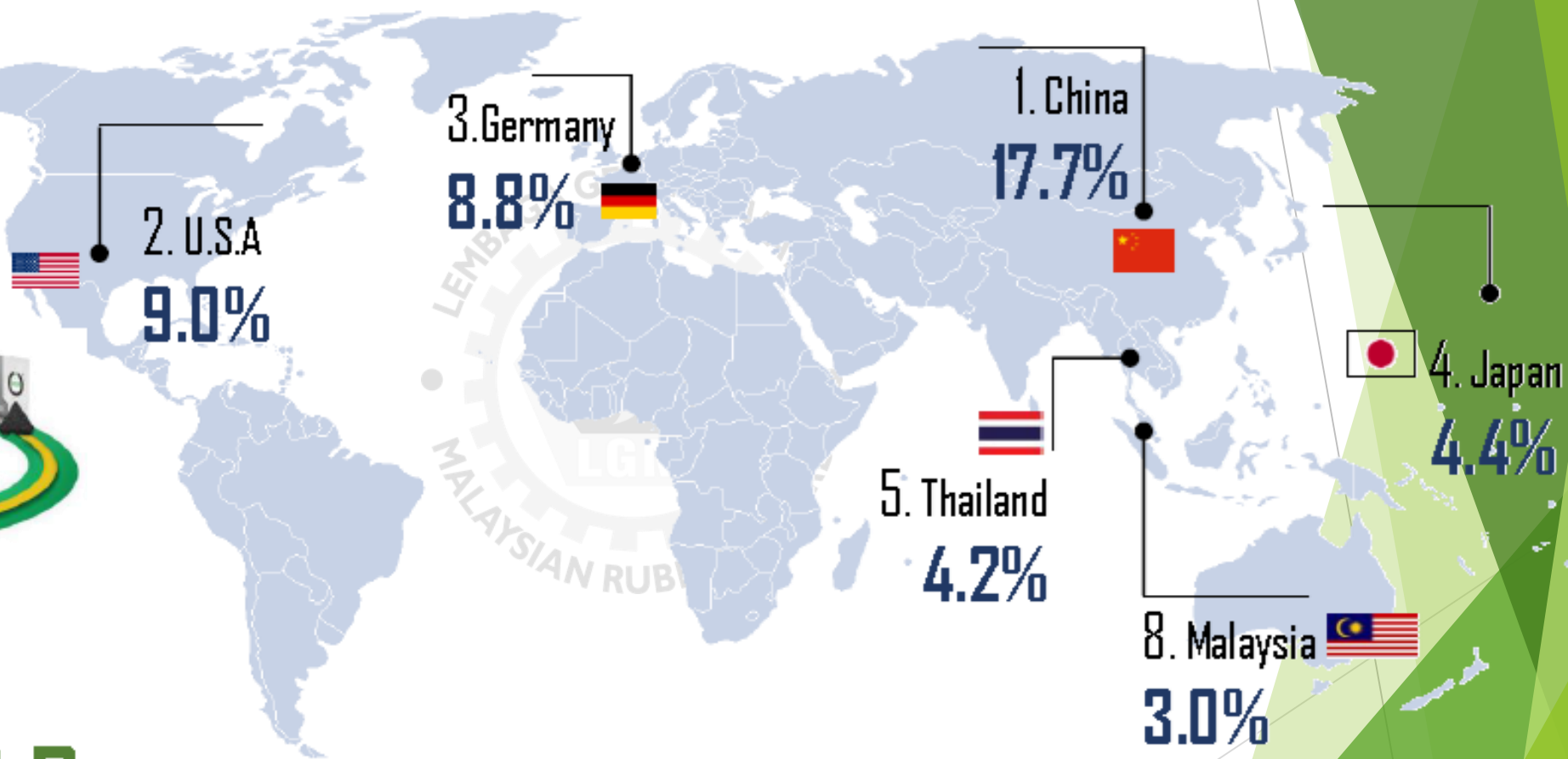
# WORLD MARKET VALUE OF RUBBER PRODUCTS 2018



Market value

**RM 841.56 B**

Source: International Trade Center




Rubber Gloves  
**74.9%**

New Tyre  
**5.3%**

Tubes, Pipes and Hoses  
**4.1%**

Latex thread  
**2.5%**

# SUSTAINABILITY OF MALAYSIAN RUBBER INDUSTRY

- 
- ❑ The Malaysian **upstream sector** can be considered as environmentally sustainable with features as listed below;
    - NR is derived from renewable resources as compared to synthetic rubber
    - Rubber trees is the source for carbon sequestration (139-319 tonnes per ha for one cycle)
    - No issues on deforestation and habitat/biodiversity destruction (Replanting basis)
    - The main challenge is to project these features into a more transparent manner through a proper traceability system

❑ The Malaysian rubber **midstream sector** is not having much problem in complying with Environmental Quality (Prescribed Premises)(Raw Natural Rubber) Regulations 1978 –thus is an assurance that the effluents discharge from this sector is within the legal limit without adverse effects to the environment

❑ The Malaysian **rubber downstream** sector is also not having much problem in complying with Environmental Quality Act with regards to Industrial Effluent 2009 and Schedule Waste Regulations 2005 as the factories are normally equip with more modern technology as compared to the rubber midstream factories.

- Natural rubber is used extensively in many applications and products, either alone or in combination with other materials. It has excellent physical properties as a general purpose elastomer. However natural rubber have several **disadvantages (i.e. oil resistance)**.
- **To overcome the disadvantages, NR was further modified. This is widen its applications in NR applications**

# MODIFICATION OF NATURAL RUBBER

Field Latex

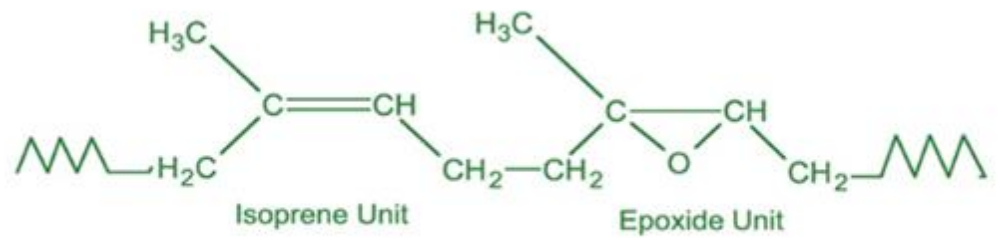
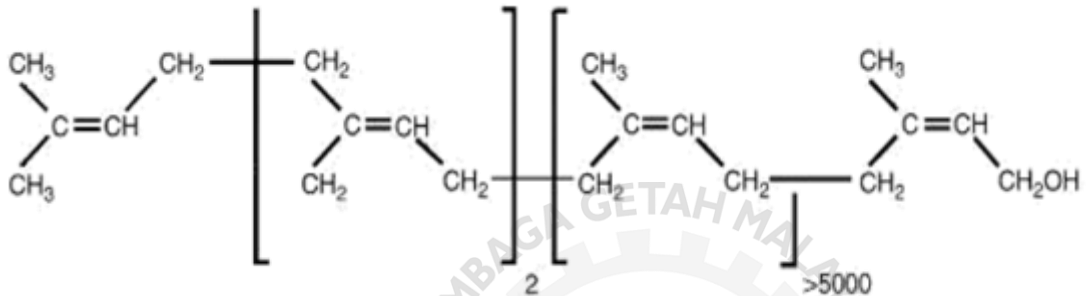
Modification of Natural Rubber

Physical

Deproteinised Natural Rubber

Chemical

Epoxidised Natural Rubber



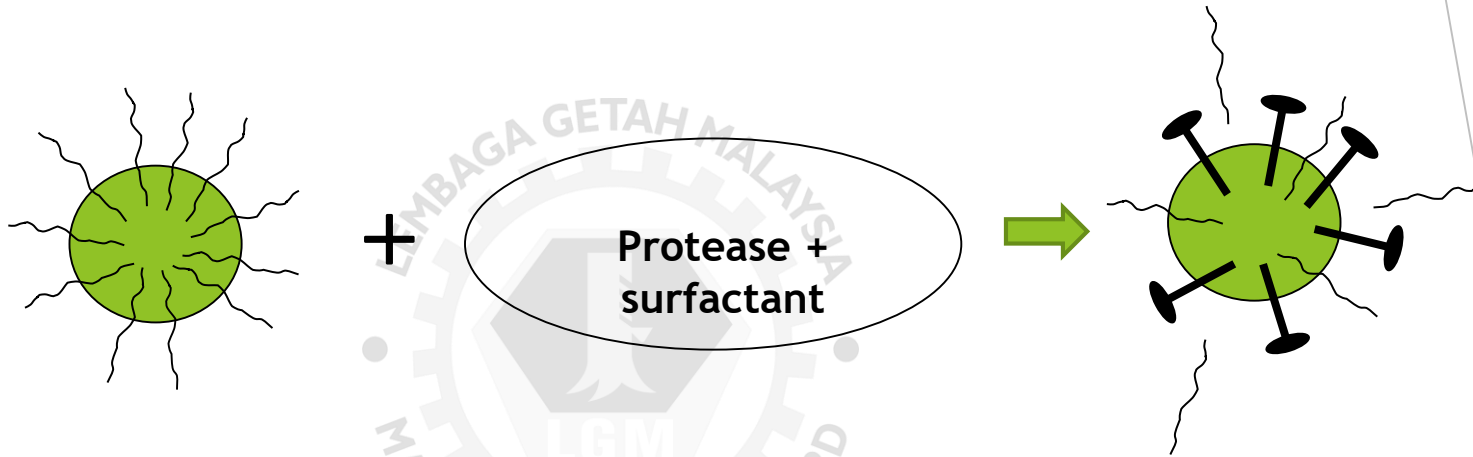
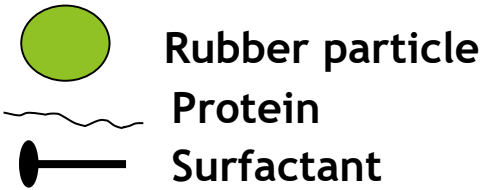
Chemical structure of EKOPRENA<sup>®</sup>



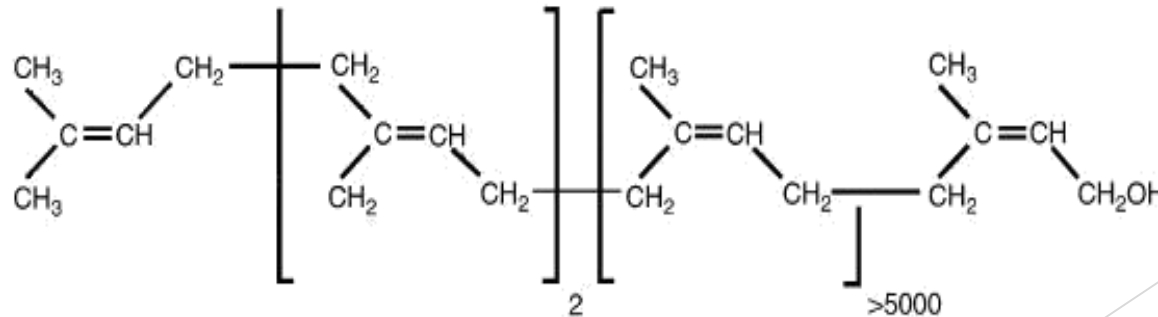


# Pureprena<sup>®</sup>

Eco-Efficient Rubber for Advanced Engineering Applications

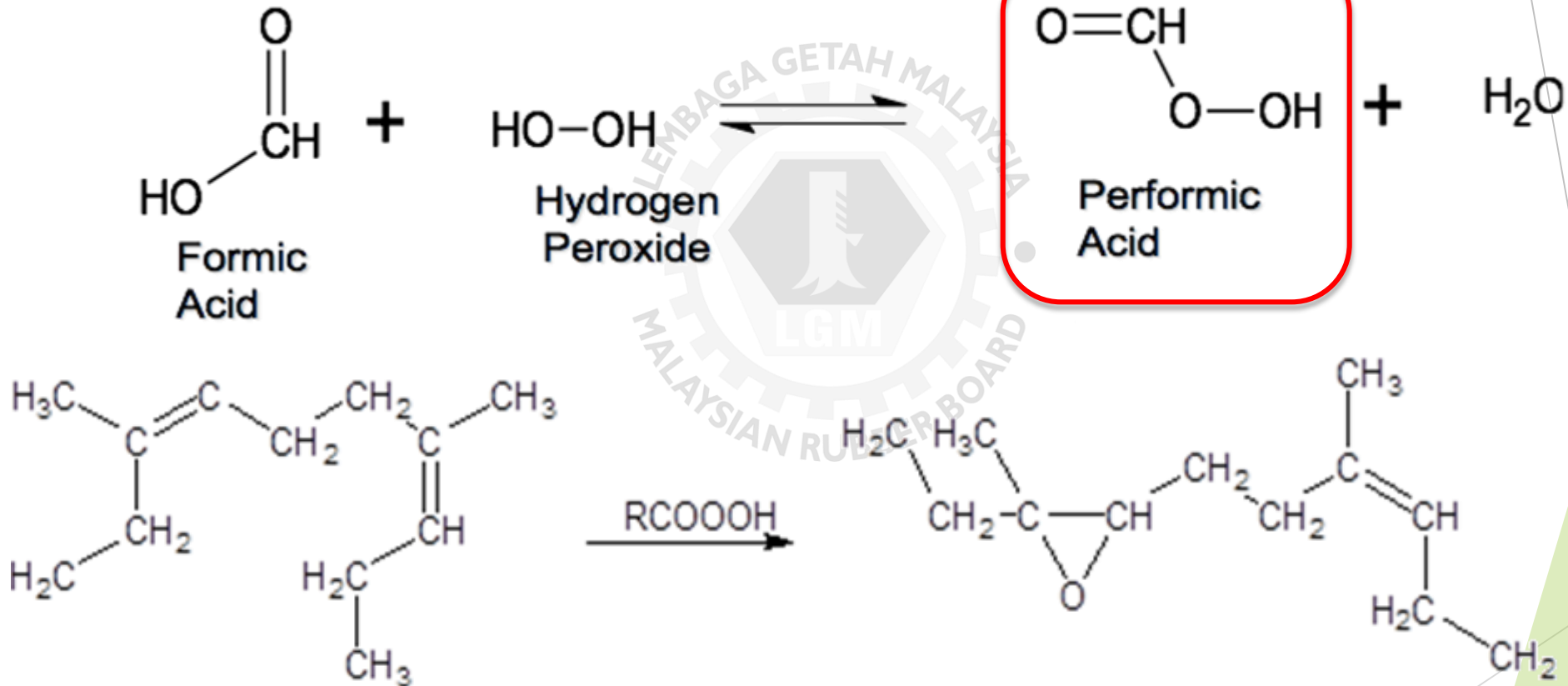


- Digestion of protein by protease during enzymatic reaction
- Replacement of protein with surfactants to stabilize latex particles



Purified Natural Rubber

# EPOXIDATION REACTION MECHANISM



Epoxidation reduces the level of **unsaturation** of natural rubber according to the extent of epoxidation during reaction







Two laboratory images showing latex processing. The left image shows a person in blue gloves pouring a white, milky latex liquid from a glass beaker into a clear glass dish. The right image shows a person in blue gloves pouring a thick, orange-brown latex concentrate from a glass beaker into a clear glass dish. In the background, a faint watermark of the "LEMBAGA GETAH MALAYSIA" logo is visible.



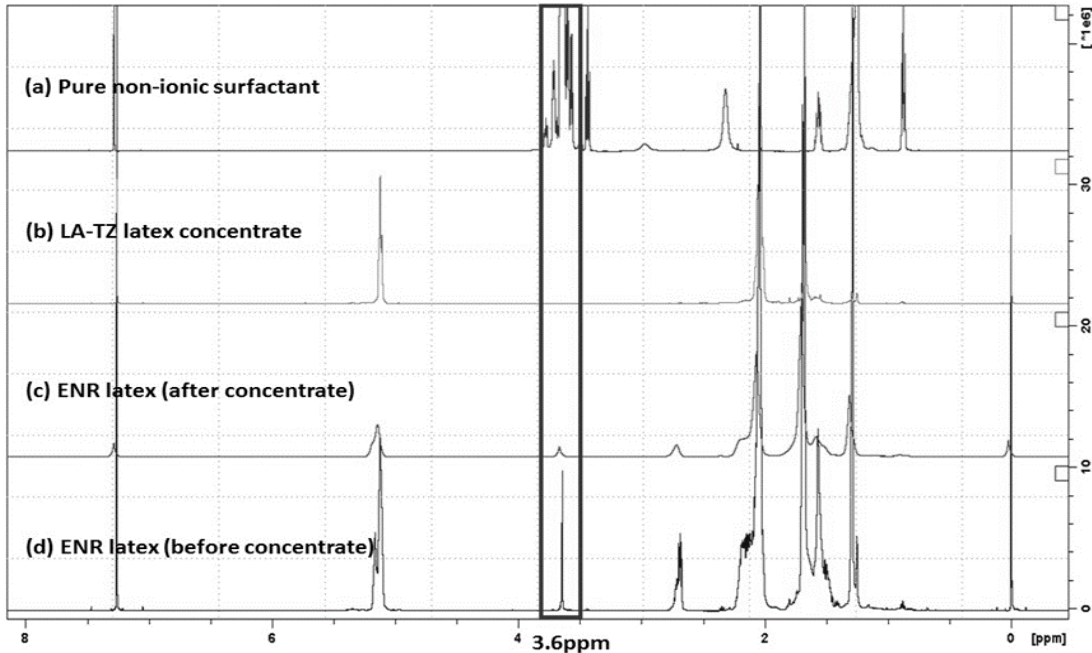
**KOPRENA**

**Pureprena**

**Latex & Latex Concentrate**

**LIQUID EPOXIDISED  
NATURAL RUBBER**

# MEMBRANE CONCENTRATION PROCESS



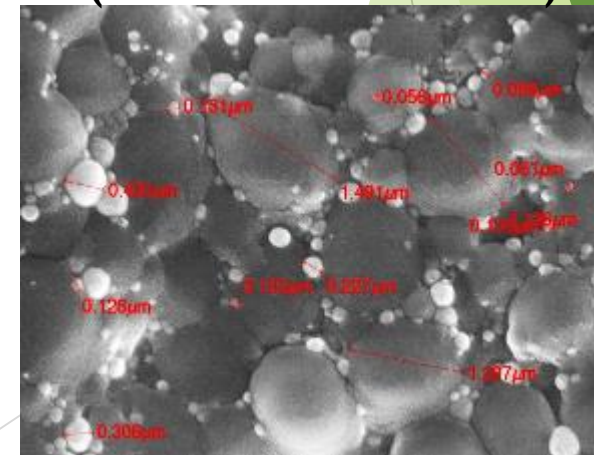
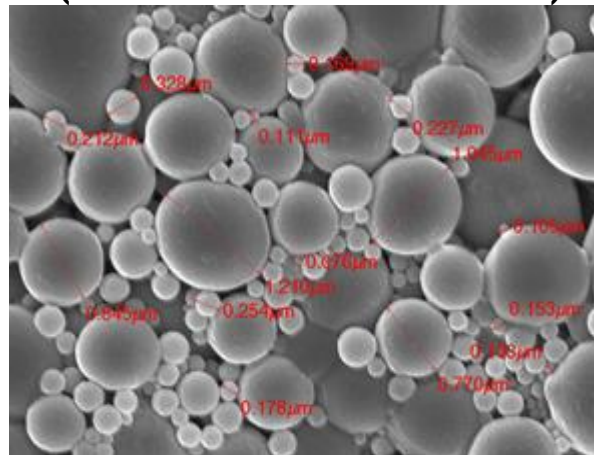
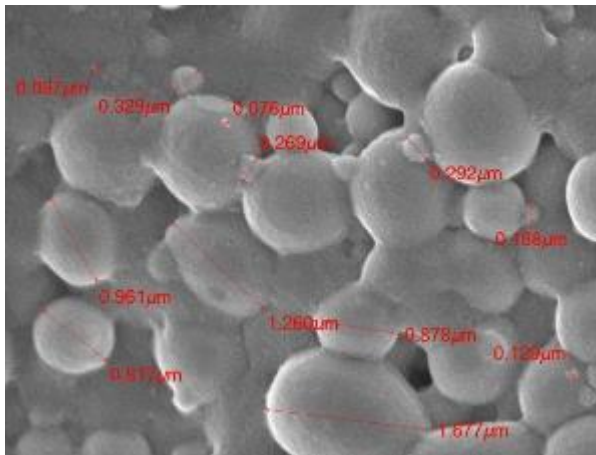
LATZ latex

Latex Properties	ENR Latex (before concentration)	ENR Latex (after concentration)
Dry rubber content (DRC)	35.7%	60.4%
Total Solid content (TSC)	36.4%	62.9%
Alkalinity (%)	0.11%	0.14%

ENR Latex (before concentration)

ENR Latex (after concentration)

## Morphology



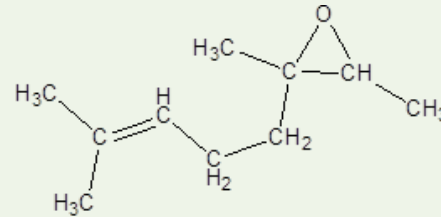
# PROPERTIES OF LIQUID EPOXIDIZED NATURAL RUBBER



Full name : Liquid epoxidized natural rubber

Abbreviation: LENR

Chemical structure:



## Physical and chemical properties

Colour Light to dark brown

Appearance Soft, sticky, flow at above 70 °C

Solubility ±95 % in solvent, i.e. toluene, chloroform, tetrahydrofuran

Average number molecular weight,  $M_n$  10 000 g/mol ± 5000

Average weight molecular weight,  $M_w$  30 000 g/mol ± 7000

Gel content <5 w/w% (low gel content)

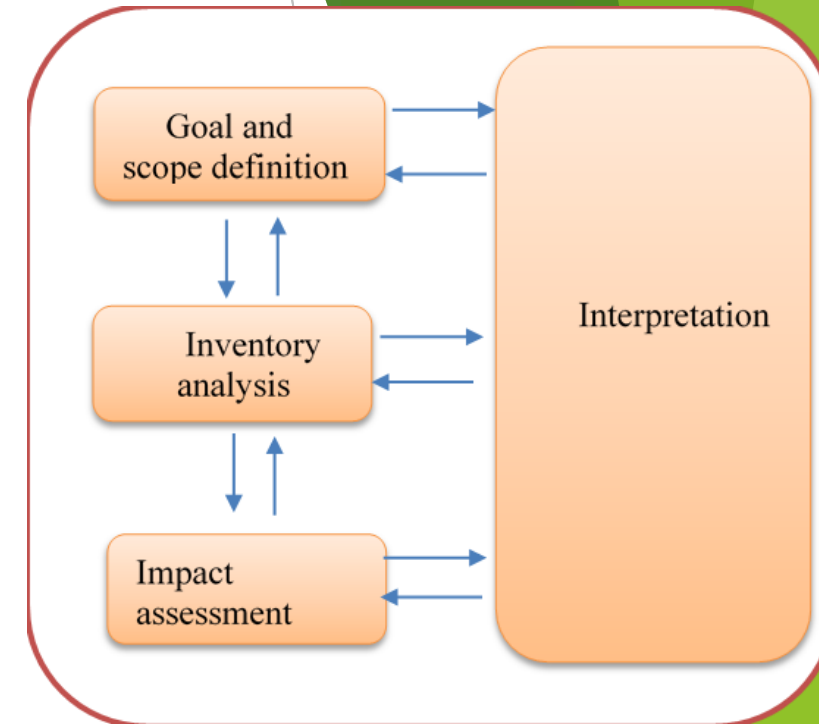
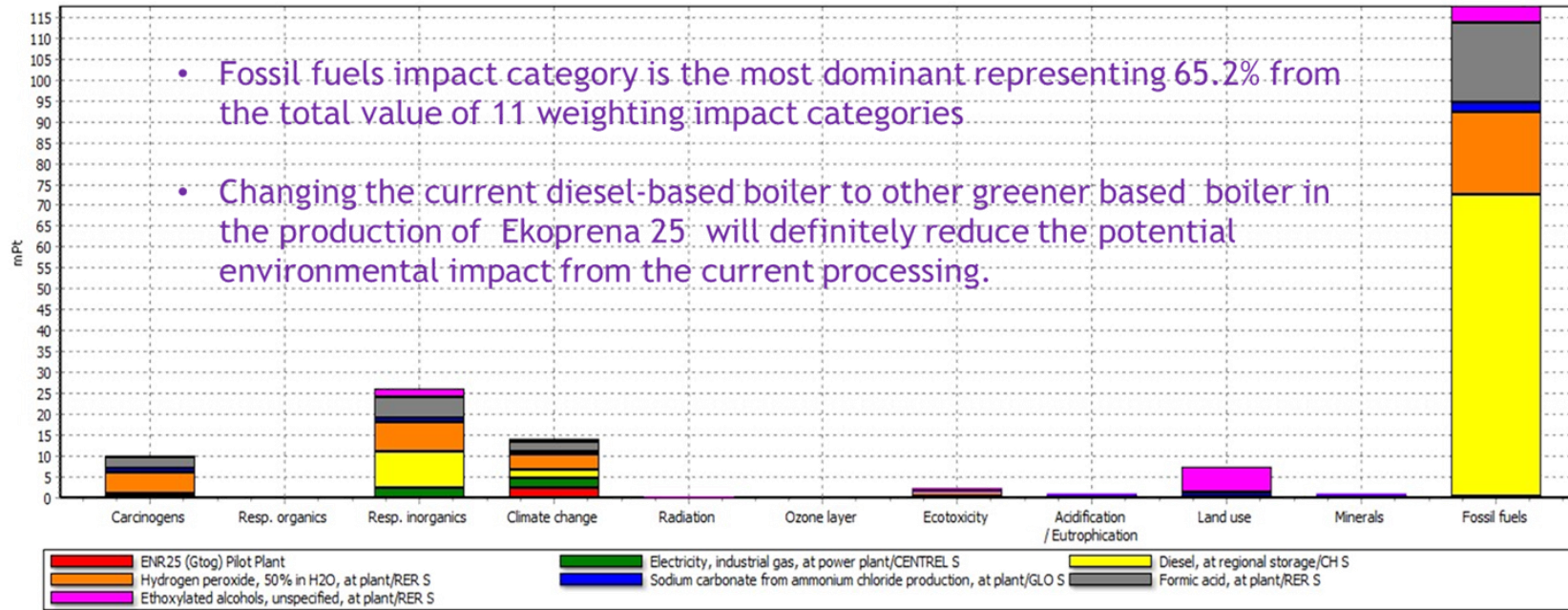
Glass transition temperature -20 °C ± 1

Epoxidation level 50 mol% ± 5

Shelf life 2 year

# LCA METHODOLOGY AS A SUSTAINABILITY TOOL IN THE CONTEXT OF SPECIALTY NR

## LCA STUDY FOR THE EKOPRENA 25 PRODUCTION AT MRB PILOT PLANT (GATE TO GATE BOUNDARY)

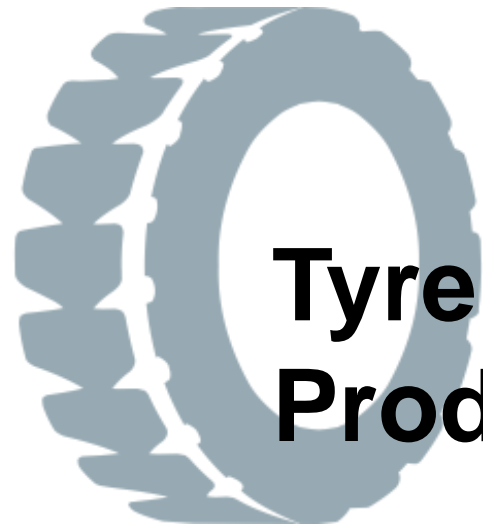


Analyzing 1 kg 'ENR25 (Gtrog) Pilot Plant';  
Method: Eco-indicator 99 (H) V2.08 / Europe EI 99 H/A / Weighting

► Life Cycle Assessment (LCA): the process of compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product throughout its life cycle (ISO 14040, 2006). Can be applied towards;

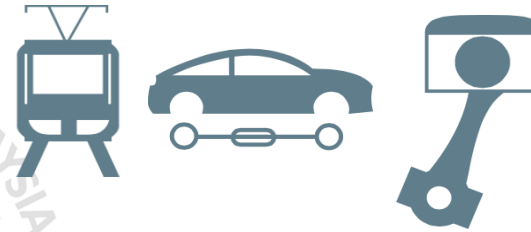
- Product sustainability improvement
- Marketing
- Eligibility for GGP (MyHIJAU Mark)

# APPLICATIONS

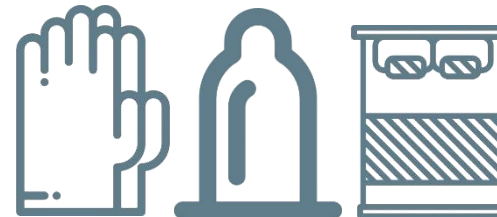


**Tyre  
Products**

**Non-Tyre  
Products**



**Latex  
Products**



# Tyre Products

**1** Commercial Tyre (Retread) : Bus & Truck

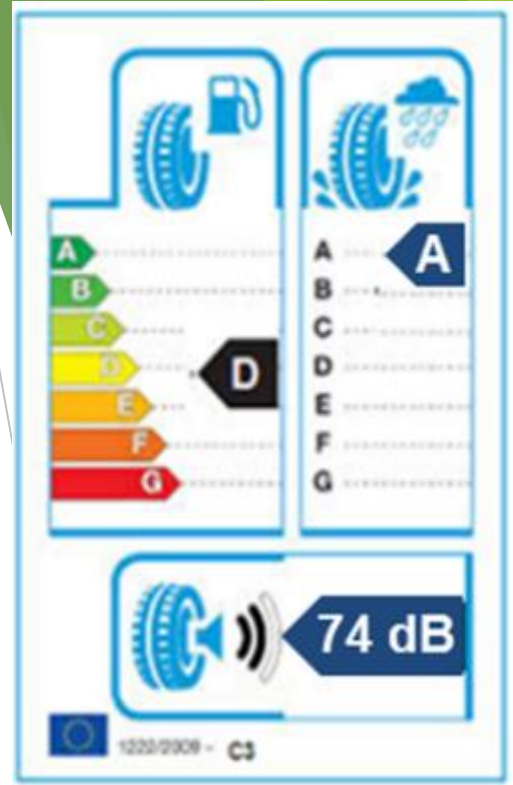
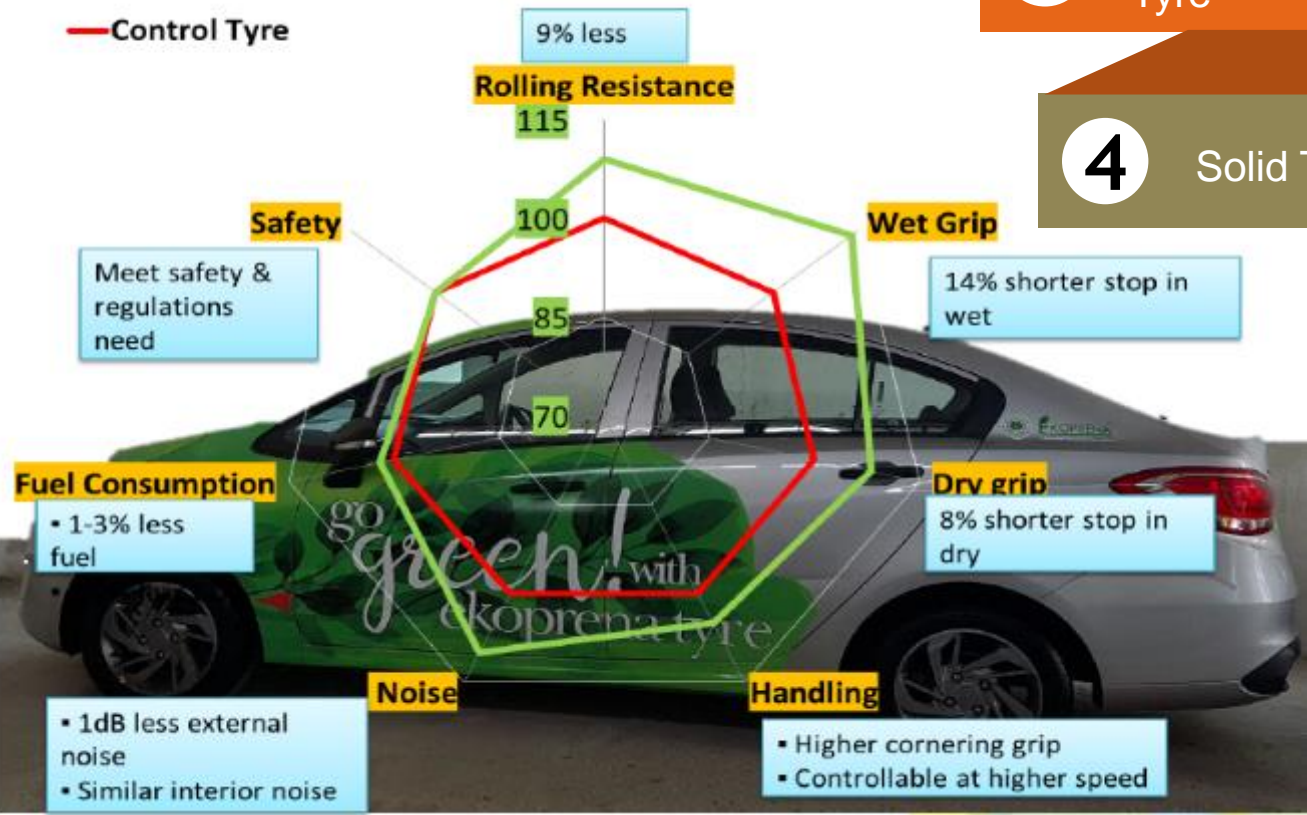
**2** Passenger Car Tyre

**3** Motorcycle Tyre

**4** Solid Tyre

More distance travel, Improved Fuel Efficiency and excellent grip

Control Tyre



# ANTISTATIC SHOE



## Features

- Specialty rubber based
- Excellent and highly consistent antistatic property (conductivity  $\leq 10^{-7}$  S/cm)
- High damping i.e. better wearing comfort
- Excellent abrasion ( $<150$  mm<sup>3</sup>) i.e. high wearing resistance
- Non-staining or marking i.e. oil-free / DOP (dioctyl phthalate)- free and natural colour of rubber
- High chemical and oil resistance property ( $<12$  % volume swelling)
- Practical to produce (via conventional thermal-mechanical mixing and compression moulding).
- Meet the international market requirement: Standard BS EN ISO 20345:2004

# MARCHING BOOTS



# SAFETY BOOTS



## ADVANTAGES

- Good damping property
- Improved Skid Resistance
- Oil Resistance
- Good abrasion resistance

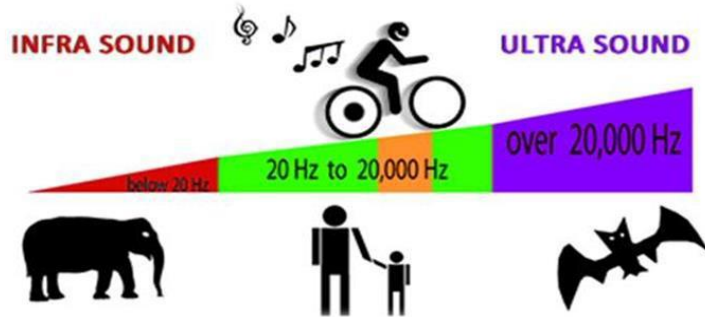
Non-Tyre  
Products





# GREEN RUBBER SOUND INSULATOR

Sound insulator acts as a sound wave barrier - an appropriate strategy for controlling noise



Human sound range : 500Hz - 4000Hz



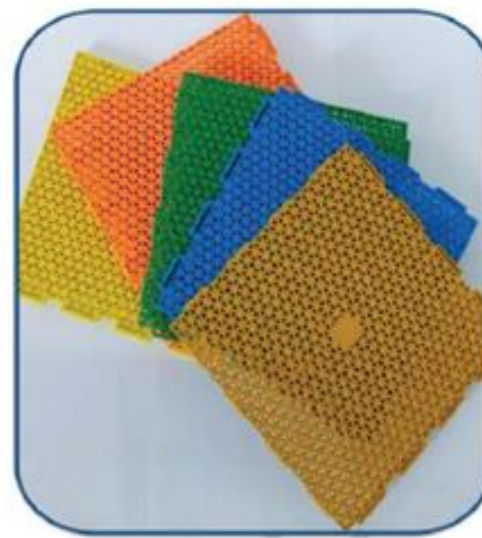
TEST	TEST STANDARD	RESULT
Heat Resistance, 60°C@ 96hr	In House	Good: No Smearing
Fire Resistance	UL-94	V-1: Good
Density (g/cm3)	ISO 2781:2008	1.25: Lighter
Sound Absortion	BS EN ISO10534-2:2001	0.07: Improved & Better
Adour	MS 1963:2007	Less Odour: Comply
High Tackiness		✓
Cost Saving		✓
DIY & Green Material		✓



Liquid Epoxidised Natural Rubber based compound is used to produce the rubber sound insulator which consist of 2 layers : rubber and aluminum; a promising product in reducing vibration with improved sound dampening effect







Improved Anti-slip feature



Low cost maintenance



Durability



Environmentally friendly product

❖ **RRIMsurf™** - A sport flooring mat that adapts practicality and sustainability. Ideal for most sports surfaces.

❖ Made from innovated formula to sustain from UV effect and providing physical comfort, better friction and less injury.

❖ It requires easy manufacturing, simple installation and low maintenance.



Adidas Street Soccer Challenge, 2017



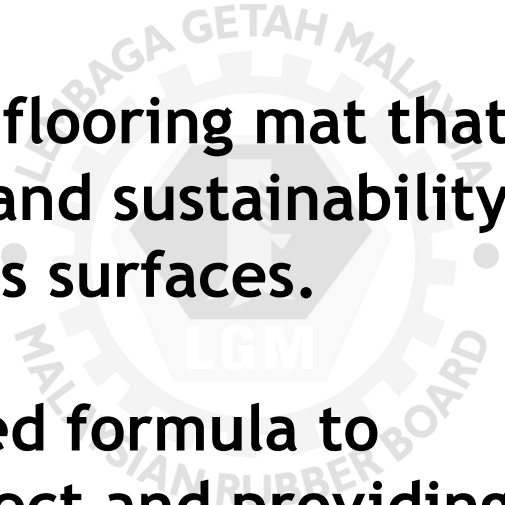
AMONA Street Soccer 2018



Multipurpose court



Dodgeball, 2018



# Internal and Exterior Paint

Latex Based  
Products



## Problems associated with existing commercial paint

- Contain petroleum based chemicals such as acrylic
- Some paints are not water based
- Most are highly odourous and posses health risks for painter when applying in confined areas
- Examples are irritation and respiratory problems
- Need to use solvent if the paints are oil based

## Advantages of Ekoprena<sup>®</sup> Latex based paint

- Made from natural sources and sustainable material
- Water based paint - no solvent or thinner utilization
- Adequately durable – good wet scrub abrasion, UV light degradation, water and salt water resistant.
- Low odor, non-toxic and very low heavy metal
- Do not cause irritation and non-corrosive
- Recommended for concrete, masonry, plaster and softboard surfaces.
- Suitable as interior and exterior paint

Elephant paddock, Kuala Gandah  
National Elephant Conservation Centre



Interior area for a house at Muar Johor

Corporate Building Protasco/IUKL



## Features

- 1 A new medium for educational, stationaries and art works comprising natural rubber as binder.
- 2 RRIMColor is safe, environmental friendly,
- 3 Easy to wash with water
- 4 Economic
- 5 Suitable usage from children to professional artist.
- 6 It is composed mainly of natural occurring material natural rubber latex, cellulose and pigments.
- 7 Not a petroleum based chemical
- 8 Safe to the aquatic environment



Latex Based  
Products



**RRIMCOLOR**

A Product of MRB

## Comparison between RRIMColor and other medium

Features/Colours	RRIM	Acrylic	Water
Drying during use	Faster	Fastest	Slowest
Cleaning after use	Easier	Easy	Easiest
Colour vibrancy	Vibrant	Most vibrant	Less vibrant
Durability	Durable	Most durable	Durable
Petroleum derived ingredients	No	Yes	No
Water resistant	Yes	Yes	No

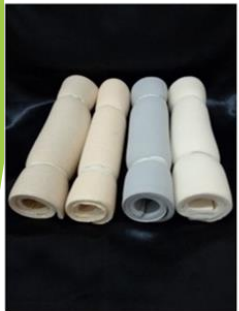


# EPOXIDISED NATURAL RUBBER LATEX FOAM

Latex Based Products



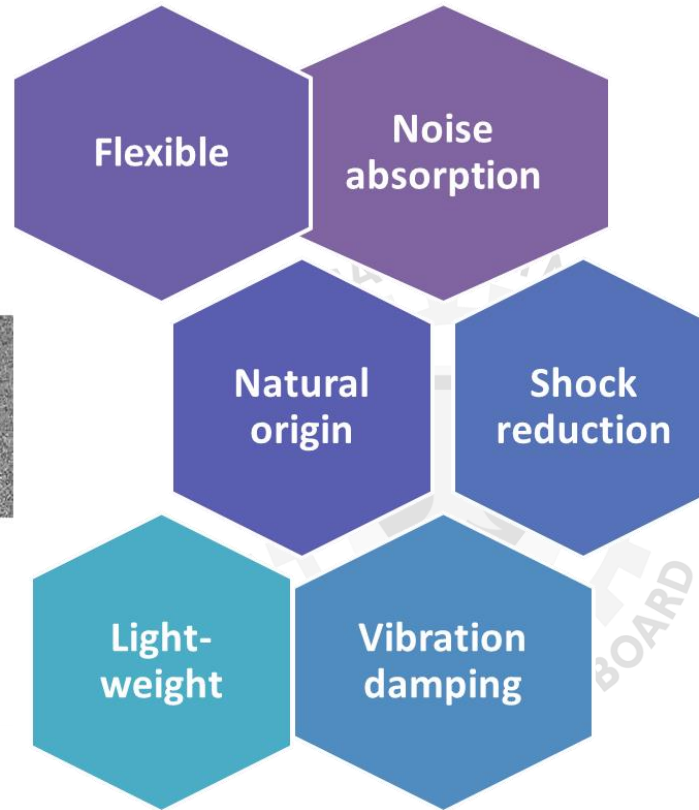
Shoe midsoles



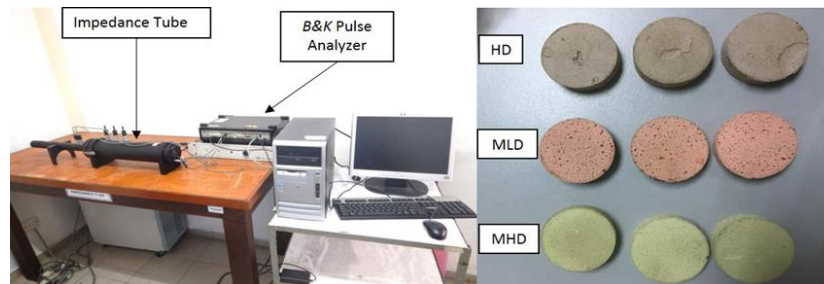
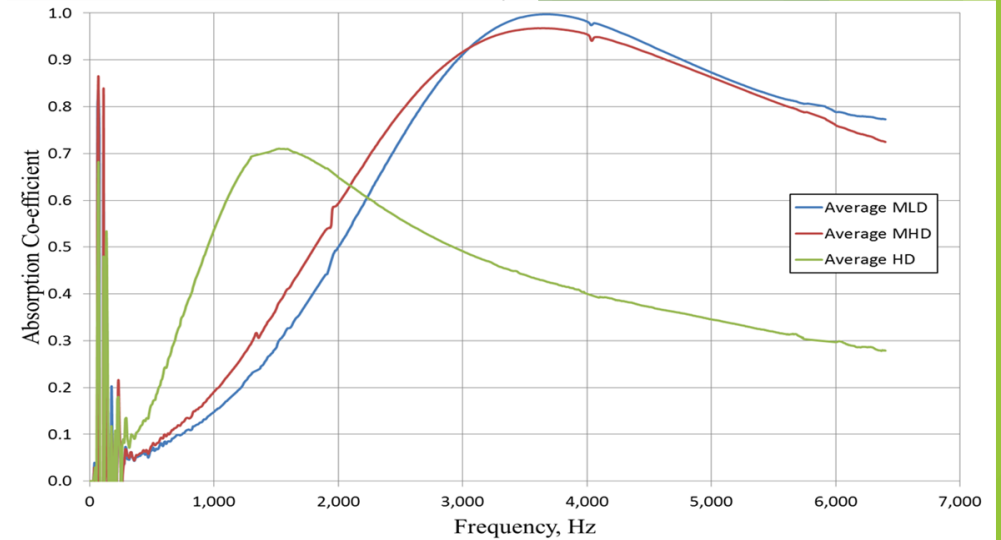
Acoustics foam panel



Anti vibration gloves



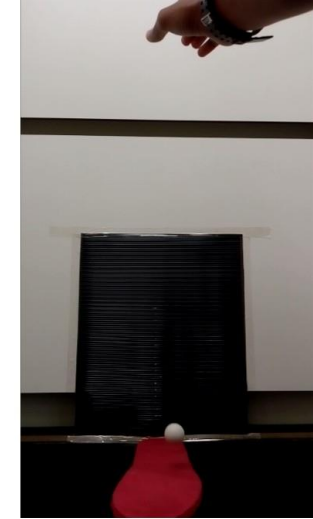
## Sound absorbing material for acoustics foam panel



Conventional synthetic foam



Normal NR latex foam



Epoxidised NR latex foam

# WATER BASED ADHESIVES FROM EPOXIDISED NATURAL RUBBER LATEX

Latex Based Products



## Wallpaper Adhesive

The wallpaper is held to a wall by an adhesive that bonds the wallpaper to the wall.



Before

After



## Latex Adhesives



## Multicolour Adhesive

Introducing the new product with dual application of an adhesive and a medium for artwork.





## Wallpaper Adhesive

### ADVANTAGES

Ekoprena® latex provides high initial tack and good holding power

Made from natural sources and sustainable material

Better adhesion

VOCs and heavy metal free

Less odour

Ideal for glueing commercial wallpaper (200 – 500 g/m<sup>2</sup>)



## Multicolour Adhesive

### ADVANTAGES

Unique & versatile product

Suitable for crafts and arts

Serves wide range of users including children, personnel and artists

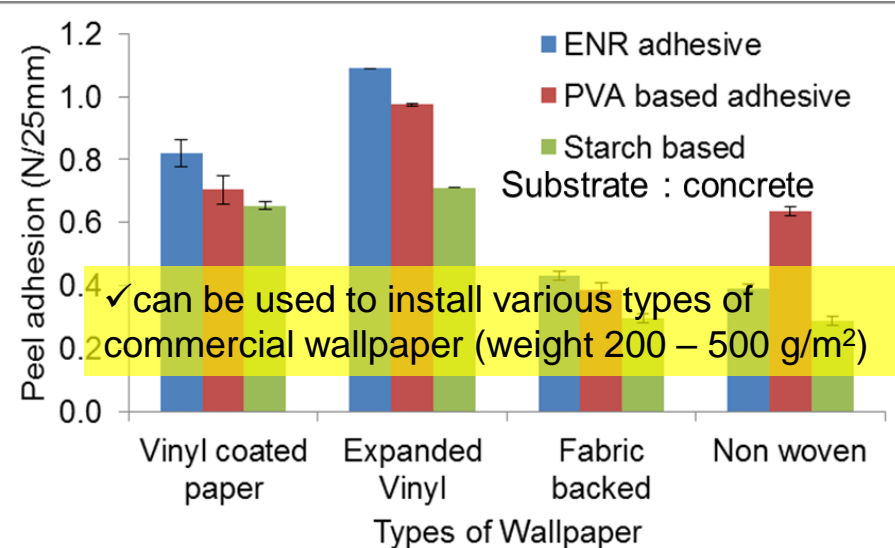
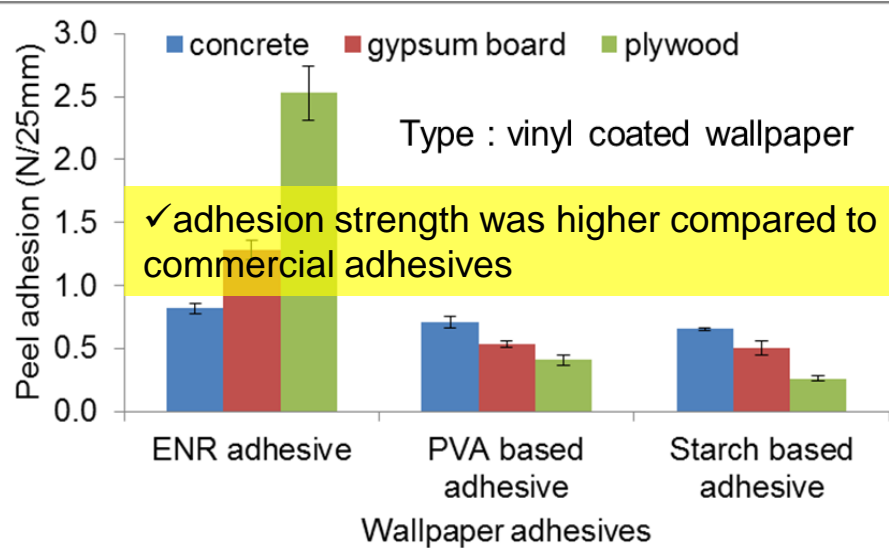
Made from natural sources and sustainable material

Easy to wash from hand after use

Easy to use/handle



# Wallpaper Adhesive



Adhesives	Odour concentration (ou/m <sup>3</sup> )
ENR latex	3,326
Starch-based	2,027
PVA-based	6,132

Sub: Sample: Wall Paper Adhesive  
 Ref: Your Email dt.25.10.2017 & Sample received on 11.01.2018.

Dear Sir,

With reference to your letter, the test report for the above-mentioned sample is given below:

**TEST REPORT** ✓undetected VOCs

Volatile Organic Compounds\* detected/emitted from the samples – NONE.



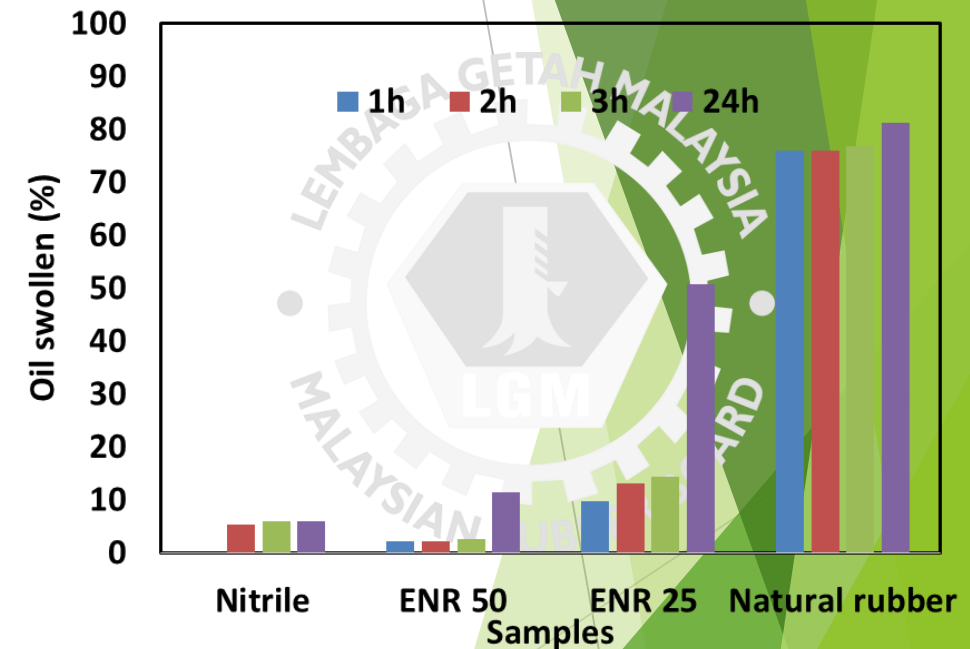
## Tensile Properties

Latex	Tensile strength (MPa)	Modulus at 300% (MPa)	Elongation at break(%)
ENR-25	21.6	0.9	924
ENR 50	19.6	0.9	800
Natural rubber	25.8	1.0	925
Nitrile	18.0	1.5	650

## Permeability Test

Chemical Permeation (EN 16523-1: 2015)	ENR	NR	Nitrile				
Sodium hydroxide(40%)	6	6	3				
Sulphuric acid (96%)	3	3	None				
Nitric acid (65%)	3	3	None				
Methanol	1	None	1				
<b>Permeation Performance Level</b>	None	1	2	3	4	5	6
<b>Measured breakthrough time (min)</b>	<10	>10	>30	>60	>120	>240	>480

## Oil Resistance





# THANK YOU



**LEMBAGA GETAH MALAYSIA**

**Kreatif • Inovatif • Progresif**