Why we will apply Phosphorescent Pigment from NIC

Make safe and recycling-oriented society by using Phosphorescent Pigment
What is Phosphorescent Pigment?
What is Phosphorescent Pigment?

- The substance can absorb energy from lights
  (sunlight, ultraviolet, fluorescent light, LED light...)
- The substance can store energy
- The substance glows when it gradually releases energy
  (Slow release = Phosphorescence, Swift release = Fluorescence)
NIC’s Target

Make a safe and recycling-oriented society by using Phosphorescent Pigment
Why is Phosphorescent Pigment **NOT** Popular today?

- **Safety Concern**
  It was developed in the early 1900’s
  Material consists of ZnS, Copper and Radium
  Radioactive Substance $\rightarrow$ Negative Image

- **Expensive** (USD200/kg. $\sim$ USD2000/kg.)

- **Limited Performance**
  (Low waterproofness, Short lifetime, Poor dispersibility,
   Equipment damage, Poor brightness)
NIC’s Strategy

Develop **High performance** And **Low price**

Phosphorescent Pigment
NIC developed new Phosphorescent Pigment with following features:

1. Contains no radioactive substance
2. Absolute low price
3. Excellent water resistance
4. Excellent dispersibility
5. No equipment damage reported
6. Excellent brightness
NIC’s Composition:

Strontium Aluminate with doped Eu & Dy

<table>
<thead>
<tr>
<th>Color</th>
<th>Formula</th>
<th>Component</th>
<th>Eu &amp; Dy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Green</td>
<td>$\text{Sr}<em>4\text{Al}</em>{14}\text{O}_{25}$</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Yellow Green</td>
<td>$\text{SrAl}_2\text{O}_4$</td>
<td>+</td>
<td>Eu &amp; Dy</td>
</tr>
</tbody>
</table>

(Eu = Europium, Dy = Dysprosium)
## 2. Absolute low price

<table>
<thead>
<tr>
<th>Competitor’s Current Price Level=Today’s Market Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Price</td>
</tr>
<tr>
<td>Lowest Price</td>
</tr>
</tbody>
</table>

NIC’s proposal Extreme low price and NIC tries to lower further
3. Excellent Water Resistance

Fact (Experiment Result)

Put both NIC’s product and their competitor’s product in water

• Competitors Product (Waterproof grade)
  Lost color (became white) and lost Luminescent Performance after 7 days after put in water

• NIC’s Product
  No change seen both in color and Luminescent Performance after 6 months after put in water
3. Excellent Water Resistance

NIC’s Unique Technology that makes it possible

Modify surface of pigment to increase water resistance
(Applying silica coating technology)

(Patent JP5729698)
4. Excellent dispersibility

Facts

• Originally Metal Oxide (Strontium Aluminate) has properties that make it react with plastic and gel (becomes jelly-like)

• Competitor’s Phosphorescent Pigment gel (becomes jelly-like)/ Our products do not gel (do not become jelly-like)

• Surface Silica Coated $\rightarrow$ No direct contact $\rightarrow$ No gelation/No curing
5. No equipment damage reported

Facts

• Competitor’s Phosphorescent Pigment damages equipment such as dispersion machines, injection molding machines, extruders, glass plates etc.

• NIC’s products do not damage them
5. No equipment damage reported

NIC’s Unique Technology that makes it possible

- Surface Silica Coated
- Softer Surface
- Much lower damage
6. Excellent Brightness

Better than competitor’s product

<table>
<thead>
<tr>
<th></th>
<th>Initial Brightness</th>
<th>Afterglow Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIC’s Yellow Green</td>
<td>8,119 mcd/m2</td>
<td>Approx. 8 hours</td>
</tr>
<tr>
<td>Competitor’s Yellow Green</td>
<td>7,434 mcd/m2</td>
<td>Approx. 8 hours</td>
</tr>
<tr>
<td>NIC’s Blue Green</td>
<td>3,014 mcd/m2</td>
<td>Approx. 8 hours</td>
</tr>
<tr>
<td>Competitors Blue Green</td>
<td>2,754 mcd/m2</td>
<td>Approx. 8 hours</td>
</tr>
</tbody>
</table>

* mcd = (millicandela, 1000 mcd = 1 candela)
What we can do with Phosphorescent Pigment

EXAMPLES
What we can do with Phosphorescent Pigment

Phosphorescent Paint
What we can do with Phosphorescent Pigment

Phosphorescent Paint – Example 1 (Outdoor Stairs)

DAYTIME  NIGHT TIME
What we can do with Phosphorescent Pigment

Phosphorescent Paint – Example 2 (Lines on Road)

*Brightness can last 10 years more or less outdoors
What we can do with Phosphorescent Pigment

Phosphorescent Paint – Expected Applications in Japan

- Lines on Road
- Outdoor Stairs
- Handrails
- Guardrails
- Evacuation paths signs
- Metal Fences
- Metal Doors
- A lot more
What we can do with Phosphorescent Pigment

Phosphorescent tape (Polyester Sheet) size: 10mm～

- As it is a fully waterproof pigment, it is possible to use outdoors over a long-term period.
- It’s possible to use on a small width of a surface, it can be used at many possible sites.

Expected Applications

Stairs (indoor and outdoor), Passages, Boat Decks
What we can do with Phosphorescent Pigment

Phosphorescent Tiles

Material (example): Tile + Glass fiber + Coating agent

Expected Applications: Walls, Floors, Tunnels, Objects
What we can do with Phosphorescent Pigment

Phosphorescent Road Marking Sheet (Polyurethane Sheet)

DAYTIME

NIGHT TIME
Phosphorescent Road Marking Sheet (Polyurethane Sheet)

**Material** - Weather resistance polyurethane sheet which is embossed on the surface layer on the sheet

**Expected Applications**

- Highly durable and flexible floor display sheet (Marking sheet for traffic signs on roads)
- It is perfect for walls and also on sidewalks or in train stations, where pedestrians and bicycles pass through
- The abrasion resistance is 10 times higher than a Vinyl chloride sheet (PVC sheet).
  - It can correspond from 80 degree C. to – 40 degree C.
  - No surface stress for approximately 3 years in walking frequency 200,000 people per day.
- Its flexibility can be fixed by wrapping over pillars etc.
What we can do with Phosphorescent Pigment

Construction materials for walls

• This product can be directly used as materials for walls.
• You can use it safely as it has been tested as a Building material.
• Whole walls can be phosphorescent. If the products are used on the wall as a part of a design, evacuation guidance by lines as recommended by Fire and Disaster Management Agency can be realized without disturbing the whole atmosphere of the space.

Expected Applications: Construction Walls (underground shopping areas, apartments etc.), Roofs, Baseboards
*Material* - PVC + Reflective tape

**Features:**

1) High water resistant phosphorescent materials are used.

2) By combining phosphorescent sheets and recursive reflective sheets, the phosphorescence emits light during blackouts as well as shining brightly by recursive reflection against the light of a torch.

**Expected Applications**

Protective Clothings, Parking Lots, Stickers
What we can do with Phosphorescent Pigment

Phosphorescent aggregate, Glass

This says “Stop” in Japanese.

Expected Applications
Crossroads, Event Sites
Business Status in Japan

Samples evaluation stage by potential clients such as:

- Plastic manufacturers
- Paint manufacturers
- Latex manufacturers
- Ink manufacturers
- Watch manufacturers
- Sign/Label manufacturers
Business Status outside Japan

NIC has just shared this proposal
Today’s Market Approx. 200 Million Dollar (Confirmed)

**Potential markets and assumed market size**

<table>
<thead>
<tr>
<th>Service</th>
<th>Market Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair of high-speed roads</td>
<td>500 million dollar</td>
</tr>
<tr>
<td>Harbors / breakwaters</td>
<td>300 million dollar</td>
</tr>
<tr>
<td>Bridges / lighthouses</td>
<td>250 million dollar</td>
</tr>
<tr>
<td>Ships (stern / inboard)</td>
<td>100 million dollar</td>
</tr>
<tr>
<td>Railway, Underground shopping center</td>
<td>850 million dollar</td>
</tr>
<tr>
<td>Automobiles, Motorcycles</td>
<td>250 million dollar</td>
</tr>
<tr>
<td>Accessories, Electronic equipment</td>
<td>500 million dollar</td>
</tr>
</tbody>
</table>
Manufacturer and Distributor

Manufacturer

NIC Corporation
2-3-6, Kitahama, Chuo-ku,
Osaka, Japan

Distributor

Daishin Corporation
5-6-7, Toyosaki, Kita-ku,
Osaka, Japan

Email: info@daishin-corp.com
## Comparison Data with Competitor’s Products

Excellent: 7 and 8  
Very Good: 5 and 6  
Good: 4  
Bad: 2 and 3  
Very Bad: 1  
(Except Mohs Scale of Hardness)

<table>
<thead>
<tr>
<th>Composition formula</th>
<th>SrAl2O4+Eu, Dy</th>
<th>Sr4Al14O25+Eu, Dy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Other company</td>
<td>NIC</td>
</tr>
<tr>
<td></td>
<td>NIC</td>
<td>NIC</td>
</tr>
<tr>
<td>Grade</td>
<td>-</td>
<td>Lightnic Yellow 20E</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>Lightnic Blue 20-E</td>
</tr>
<tr>
<td>Center Wavelength (CWL)</td>
<td>520nm</td>
<td>520nm</td>
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<tr>
<td></td>
<td>490nm</td>
<td>490nm</td>
</tr>
<tr>
<td>Emitting Color</td>
<td>Yellow Green</td>
<td>Blue Green</td>
</tr>
<tr>
<td>Initial Brightness</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Water Resistance</td>
<td>Loss of Luminescent Performance in approximately 7 days</td>
<td>No Degradation of Performance</td>
</tr>
<tr>
<td></td>
<td>Loss of Luminescent Performance in less than 6 months</td>
<td>No Degradation of Performance</td>
</tr>
<tr>
<td>Water Solubility</td>
<td>47.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>5.6%</td>
<td>1.2%</td>
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<tr>
<td></td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Weather Resistance</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
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<td>4</td>
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<td>Dispersibility</td>
<td>3</td>
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<td></td>
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<td>Aptitude for Resin</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Degradation of Dispersion Media</td>
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</tr>
<tr>
<td></td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Mohs Scale of Hardness</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Lifetime</td>
<td>Less than one year</td>
<td>More than 5 years</td>
</tr>
<tr>
<td></td>
<td>Less than 3 years</td>
<td>More than 5 years</td>
</tr>
<tr>
<td></td>
<td>More than 5 years</td>
<td></td>
</tr>
<tr>
<td>Mixture for Paints / Ink</td>
<td>After some time it will get Gelation/Curing</td>
<td>No Gelation/Curing</td>
</tr>
<tr>
<td></td>
<td>After some time it will get Gelation/Curing</td>
<td>No Gelation/Curing</td>
</tr>
<tr>
<td></td>
<td>No Gelation/Curing</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>Low Yield and Expensive</td>
<td>High Yield and Low Cost</td>
</tr>
<tr>
<td></td>
<td>Low Yield and Expensive</td>
<td>High Yield and Low Cost</td>
</tr>
<tr>
<td></td>
<td>High Yield and Low Cost</td>
<td></td>
</tr>
</tbody>
</table>

*Note: For Mohs Scale of Hardness, values range from 1 to 10.*
What will we do?

Thank you

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