Introduction of DAIKIN’s Coating Technology

DAIKIN INDUSTRIES,LTD
BUSINESS DEVELOPMENT DEPT.CHEMICAL DIV.
## “Coating Market Map”

<table>
<thead>
<tr>
<th>Market</th>
<th>Function</th>
<th>Coating type</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics (include IT, media)</td>
<td>Protection</td>
<td>Conformal Coating</td>
<td>Ftone MM series</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oil barrier Coating</td>
<td>Ftone OC series</td>
</tr>
<tr>
<td>Auto mobile</td>
<td>Protection</td>
<td>Conformal Coating</td>
<td>Ftone MM series</td>
</tr>
<tr>
<td></td>
<td>Easy Clean</td>
<td>Interior Protection</td>
<td>Ftone AT series</td>
</tr>
<tr>
<td></td>
<td>Lubrication</td>
<td>Optical Protection</td>
<td>OPTOOL series</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry Lubrication</td>
<td>Tough Coat Enamel</td>
</tr>
<tr>
<td>Construction</td>
<td>Stay Clean</td>
<td>Stone protection</td>
<td>Ftone GM series</td>
</tr>
<tr>
<td></td>
<td>Easy Clean</td>
<td>Interior Protection</td>
<td>Ftone AT series</td>
</tr>
<tr>
<td></td>
<td>Weather resistant</td>
<td>Outside wall protection</td>
<td>ZEFFLE series</td>
</tr>
<tr>
<td>House hold</td>
<td>Easy Clean</td>
<td>PTFE Coating</td>
<td>Tough Coat Enamel</td>
</tr>
<tr>
<td>Optical</td>
<td>Easy Clean</td>
<td>Optical protection</td>
<td>OPTOOL series</td>
</tr>
</tbody>
</table>
Our Coating Lineup

1. PTFE Coating “Tough Coat Enamel”
2. Fluoropolymer for paint “ZEFFLE”
3. Hydrophilic Additive “ZEFFLE GH”
4. ZEFFLE Thermal Insulation Coating system
5. Anti-Stain Coating “Ftone” AT / GM
6. Anti-Fouling nano Coating “OPTOOL” DSX / DAC
8. Electric Coating –1 Conformal Coating
9. Electric Coating –2 Oil barrier Coating
10. Fluoro-SOL/GEL Coating
Fluoropolymer for paint “ZEFFLE”

Fluoro polymer : Chemically Stable because of large bonding energy.
*Cure condition: Room temp. ~ 150°C

Bonding energy

C-F : 485.6 kJ/mol
C-H : 410.6 kJ/mol
C-Cl : 326.5 kJ/mol

Weathering test result @ MIYAKOJIMA

White pigmented coatings

Fluoro polymer : Chemically Stable because of large bonding energy.

Commercial available
Fluoropolymer for paints “ZEFFLE”

Product Lineup

- **GK series**  
  Solvent based 2-component system  
  High Reliability

- **SE series**  
  Water based emulsion system  
  Environmentally Friendly

- **LC series**  
  Solvent based 1-component system  
  Easy to Apply

Application example
- **- Super Durability paint -**

  - **- Anti - Corrosion -**

  - Tokyo ROPPONGI

  - **- Anti - Satins ( Car Bumper )-**
Hydrophilic additive **ZEFFLE GH** can migrate to the surface quickly. It’s driving force is the difference of *Surface Free Energy*.

**Migration to the surface of the coating**

**Formation of the hydrophilic surface**

- **O - Rf**
- **-(Si – O)n- R**

- **OH**
- **-(Si – O)n- R**

- **Surface free energy**
  - Around 20 mN/m

- **Coating material**
  - Surface free energy
  - Around 35 mN/m

**Graph:**
- **Coating with normal hydrophilic addition**
- **Coating With ZEFFLE GH**

**Month:**
- 0
- 3
- 6
- 9
- 12
Hydrophilic additive “**ZEFFLE GH**”

**ZEFFLE GH application example**

Ordinary Coating

Hydrophilic Coating

- **H₂O**
- **soil**
- **hydrophobic surface**

- **H₂O**
- **soil**
- **hydrophilic surface**
Anti-Stain Coating “Ftone AT”

Performance of Ftone AT series

Fluoro resin

Fluoro resin + X + X → R + R

Reaction
@ room temp. or heat cure (~150℃)

Non-stick properties
High durability
Anti-Stains, Chemicals, Acids

Application Example

Commercial available

confidential
**Anti-Stain Coating “Ftone GM”**

**For Porosity substrate**
(such as Stone, concrete, wood etc.)
Excellent Stain removability
without changing appearance

- Motor oil
- Olive oil
- Mustard
- Ketchup
- Orange juice
- Coke
- Soy sauce
- Blue ink
- Coffee

**Olive oil**
**Motor oil**
**Mustard**
**Ketchup**
**Orange juice**
**Coke**
**Soy sauce**
**Blue ink**
**Coffee**

**Ftone GM mechanism**

- Perfluorochemical
- Invisible thin layer

**Surface free energy of solid**
\[ \gamma_c \]
**Surface free energy of liquid**
\[ \gamma \]

<table>
<thead>
<tr>
<th>Liquid</th>
<th>Surface Energy (mN/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>70</td>
</tr>
<tr>
<td>Wine</td>
<td>50</td>
</tr>
<tr>
<td>Milk</td>
<td>30</td>
</tr>
<tr>
<td>Olive Oil</td>
<td>20</td>
</tr>
<tr>
<td>Paraffin Oil</td>
<td>10</td>
</tr>
<tr>
<td>Petrol</td>
<td>10</td>
</tr>
<tr>
<td>n-Heptane</td>
<td>10</td>
</tr>
<tr>
<td>Paraffin</td>
<td>10</td>
</tr>
<tr>
<td>Polyester</td>
<td>30</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>40</td>
</tr>
<tr>
<td>Polyvinyl chloride</td>
<td>50</td>
</tr>
<tr>
<td>Silicone</td>
<td>70</td>
</tr>
<tr>
<td>Polytetrafluoroethylene</td>
<td>100</td>
</tr>
</tbody>
</table>

\[ \gamma \leq \gamma_c \]
**Ftone treated surface**
Invisible thin layer

\[ \gamma > \gamma_c \]
**Stain**
**OPTOOL DSX**

*for Inorganic material (Glass, AR coating etc.)*

### Performance of OPTOOL DSX

- Excellent oil and water repellent, ant-fouling
- Prevents scratches caused by wiping with tissue paper
- Prevents fingerprints, easy to wipe away.

<table>
<thead>
<tr>
<th>Finger print (oleic acid)</th>
<th>After wipe off</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTOOL DSX</td>
<td></td>
</tr>
<tr>
<td>Other fluorochemical</td>
<td></td>
</tr>
<tr>
<td>Untreated</td>
<td></td>
</tr>
</tbody>
</table>
OPTOOL DAC for Acrylic Hard coat

* Excellent oil and water repellent, ant-fouling
* Prevents scratches.
* Prevents fingerprints, easy to wipe away.

**Performance of OPTOOL DAC**

<table>
<thead>
<tr>
<th></th>
<th>Finger print (oleic acid)</th>
<th>After wipe oil</th>
<th>marker</th>
<th>After wipe off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard coat with DAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Hard coat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>