PLANTIC™ introduction as Biomass-derived Gas Barrier Material and Future Growth

September 30, 2019

KURARAY CO., LTD.
About Plantic Business

- Company name: Plantic Technologies Limited
- Location: Altona (near Melbourne), Victoria, Australia
- History:
  2002 Establish a corporate entity of industry-academia collaboration based on the technology developed by Australia's CRC* (* Co-operative Research Centre for International Food Packaging)
  2003 Commercialize biodegradable resin PLANTIC™ and adopted for confection sheets
  2009 Commercialize high-barrier packaging materials
  2011 Business start with the major Australian supermarket “Coles”
  2015 Join to Kuraray Group by acquisition
  2018 Decision made to invest in PLANTIC™ resin production in the U.S. (Scheduled to start operation in early 2020)
- Impairment loss in Plantic business

- Business overview:
  Development/Production/Sales of biodegradable barrier materials using special starch as the raw material
  - PLANTIC™ mono-layer film and sheet
  - PLANTIC™ multi-layer film and sheet
The Kuraray Group creates economic and social value through the provision of its excellent products and services to the market and aims to contribute to the realization of a sustainable society.
What is PLANTIC™?

- **Not biodegradable**
- **Petroleum-derived**
- **Use**: Food packaging materials, fuel tanks, etc.

**Ethylene vinyl-alcohol copolymers**

**EVAL™**

- Oxygen barrier performance: 
  \[(20^\circ C \cdot 65\% RH) 0.7cc \cdot 20\mu m^2 \cdot \text{day} \cdot \text{atm} \]

- The basic manner of use as a barrier product is the same.

- **Biodegradable**
- **Biomass-derived**
- **Use**: Food packaging materials (mainly MAP packaging for meat and dry food)

**PLANTIC™**

- Oxygen barrier performance: 
  \[(20^\circ C \cdot 65\% RH) 0.8cc \cdot 50\mu m^2 \cdot \text{day} \cdot \text{atm} \]

Reference:
LDPE oxygen barrier performance: 
\[(20^\circ C \cdot 65\% RH) 6,700cc \cdot 20\mu /m^2 \cdot \text{day} \cdot \text{atm} \]
# PLANTIC™ Environmental Certification of Products

<table>
<thead>
<tr>
<th>Mono-layer film</th>
<th>TUV (Austria) certification mark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Biodegradable WATER &amp; SOIL</td>
</tr>
<tr>
<td></td>
<td>Compost INDUSTRIAL &amp; HOME</td>
</tr>
<tr>
<td></td>
<td>Biobased</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multi-layer film</th>
<th>Japan Organics Recycling Association certification mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-layer RE grade</td>
<td>- The CO₂ generated by incinerating biomass plastic is excluded from the amount of CO₂ generated in Japan.</td>
</tr>
<tr>
<td>Multi-layer EF grade</td>
<td>- Products granted the biomass mark are eligible to receive an official certificate from the Association indicating the amount of CO₂ reduced.</td>
</tr>
</tbody>
</table>

Conforms to the basic principles of the Ministry of the Environment's plastic resource recycling strategy "3R + Renewable".
PLANTIC™ Cases of Adoption in Australia

Coles (Major Australian supermarket)

FY19 Sales Revenue: AU$35,001MM (Retail Business)
Number of stores : 2,445 (June, 2019) -from Coles HP-

-Shop display of processed meat using PLANTIC™ trays.
-PLANTIC™ is used in trays by combined with PET. Certified as recyclable containers in Australia.

"While the majority of Coles Brand products are now in recyclable packaging, by 2020 all Coles Brand packaging will be recyclable at kerbside or in store."
(from Coles HP “Sustainability at Coles”)
Our proposal as biodegradable packaging materials with paper

Mainly targeting pouches for dry food with keywords “Biomass”, “Biodegradable” and “Compostable”.
Example: Roasted coffee bean packaging materials (right)

Our proposal of barrier materials that can be recycled as paper

Skin-pack is growing and popular form of packaging in Europe
Three-dimension, Designability, Novelty and No leak of meat juices
Can be laid or hung vertically and give flexibility in transportation
PLANTIC™ Expansion to Resin Business

Alliance with Sealed Air Corporation (U.S.)

Sealed Air exclusively deploy the business in North America (U.S., Canada, Mexico).

Manufacturing and sale of PLANTIC™ resin

Kuraray America Inc.

Resin production facilities currently under construction

Resin Supply

Manufacturing and sale of multi-layer film packaging products

Sealed Air Corporation

Film production line currently under construction

Sealed Air Corporation

-FY2018 Net Sales: US$ 4,732.7MM (Food Care: US$ 2,908.1MM)

"At Sealed Air, we pledge to design and advance our innovative packaging solutions to be 100% recyclable or reusable by 2025."

(from Sealed Air HP “2025 Sustainability & Plastics Pledge”)
- Promote sales by cooperation with Sealed Air which has a strong presence in food packaging market in North America.
- By the start of resin business, we’re able to make various proposals in the value-chain.
In addition to business increase of film packaging outside Australia, we accelerate development of new products and application.

FY2026 consolidated earning target
Net sales: Over US$100 million
Operating margin: 20%
Kuraray Group Technologies in the Automotive industry

**Safety**
- PVB film <TROSIFOL™>
- Methacrylic resin molding material <PARAPET™>
- PVA fiber <KURALON™>

**Lighter weight**
- Heat-resistant polyamide resin <GENESTAR™>
- Styrenic thermoplastic elastomer <SEPTON™>
- Molded hook fasteners <MAGILOCK™>

**Comfortable**
- Methacrylic Resin Molding Material < PARAPET ™>
- Styrenic thermoplastic elastomer <SEPTON™> <HYBRAR™>
- Liquid rubber <KURARAY LIQUID RUBBER™>
- Activated carbon <KURARAY COAL™>
- Melt-blown non-woven fabric

**Low-emission**
- EVOH resin <EVAL™>
- Heat-resistant polyamide resin < GENESTAR ™>
- Activated carbon < KURARAY COAL™ >
Megatrends & Target Domain in the Automotive industry

Megatrends

- Connected / Autonomous
- Shared & Service (MaaS)
- Fuel Diversity

Kuraray’s Target Domain

1. Fuel management (HV/PHV/FCV)
2. Electrification
3. Autonomous Driving

While the ratio of electric cars increases each year, the percentage of cars equipped with engines including HV/PHV will be over 80% even in 2030.

Source: Ministry of Economy, Trade and Industry 2018 manufacturing whitepaper (Created by the Ministry of Economy, Trade and Industry based on IEA "ETP (Energy Technology Perspectives) 2017")
The percentage of cars equipped with engines would be over 80% even in 2030.

Increasing requirements for advanced fuel management systems in hybrid vehicles (HV/PHV)

Proposal of new fuel management systems based on Kuraray’s technology related to high fuel barrier.
### Megatrends: Fuel Management

<table>
<thead>
<tr>
<th>Market trends</th>
<th>Target parts</th>
<th>Materials needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion of the demand for hybrid cars</td>
<td>Gasoline tank</td>
<td>Conversion to a compact module</td>
</tr>
<tr>
<td>Conversion to hydrogen energy</td>
<td>Canister</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FCV fuel tank</td>
<td>Hydrogen barrier</td>
</tr>
</tbody>
</table>

### Kuraray's solutions
- Heat-resistant polyamide resin *<GENESTAR™>*
- High-performance activated carbon *<KURARAY COAL™>*
- Gas barrier resin *<EVAL™>* , etc.

### Increasing requirements for advanced fuel management systems in hybrid vehicles (HV/PHV)

Proposal of new fuel cell vehicle (FCV) high-pressure tank based on Kuraray’s hydrogen barrier technologies

*<EVAL™> <GENESTAR™> <VECSTAR™>*
## Megatrends

### Electrification

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<th>Materials needs</th>
<th>Kuraray's solutions</th>
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</thead>
<tbody>
<tr>
<td>Increased number of</td>
<td>ECU connector</td>
<td>Stable dimensions, strength, heat resistance</td>
<td>Heat-resistant polyamide resin &lt;GENESTAR™&gt;</td>
</tr>
<tr>
<td>electronic control parts</td>
<td>Actuator gear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Miniaturization needs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher battery</td>
<td>Anode Material for Lithium-ion</td>
<td>High input/output characteristics</td>
<td>Hard carbon &lt;KURANODE™&gt;</td>
</tr>
<tr>
<td>functionality</td>
<td>Battery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat management</td>
<td>Cooling system</td>
<td>Cooling water resistance</td>
<td>Heat-resistant polyamide resin &lt;GENESTAR™&gt;</td>
</tr>
<tr>
<td>Transition to glass thin film</td>
<td>Side glass</td>
<td></td>
<td>High-rigidity acoustic interlayer film &lt;TROSIFOL™&gt;</td>
</tr>
<tr>
<td>Resin glazing</td>
<td>Sunroof</td>
<td></td>
<td>PMMA/PC laminated sheet 〈PARAMIGHTY™〉</td>
</tr>
<tr>
<td>Multi-material</td>
<td>Structural parts, etc.</td>
<td></td>
<td>Thermoplastic composite &lt;GENESTAR™&gt;</td>
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</table>

### Size reduction of electronic control parts

### Increasing needs for heat management

Increasing sales to the application such as ECU connectors, actuator gears and heat management system based on higher dimension stability and heat resistance
Megatrends  Electrification

Market trends

- Increased number of electronic control parts (Miniaturization needs)
- Higher battery functionality
- Heat management
- Transition to glass thin film
- Resin glazing
- Multi-material

Target parts

- ECU connector
- Actuator gear
- Anode Material for Lithium-ion Battery
- Cooling system
- Side glass
- Sunroof
- Structural parts, etc.

Materials needs

- Stable dimensions, strength, heat resistance
- High input/output characteristics
- Cooling water resistance
- High rigidity/sound insulation
- Weather resistance/heat shielding
- Physical stability

Kuraray's solutions

- Heat-resistant polyamide resin <GENESTAR™>
- Hard carbon <KURANODE™>
- Heat-resistant polyamide resin <GENESTAR™>
- High-rigidity acoustic interlayer film <TROSIFOL™>
- PMMA/PC laminated sheet 〈PARAMIGHTY™〉
- Thermoplastic composite <GENESTAR™>

Strong demand for faster charge and longer life of battery

Evaluation for the anode materials for lithium-ion battery, utilizing its high input / output characteristics
Growing need for lighter structural parts for longer battery mileage

Thinner laminated glasses with high-rigid acoustic interlayer film
Thermoplastic composites stable even under high temperature and humidity
Rapid growth of sensor demand caused by the popularization of autonomous driving

Substrate material which contributes lower transmission loss used in antennas for millimeter wave radar
Investment for mass-production facilities for LCP film copper-clad laminate was determined to react to various specification requirements
The image contains a table and a diagram highlighting the Megatrends 5G (technology/infrastructure) and Autonomous Driving. The table lists the market trends, target parts, and materials needs for various applications. Key points include:

- **High-speed memory DDR5 connector for next-generation servers**
  - Co-development with customers, utilizing the features of heat resistance and stable dimensions.

The diagram shows the relationship between market trends, target parts, and materials needs, emphasizing features such as Ultra-high-speed/large capacity response to communications and Advanced display.

**Market trends**
- Ultra-high-speed/large capacity response to communications
- Advanced display

**Target parts**
- Sensor antenna
- DDR5 connector
- HUD
- Each type of display

**Materials needs**
- Low transmission loss
- Dimensional stability
- Higher brightness
- Improved visibility

**Kuraray's solutions**
- LCP film <VECSTAR™>
- Heat-resistant polyamide resin <GENESTAR™>
- Intermediate screen micro-lens array
- PMMA/PC laminated sheet 〈PARAMIGHTY™〉

This section of the document focuses on the technical advancements and materials solutions in the context of 5G technology and autonomous driving.
Megatrends  5G (technology/infrastructure) and Autonomous Driving

**Market trends**

- Ultra-high-speed/large capacity response to communications
- Advanced display

**Target parts**

- Sensor antenna
- DDR5 connector
- HUD
- Each type of display

**Materials needs**

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**Growing demand for advanced HUD (Head-Up Display)**

**Intermediate screen for head-up display (HUD)**

Microfabrication technology to control light diffusion and to improve the display visibility
Efforts Toward Growth

Establish business model sustainable even in revolutionary time, as symbolized by “CASE”

Promotion of cross-divisional work

- Joint events & actions
  - Automotive Engineering Exposition (Yokohama, Nagoya)
  - K2019 (Germany), Elexcon (China), Auto Expo (India), etc.
- Next-generation mobility workshop
- Automobile disassembly training

From "competition" to "co-creation"

- Horizontal co-creation: Materials manufacturers, equipment manufacturers, design/prototype companies, etc.
- Vertical co-creation: To be a reliable co-creation partner with customers

Global deployment

- US/Europe: New office in Detroit for customer service and marketing (Europe: planned)
- Asia: New production plant in Thailand (SEPTON™, GENESTAR™, etc)