Recycling in Japan

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History of Pavement Recycling

1970s  Development of Recycling Technology for Pavement Wastes was started.

1984  Published “Handbook of Recycling Technology of Pavement Waste”

1986  Published “Handbook of In-situ Surface Recycling”

1987  Published “Handbook of In-situ Basecourse Recycling”

1992  Published “Handbook of Plant Recycling of Pavement”

2004  Published “Handbook of Pavement Recycling”
Recycling Ratio of Construction By-Products

- Recycling Ratio of Asphalt Concrete is Over 98%

<table>
<thead>
<tr>
<th>Construction By-Products</th>
<th>2000 Fiscal Year</th>
<th>1995 Fiscal Year</th>
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<tbody>
<tr>
<td>All of Construction</td>
<td>58%</td>
<td>85%</td>
</tr>
<tr>
<td>By-Products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphalt Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement concrete</td>
<td>65%</td>
<td>83%</td>
</tr>
<tr>
<td>Waste from Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Sludge</td>
<td>40%</td>
<td>41%</td>
</tr>
<tr>
<td>Construction Sludge</td>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td>Mixed Construction</td>
<td></td>
<td></td>
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<tr>
<td>Wastes</td>
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</tbody>
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Recycling Method for Pavement

- Base course waste
- Asphalt mixture waste
- Cement concrete waste

- Plant recycling method
- Recycled base course material
- Recycled asphalt mixture
- Recycled surface / binder course

- In-place recycling method
- In-place recycled base course
- In-place recycled surface

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Asphalt Pavements and Environment
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Plant Recycling

- Recycle pavement by-products at a stationary mixing plant (recycling mixing plant)
- Reuse them as pavement materials

Most popular in Japan
- Recently, the ratio of recycled asphalt mixture is close to 70%.
- Recycled asphalt mixture has already been promoted to use according to the following law
  - Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities (*Law on Promoting Green Purchasing*), enacted in FY2000
In-place Base Course Recycling

- Crush existing asphalt mixtures
- Mix the milled asphalt mixture with existing granular base material and stabilizing agents such as cement and/or emulsified asphalt
- Compact this mixture to form a new base course
- Finally, construct new asphalt layers as surface and binder courses

In-place Base Course Recycling Method

- Limitation on the thickness of existing asphalt layers (to 10cm)
- Rather popular at local roads
- Technology transfer has been tried to Vietnam or other Asian countries
In-place Surface Recycling

- Heat the existing asphalt mixture
- Scarify to loosen the material
- Add new asphalt mixture and/or rejuvenators if necessary
- Spread and compact it to construct a new surface course or binder course.

Once it was popular in expressways
- Drainage asphalt pavement (DAP) has become popular
- In-place surface recycling is not adequate for DAP
- There is an environmental problem such as an influence of heated air to plants along the roads
Outstanding problems about AC (Asphalt Concrete) recycle

- **Improve the ratio of AC waste reclaimed to AC**
  - According to the survey in 2002,
    - Total amount of AC waste in Japan is 30 million tons
    - Amount of AC waste recycled to reclaimed AC is 15 million tons (≈50%)
    - The rest has been reused as recycled base course material
  - Recycle use of modified AC and Porous AC
    - How will modifier act in the recycled mixture?
    - How about the influence of the difference in gradation between dense-graded AC and Porous AC
- **Evaluation method for recycled asphalt**
  - Present: Penetration of old asphalt
  - Revised: Indirect tensile test for reclaimed AC mixture
Typical wastes from other areas

- Wood
- Molten slag made from municipal waste and sewer sludge
- Glass
- Steel slag
- Used tire rubber
- Fly ash from fire power plants

Attention to use waste from other areas

- Environmental Safety
  - No seeping out of any harmful materials such as lead, chrome, etc.
- Durability
  - Equal strength with natural aggregate in hardness, wear-resist, etc.
- Economical
  - Not so expensive rather than natural aggregate
- Stable supply
  - Can be supplied with constant quantity and uniform quality
- Sustainability
  - Can be recycled in several times
Thank you for your attention!

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