Industrial IJ Head
Applicable to Wide Range of Inks

Konica Minolta Technology Center Inc.,
IJT R&D Center
Dr. Shinichi Nishi
Business Development Center
Akiyoshi Ohno
October 21, 2004
1. Introduction
   1. Konica Minolta
   2. IJ Technology of Konica Minolta
2. IJ Head for Industrial Applications
3. Design Concept of Industrial IJ Head
   1. Adhesives
   2. Wave form
   3. Heat Control
4. One Pass Printing
5. Line Stitch
6. Summary
(Unit: billions of yen)

<table>
<thead>
<tr>
<th>FY2002 Forecast</th>
<th>FY2005 Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minolta</td>
<td>387.0</td>
</tr>
<tr>
<td>Konica</td>
<td>131.0</td>
</tr>
<tr>
<td>M + K</td>
<td>183.0</td>
</tr>
<tr>
<td>825.0</td>
<td>1,094.3</td>
</tr>
<tr>
<td>Medical &amp; Graphic Imaging Products and Others</td>
<td>(Unit: billions of yen)</td>
</tr>
<tr>
<td>Optical Devices</td>
<td>35.0</td>
</tr>
<tr>
<td>Cameras/Consumer Imaging Products</td>
<td>92.7</td>
</tr>
<tr>
<td>Image Information</td>
<td>9.6</td>
</tr>
</tbody>
</table>

FY2005 Target = 1.3 trillion yen = $12 billion
IJ Business Development

Integration

Key Components
Technology Required for Solvent Ink

Requirements for Components of IJ Head

• No Chemical and Physical Change: dissolve, swelling, deforming
• No Mechanical and Electrical Change: stress, strain
• No Influence on Ink Property: Pigment Dispersion
  Collapse, cohesion, viscosity change
• No Influence on Ink Reactivity:
  ex) UV curable ink; hardening, decrease sensitivity
  Organic EL materials; decrease emitting efficiency
Adhesives Applicable for Solvent Inks

- Requirements for Solvent Resistance of Adhesives
  - Property of Adhesives
    - Hardness
    - High glass transition temperature
  - Process Usability of Adhesives
    - Viscosity and thixotropy
    - Curing temperature

- We have developed new epoxy adhesives.
  - Highly network structure obtained by new epoxy compounds and new hardener.
# Newly-Developed Adhesive

## Material Compatibility of Epoxy Adhesives

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLVENT INK</td>
<td>bad</td>
<td>good</td>
<td>excellent</td>
</tr>
<tr>
<td>UV INK</td>
<td>bad</td>
<td>good</td>
<td>excellent</td>
</tr>
<tr>
<td>OIL INK</td>
<td>good</td>
<td>good</td>
<td>excellent</td>
</tr>
<tr>
<td>NMP</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Butyl Lactate</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Cyclohexanone</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Anisole</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Xylene</td>
<td>bad</td>
<td>good</td>
<td>good</td>
</tr>
<tr>
<td>Ethyleneglycolol mono-butylether</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Ethyleneglycolol butylether acetate</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solvents</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLVENT INK</td>
<td>bad</td>
<td>good</td>
<td>excellent</td>
</tr>
<tr>
<td>UV INK</td>
<td>bad</td>
<td>good</td>
<td>excellent</td>
</tr>
<tr>
<td>OIL INK</td>
<td>good</td>
<td>good</td>
<td>excellent</td>
</tr>
<tr>
<td>NMP</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Butyl Lactate</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Cyclohexanone</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Anisole</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Xylene</td>
<td>bad</td>
<td>good</td>
<td>good</td>
</tr>
<tr>
<td>Ethyleneglycolol mono-butylether</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
<tr>
<td>Ethyleneglycolol butylether acetate</td>
<td>bad</td>
<td>bad</td>
<td>good</td>
</tr>
</tbody>
</table>

A: normal epoxy glue  
B: network epoxy glue  
C: highly network epoxy glue
Stable Ejection of Solvent Inks

- Difficulty of Stable Jetting of Solvent Ink
  - oil-based > UV curable > solvent-based
    - more volatile
    - generation of mist
    - pigment dispersion
    - high viscosity

- KonicaMinolta resolves the difficulty by harmonizing head performance with ink properties.
  - stability improvement by waveform modification
  - Temperature control by built-in heater
Drop Formation of Various Inks

Aqueous Ink | Oil Ink | Surface Tension

low | high
Stability Improvement -1-

• Waveform Modification

  – For highly volatile solvent-based inks, “shaking” waveform shall be applied, in order

    • to assist mixing of ink close to meniscus
    • to prevent increase of viscosity of ink near meniscus
    • to maintain the stability of drop ejection
Modified Waveform

Shaking Waveform = shaking pulse + ejecting pulse

First Drop Speed vs Ejection Interval

- with meniscus vibration
- without meniscus vibration
Stability Improvement

• Waveform Modification

  – For non-Newtonian inks and polymer containing inks, “shaking” waveform shall be applied, in order

    • to assist mixing of ink close to nozzle corn
    • to prevent return to viscous state of ink
    • to decrease the viscous change through ejecting
    • to maintain the stability of drop formation

Useful for UV curable ink containing oligomer components and/or polymer rich inks
Temperature Control by built-in Heater

- Thermistor
- Nozzle plate
- Manifold
- Ribbon heater
Temperature Control

Head Temperature Controlled at 50°C

[Temperature °C]

[min]
# 3 Cycle Driven Head

<table>
<thead>
<tr>
<th>Type</th>
<th>nozzle</th>
<th>dpi</th>
<th>ink</th>
<th>pl</th>
<th>KHz</th>
<th>with built in Heater</th>
<th>without built in Heater</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>512</td>
<td>360</td>
<td>Oil Solvent UV (Aqu.) Special</td>
<td>42</td>
<td>7.6</td>
<td>X</td>
<td>X</td>
<td>Single-pass</td>
</tr>
<tr>
<td>M</td>
<td>512</td>
<td>360</td>
<td>Oil Solvent UV (Aqu.) Special</td>
<td>14</td>
<td>12.8</td>
<td>X</td>
<td>X</td>
<td>Fine print image 4 Step Gray Scale</td>
</tr>
<tr>
<td>S</td>
<td>4-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>Super fine image Multi Gray Scale</td>
</tr>
</tbody>
</table>

X sample available  (X) coming soon
Easy to Stitch
Multi Color
Single Pass
Type512L/LH & Type512M/MH

- Type 512L_/LH
  - Ideal for **Single-pass** print
    - Coding/Marking
    - Industrial
      (Outdoor) Signage
- Type 512M_/MH
  **Fine Image Quality** (Smaller Drop Size)
  Higher Driving Frequency
  (Indoor) Signage
  Industrial
  where small drop size required
5. Gray Scale Technology

C-cycle
B-cycle
A-cycle
Multi Step Gray Scale
Summary

1. KonicaMinolta IJ Head Technologies for Industrial Applications

   1. New epoxy adhesives developed
   2. Modified waveform increase jetting stability for volatile solvent based inks and non Newtonian inks
   3. Built-in heater for ink temperature controls

2. 512 Head Family, good for ...

   1. One Pass Printing
   2. Line Stitch Alignment
   3. Grey Scale Applications