Chloroprene Rubber
Established in 1915
Number of Employees : 2,853
Total Annual Sales : 280 Billion Yen $\approx 2$ Billion €

Location of CR factory

- Head Office
- Plant
- Research Center
- Branch

Omuta Plant

Omi Plant

Shibukawa Plant

Head Office

Chiba plant

Research Center

Ofuna plant

Office/Plant Location
**Chloroprene Monomer Process**

(Acetylene method)

- **Limestone (石灰石)**
- **Calcium Oxide (生石灰)**
- **Carbide (カーバイド)**
- **Acetylene (アセチレン)**

\[
\text{CaCO}_3 \rightarrow \text{CaO} + \text{C} \rightarrow \text{CaC}_2 \rightarrow \text{C}_2\text{H}_2
\]

- **NaCl (工業塩)**
- **HCl (塩酸)**

\[
\text{CH}_2=\text{C}-\text{CH=CH}_2
\]

**Chloroprene Monomer**
Limestone Mines

- Deposits: 5 Billion tons (estimate)
- Digging Capacity: 4 Million tons per year
- Mining Area: 1.2 Million sq. m
Calcium Carbide taken out of electric furnace
Omi Electric Power Plant
Chloroprene Monomer Process

« Acetylene Method »

H-C≡C-H → H-C≡C-CH=CH₂ → CH₂=C-CH=CH₂

Acetylene → Vinylacetylene → Chloroprene Monomer

« Butadiene Method »

CH₂=CH-CH=CH₂ + Cl₂ → CH₂=CH-CHCH₂CL + HCl

Butadiene 3,4-Dichloro-1-butene Chloroprene Monomer
CR Manufacturing Process

Chloroprene Monomer

Polymerization

Finishing

Product

\((-\text{CH}_2-\text{C} = \text{CH}-\text{CH}_2-)_{\text{n}}\)

Poly-Chloroprene
A. Classification of CR in Chemical Structure

1) Mercaptan modified CR

\[
\begin{align*}
\text{Cl} \\
\text{CH}_2\text{C} = \text{CH} - \text{CH}_2 - \text{S} - \text{R}
\end{align*}
\]

2) Xathogen modified CR

\[
\begin{align*}
\text{Cl} \\
\text{CH}_2\text{C} = \text{CH} - \text{CH}_2 - \text{S} - \text{C} - \text{O} - \text{R}
\end{align*}
\]

3) Sulfur modified CR

\[
\begin{align*}
\text{Cl} \\
\text{CH}_2\text{C} = \text{CH} - \text{CH}_2 - \text{S}_x - \text{S} - \text{C} - \text{N} - \text{R}
\end{align*}
\]
B. Crystallization Rare

Classification of DENKA CR

<table>
<thead>
<tr>
<th>Grade</th>
<th>Crystallization Rate</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-90</td>
<td>Fast</td>
<td>Adhesive</td>
</tr>
<tr>
<td>M-40</td>
<td>Medium</td>
<td>Industrial</td>
</tr>
<tr>
<td>S-40</td>
<td>Slow</td>
<td>Low Temp.resistance</td>
</tr>
<tr>
<td>S-40V</td>
<td>Very Slow</td>
<td>Improved on Low Temp.</td>
</tr>
</tbody>
</table>

Standing Time (hr °C)

Hardness (JIS-A)
<table>
<thead>
<tr>
<th>Type</th>
<th>Crystallization Rate</th>
<th>Mooney Viscosity</th>
<th>Typical Applications / Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-40</td>
<td>Medium</td>
<td>48±5</td>
<td>General purpose, cable, belt, hose, other industrial goods</td>
</tr>
<tr>
<td>M-41</td>
<td>Medium</td>
<td>48±5</td>
<td>Same purpose as M-40 with less roll sticking and mold staining</td>
</tr>
<tr>
<td>M-30</td>
<td>Medium</td>
<td>38±4</td>
<td>General purpose as M-40 with low viscosity</td>
</tr>
<tr>
<td>M-31</td>
<td>Medium</td>
<td>38±4</td>
<td>Same purpose as M-30 with less roll sticking and mold staining</td>
</tr>
<tr>
<td>M-70</td>
<td>Medium</td>
<td>70±10</td>
<td>General purpose as M-40 with high viscosity</td>
</tr>
<tr>
<td>M-100</td>
<td>Medium</td>
<td>100±10</td>
<td>Industrial goods (for high loading)</td>
</tr>
<tr>
<td>M-120</td>
<td>Medium</td>
<td>120±10</td>
<td>Sheet, packing, hose, other industrial goods (for high loading)</td>
</tr>
<tr>
<td>S-40</td>
<td>Slow</td>
<td>48±5</td>
<td>Industrial goods / low temperature resistance</td>
</tr>
<tr>
<td>S-41</td>
<td>Slow</td>
<td>48±5</td>
<td>Same purpose as S-40 with less roll sticking and mold staining</td>
</tr>
<tr>
<td>S-40V</td>
<td>Very slow</td>
<td>48±5</td>
<td>Same purpose as S-40 / improved on low temperature resistance, less roll sticking and mold staining</td>
</tr>
<tr>
<td>DCR-30</td>
<td>Very slow</td>
<td>120±10</td>
<td>Industrial goods / low temperature resistance (for high loading)</td>
</tr>
<tr>
<td>DCR-31</td>
<td>Very slow</td>
<td>80±10</td>
<td>Same purpose as DCR-30 with low viscosity</td>
</tr>
<tr>
<td>DCR-34</td>
<td>Slow</td>
<td>65±7</td>
<td>Industrial goods / high heat resistance and mechanical strength</td>
</tr>
<tr>
<td>DCR-36</td>
<td>Very slow</td>
<td>80±10</td>
<td>Industrial goods, suitable for injection molding / low temperature resistance</td>
</tr>
</tbody>
</table>
## Extrusion types

<table>
<thead>
<tr>
<th>Type</th>
<th>Crystallization Rate</th>
<th>Mooney viscosity</th>
<th>Typical Applications / Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES-40</td>
<td>Very slow</td>
<td>43±5</td>
<td>Calendered sheet, extruded goods with precise shape and low temperature resistance</td>
</tr>
<tr>
<td>ES-70</td>
<td>Very slow</td>
<td>75±5</td>
<td>Same purpose as ES-40 with high viscosity (for high loading)</td>
</tr>
<tr>
<td>EM-40</td>
<td>Medium</td>
<td>48±5</td>
<td>Calendered sheet, extruded goods with precise shape</td>
</tr>
<tr>
<td>MT-40</td>
<td>Medium</td>
<td>48±5</td>
<td>Calendered sheet, extruded goods / well-balanced on extrudability and mechanical strength</td>
</tr>
<tr>
<td>MT-100</td>
<td>Medium</td>
<td>95±10</td>
<td>Extruded goods (for high loading)</td>
</tr>
</tbody>
</table>
## Xanthogen modified types

![Chemical structure](attachment:image.png)

<table>
<thead>
<tr>
<th>Type</th>
<th>Crystallization Rate</th>
<th>Mooney Viscosity</th>
<th>Typical Applications / Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCR-42A</td>
<td>Medium</td>
<td>40~55</td>
<td>Cable, Hose, / high performance and high loading</td>
</tr>
<tr>
<td>DCR-66</td>
<td>Very slow</td>
<td>60~80</td>
<td>Auto parts (CVJ boots etc.) / high loading and high performance with low temperature resistance</td>
</tr>
</tbody>
</table>
## Sulfur modified types

![Chemical Structure](image)

<table>
<thead>
<tr>
<th>Type</th>
<th>Crystallization Rate</th>
<th>Mooney Viscosity</th>
<th>Typical Applications / Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM-40</td>
<td>Medium</td>
<td>50±10 *</td>
<td>Sulfur-modified type, suitable for belt, sponge, cable sheath, and shockabsorber</td>
</tr>
<tr>
<td>PM-40NS</td>
<td>Medium</td>
<td>50±10 *</td>
<td>Same purpose as PM-40, especially for non-discoloring or non-staining goods</td>
</tr>
<tr>
<td>DCR-40</td>
<td>Slow</td>
<td>40~55 *</td>
<td>Sulfur-modified type,suitable for belt, sponge and molded goods</td>
</tr>
<tr>
<td>DCR-40A</td>
<td>Slow</td>
<td>35~50 *</td>
<td>Sulfur-modified / improved heat resistance and storage stability</td>
</tr>
<tr>
<td>PS-40A</td>
<td>Slow</td>
<td>30~55 *</td>
<td>Same purpose as PM-40NS/ improved on storage stability and low temperature resistance</td>
</tr>
</tbody>
</table>

* at production

* Sulfur modified types

\[
\begin{align*}
\text{Cl} & \quad \text{CH}_2-\text{C}=\text{CH}-\text{CH}_2-S_x & S & \quad \text{S-N-R} \\
\end{align*}
\]
Automotive Belt

PS-40A, DCR-40A etc.
CVJ Boots and Dust Cover Boots

S-40V, DCR-36, DCR-66 etc.
Hose

ES-40, ES-70, S-40, S-40V etc.
Automotive Air Suspension

Automotive air suspension

PS-40A, DCR-40A etc.
Wire and Cable

M-40, M-70, M-100, DCR-42A etc.
Rubber Bearing Pad

S-40V, DCR-66 etc.
Wet Suit (Sponge)

PM-40NS etc.
DENKA Chloroprene adhesive grade
Thank you very much for your kind attention.