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


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Wednesday, 24 June 2020

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WORLD MARKET VALUE OF RUBBER PRODUCTS 2018

Market value
RM 841.56 B

Source: International Trade Center

1. China 17.7%
2. U.S.A 9.0%
3. Germany 8.8%
4. Japan 4.4%
5. Thailand 4.2%
8. Malaysia 3.0%

Rubber Gloves 74.9%
Tubes, Pipes and Hoses 4.1%
New Tyre 5.3%
Lace 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

**Physical**

- Deproteinised Natural Rubber

**Chemical**

- Epoxidised Natural Rubber

Chemical structure of EKOPRENA®
• Digestion of protein by protease during enzymatic reaction
• Replacement of protein with surfactants to stabilize latex particles
Epoxidation reduces the level of **unsaturation** of natural rubber according to the extent of epoxidation during reaction.
PRODUCTION FLOW CHART

Field Latex / Latex Concentrate

Epoxidation Reaction

Neutralisation

Steam Coagulation

Size reduction, drying, packing

Surfactant, Peroxide & Acid

Specialty Latex

Field Latex

Deprotenised Reaction

Steam Coagulation

Size reduction, drying, packing

Dr Fatimah Rubaizah (rubaizah@lgm.gov.my) +603-61459505
Rubber Block

Latex

LIQUID EPOXIDISED NATURAL RUBBER

Latex & Latex Concentrate

Dr Fatimah Rubaizah (rubaizah@lgm.gov.my) +603-61459505
MEMBRANE CONCENTRATION PROCESS

Latex Properties

<table>
<thead>
<tr>
<th>Latex Properties</th>
<th>ENR Latex (before concentration)</th>
<th>ENR Latex (after concentration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry rubber content (DRC)</td>
<td>35.7%</td>
<td>60.4%</td>
</tr>
<tr>
<td>Total Solid content (TSC)</td>
<td>36.4%</td>
<td>62.9%</td>
</tr>
<tr>
<td>Alkalinity (%)</td>
<td>0.11%</td>
<td>0.14%</td>
</tr>
</tbody>
</table>

Morphology

Dr Fatimah Rubaizah (rubaizah@lgm.gov.my) +603-61459505
## PROPERTIES OF LIQUID EPOXIDIZED NATURAL RUBBER

<table>
<thead>
<tr>
<th>Full name</th>
<th>Liquid epoxidized natural rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbreviation:</td>
<td>LENR</td>
</tr>
<tr>
<td>Chemical structure:</td>
<td><img src="image" alt="Chemical structure" /></td>
</tr>
</tbody>
</table>

### Physical and chemical properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Light to dark brown</td>
</tr>
<tr>
<td>Appearance</td>
<td>Soft, sticky, flow at above 70 °C</td>
</tr>
<tr>
<td>Solubility</td>
<td>±95 % in solvent, i.e. toluene, chloroform, tetrahydrofuran</td>
</tr>
<tr>
<td>Average number molecular weight, $M_n$</td>
<td>10 000 g/mol ± 5000</td>
</tr>
<tr>
<td>Average weight molecular weight, $M_w$</td>
<td>30 000 g/mol ± 7000</td>
</tr>
<tr>
<td>Gel content</td>
<td>&lt;5 w/w% (low gel content)</td>
</tr>
<tr>
<td>Glass transition temperature</td>
<td>-20 °C ± 1</td>
</tr>
<tr>
<td>Epoxidation level</td>
<td>50 mol% ± 5</td>
</tr>
<tr>
<td>Shelf life</td>
<td>2 year</td>
</tr>
</tbody>
</table>
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)

- Fossil fuels impact category is the most dominant representing 65.2% from the total value of 11 weighting impact categories.
- Changing the current diesel-based boiler to other greener based boiler in the production of Ekoprena 25 will definitely reduce the potential environmental impact from the current processing.

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)

Dr Zameri (zameri@lgm.gov.my) +603-61459409
APPLICATIONS

Tyre Products

Non-Tyre Products

Latex Products
More distance travel, Improved Fuel Efficiency and excellent grip

1. Commercial Tyre (Retread) : Bus & Truck
2. Passenger Car Tyre
3. Motorcycle Tyre
4. Solid Tyre

Dr Siti Salina (ssalina@lgm.gov.my) +603-61459528
ANTISTATIC SHOE

- Specialty rubber based
- Excellent and highly consistent antistatic property (conductivity ≤ 10-7 S/cm)
- High damping i.e. better wearing comfort
- Excellent abrasion (<150 mm3) i.e. high wearing resistance
- Non-staining or marking i.e. oil-free / DOP (diocyl 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

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

SAFETY BOOTS

Dr Yong Kok Chong (kcyong@lgm.gov.my) +603-61459501
Dr Mohamad Asri Ahmad (asri@lgm.gov.my) +603-61459520
GREEN RUBBER SOUND INSULATOR

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

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.

Human sound range: 500Hz - 4000Hz

<table>
<thead>
<tr>
<th>TEST</th>
<th>TEST STANDARD</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Resistance, 60℃ @ 96hr</td>
<td>In House</td>
<td>Good: No Smearing</td>
</tr>
<tr>
<td>Fire Resistance</td>
<td>UL-94</td>
<td>V-1: Good</td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>ISO 2781:2008</td>
<td>1.25: Lighter</td>
</tr>
<tr>
<td>Sound Absorption</td>
<td>BS EN ISO10534-2:2001</td>
<td>0.07: Improved &amp; Better</td>
</tr>
<tr>
<td>Adour</td>
<td>MS 1963:2007</td>
<td>Less Odour: Comply</td>
</tr>
<tr>
<td>High Tackiness</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Cost Saving</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>DIY &amp; Green Material</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Dr Mohamad Asri Ahmad (asri@lgm.gov.my) +603-61459520
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.

Dr Nik Intan (nikintan@lgm.gov.my) +603-61459492
Internal and Exterior Paint

Problems associated with existing commercial paint
- Contain petroleum based chemicals such as acrylic
- Some paints are not water based
- Most are highly odorous 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® 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
**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

**Comparison between RRIMColor and other medium**

<table>
<thead>
<tr>
<th>Features/Colours</th>
<th>RRIM</th>
<th>Acrylic</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying during use</td>
<td>Faster</td>
<td>Fastest</td>
<td>Slowest</td>
</tr>
<tr>
<td>Cleaning after use</td>
<td>Easier</td>
<td>Easy</td>
<td>Easiest</td>
</tr>
<tr>
<td>Colour vibrancy</td>
<td>Vibrant</td>
<td>Most vibrant</td>
<td>Less vibrant</td>
</tr>
<tr>
<td>Durability</td>
<td>Durable</td>
<td>Most durable</td>
<td>Durable</td>
</tr>
<tr>
<td>Petroleum derived ingredients</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Water resistant</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
EPOXIDISED NATURAL RUBBER LATEX FOAM

Flexible

Noise absorption

Natural origin

Shock reduction

Light-weight

Vibration damping

Sound absorbing material for acoustics foam panel

Shoe midsoles

Anti vibration gloves

Acoustics foam panel

Impedance Tube

BS&K Pulse Analyzer

Conventional synthetic foam

Normal NR latex foam

Epoxidised NR latex foam

Roslimg (roslim@lgm.gov.my) +603-61459428
WATER BASED ADHESIVES FROM EPOXIDISED NATURAL RUBBER LATEX

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

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

Before

After

WATER BASED ADHESIVES FROM EPOXIDISED NATURAL RUBBER LATEX

Wallpaper Adhesive

Multicolour Adhesive

Latex Adhesives

Rohani Abu Bakar (rohani@lgm.gov.my) +603-61459546
Wallpaper Adhesive

- Ekoprena® latex provides high initial tack and good holding power
- Made from natural sources and sustainable material
- Better adhesion
- Less odour
- Ideal for glueing commercial wallpaper (200 – 500 g/m²)
- VOCs and heavy metal free

Multicolour Adhesive

- 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 use/handle
- Easy to wash from hand after use

Rohani Abu Bakar (rohani@lgm.gov.my) +603-61459546
Wallpaper Adhesive

- Adhesion strength was higher compared to commercial adhesives
- Can be used to install various types of commercial wallpaper (weight 200 – 500 g/m²)
- Undetected VOCs

### Odour concentration (ou/m³)

<table>
<thead>
<tr>
<th>Adhesives</th>
<th>Odour concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENR latex</td>
<td>3,326</td>
</tr>
<tr>
<td>Starch-based</td>
<td>2,027</td>
</tr>
<tr>
<td>PVA-based</td>
<td>6,132</td>
</tr>
</tbody>
</table>

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**

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

Rohani Abu Bakar (rohani@lgm.gov.my) +603-61459546
### Tensile Properties

<table>
<thead>
<tr>
<th>Latex</th>
<th>Tensile strength (MPa)</th>
<th>Modulus at 300% (MPa)</th>
<th>Elongation at break (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENR-25</td>
<td>21.6</td>
<td>0.9</td>
<td>924</td>
</tr>
<tr>
<td>ENR 50</td>
<td>19.6</td>
<td>0.9</td>
<td>800</td>
</tr>
<tr>
<td>Natural rubber</td>
<td>25.8</td>
<td>1.0</td>
<td>925</td>
</tr>
<tr>
<td>Nitrile</td>
<td>18.0</td>
<td>1.5</td>
<td>650</td>
</tr>
</tbody>
</table>

### Oil Resistance

**Chemical Permeation (EN 16523-1: 2015)**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>ENR</th>
<th>NR</th>
<th>Nitrile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium hydroxide (40%)</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Sulphuric acid (96%)</td>
<td>3</td>
<td>3</td>
<td>None</td>
</tr>
<tr>
<td>Nitric acid (65%)</td>
<td>3</td>
<td>3</td>
<td>None</td>
</tr>
<tr>
<td>Methanol</td>
<td>1</td>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

**Permeation Performance Level**

<table>
<thead>
<tr>
<th>Measured breakthrough time (min)</th>
<th>None</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>10</td>
<td>&gt;30</td>
<td>&gt;60</td>
<td>&gt;120</td>
<td>&gt;240</td>
<td>&gt;480</td>
<td></td>
</tr>
</tbody>
</table>

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Dr Dazylah Darji (dazylah@lgm.gov.my) +603-61459481