High Rate Recycling in Batch Plants

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Ammann Schweiz AG
# Ecological and Economic Consequence of the Global Asphalt Production

<table>
<thead>
<tr>
<th>Region</th>
<th>Asphalt Production</th>
<th>US$</th>
<th>Market Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>1'200 Mio. t/a</td>
<td>50 Mia.</td>
<td>➔</td>
</tr>
<tr>
<td>USA</td>
<td>600 Mio. t/a</td>
<td>25 Mia.</td>
<td>➔</td>
</tr>
<tr>
<td>Europe</td>
<td>300 Mio. t/a</td>
<td>13 Mia.</td>
<td>➔</td>
</tr>
<tr>
<td>China</td>
<td>130 Mio. t/a</td>
<td>5.5 Mia.</td>
<td>➔</td>
</tr>
<tr>
<td>Rest of the World *</td>
<td>170 Mio. t</td>
<td>7.0 Mia.</td>
<td>➔</td>
</tr>
</tbody>
</table>

* Eastern Europe, Middle East, India, SEA, Australia, Africa etc.

1'140 Mio. t of processed aggregate ➔ Mountain of 1'200 m² ➔ x 1’800 m h
60 Mio. t of bitumen ➔ 2 Mio. fuelling vehicles
RAR – RA ring (cold RA addition into drum)

Feed of recycling material into the drum via ring
Aggregates and recycling are mixed before entering the mixing tower.

The pre-mixed virgin and recycling materials have to by-pass the screen.

20% RA @ 3% H₂O
RAC – Cold RA (directly into mixer)

Mixing cycle

- Aggregate
- RA
- Evaporation
- Filler
- Bitumen
- Mixing
- Emptying

30% RA @ 3% H₂O

Feed of recycling material into the mixer
Aggregates and recycling remain fully separated before the mixer

Superheated Aggregates

270°C

170°C

20°C

Evacuation of steam
RAC – Superheated Aggregates

Asphalt mixture: 170°C

Design point

Aggregate temp. [°C]  
450 400 350 300 250 200 150

RA rate [%]  
40 35 30 25 20 15 10

Moisture content [%]  
0 1 2 3 4 5 6 7

AMMANN  
www.irf2010.com
60% RA @ 3% H₂O

System to add up to 60% of dried and heated recycling material using a parallel drum

Feed of recycling material via parallel drum

Aggregates and recycling remain fully separated before the mixer

Superheated aggregates

Storage of different material qualities

RAH – Hot Recycling
RAH – Hot Recycling

VOC-Concentration

![Graph showing the relationship between RA-Temperature and VOC-Concentration]

- **RA-Temperature [°C]**
  - 110
  - 120
  - 130
  - 140
  - 150
  - 160

- **CₓHᵧ [ppm]**
  - 0
  - 50
  - 100
  - 150
  - 200
  - 250
  - 300
  - 350

The graph shows an upward trend in VOC concentration as the RA Temperature increases.
Worldwide 1st plant using up to 100% recycling asphalt

100% recycling device
100% recycling device
100% recycling device (protected)

- Low ageing of bitumen
  - No radiation heat
  - Low oxygen content

- High efficiency
  - Counter flow dryer
  - Air recirculation

- Low emissions (VOC)
  - Indirectly heated recycling drum

Hot Recycling-Asphalt: 165 °C
Storage: well separated recycling material fractions
Blending of recycling material
First Plant in Switzerland using latest technology

RA 100 drum for hot recycling
- Currently mixing a motorway foundation with an average of 80% RAP @ 200t/h
# Comparison of Recycling Methods in batch Plants

<table>
<thead>
<tr>
<th>Economy</th>
<th>Ecology</th>
<th>Quality</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low investment</td>
<td>• Risk of higher emissions</td>
<td>• Only Bypass Production</td>
<td>via ring in drum RAR</td>
</tr>
<tr>
<td>• Maintains mixing time</td>
<td>• Up to 20% RAP</td>
<td>• inflexible (change of recycling % or recipe)</td>
<td></td>
</tr>
<tr>
<td>• Medium investment</td>
<td>• Low emissions</td>
<td>• Production via Bypass and Screen</td>
<td>direct in mixer RAC</td>
</tr>
<tr>
<td>• Increase mixing time</td>
<td>• Up to 30% RAP</td>
<td>• flexible</td>
<td></td>
</tr>
<tr>
<td>• High saving of resources</td>
<td>• Low emissions</td>
<td>• Superheated stones necessary</td>
<td>Recycling drum RAH</td>
</tr>
<tr>
<td></td>
<td>• Up to 60% RAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Higher Investment</td>
<td>• Very low emissions</td>
<td>• Production via Bypass and Screen</td>
<td>Recycling drum RA 100</td>
</tr>
<tr>
<td>• Very high Recycling rate and output</td>
<td>• Up to 100% RAP</td>
<td>• All productions possible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• High output (240 t/h)</td>
<td>• Very flexible</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No superheated stones</td>
<td></td>
</tr>
</tbody>
</table>

**Economy**
- Low investment
- Maintains mixing time

**Ecology**
- Risk of higher emissions
- Up to 20% RAP

**Quality**
- Only Bypass Production
- inflexible (change of recycling % or recipe)

**Technology**
- via ring in drum RAR
- direct in mixer RAC
- Recycling drum RAH
- Recycling drum RA 100
Discussion

• Thank you for your attention
# Profit with higher RA addition

<table>
<thead>
<tr>
<th></th>
<th>binder content</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>aggregates</td>
<td>10,00 €</td>
<td></td>
</tr>
<tr>
<td>binder</td>
<td>300,00 €/t</td>
<td>15,00 €</td>
</tr>
<tr>
<td>cost per t</td>
<td>25,00 €</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>cost RA</th>
<th>3,00 €</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA preparation</td>
<td></td>
<td>3,00 €</td>
</tr>
<tr>
<td>handling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>crushing, screening, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA analysis</td>
<td>0,60 €</td>
<td></td>
</tr>
</tbody>
</table>

**Total cost / t**

<table>
<thead>
<tr>
<th>Ratio new / RA</th>
<th>100 / 0</th>
<th>90 / 10</th>
<th>80 / 20</th>
<th>70 / 30</th>
<th>60 / 40</th>
<th>50 / 50</th>
<th>40 / 60</th>
<th>30 / 70</th>
<th>20 / 80</th>
<th>10 / 90</th>
<th>0 / 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>cost per t (5% binder) €</td>
<td>25,00</td>
<td>23,16</td>
<td>21,32</td>
<td>19,48</td>
<td>17,64</td>
<td>15,80</td>
<td>13,96</td>
<td>12,12</td>
<td>10,28</td>
<td>8,44</td>
<td>6,60</td>
</tr>
<tr>
<td>benefit € / t</td>
<td>€</td>
<td>1,84</td>
<td>3,68</td>
<td>5,52</td>
<td>7,36</td>
<td>9,20</td>
<td>11,04</td>
<td>12,88</td>
<td>14,72</td>
<td>16,56</td>
<td>18,40</td>
</tr>
</tbody>
</table>

Asphalt production per year 100,000 t
- 30,000 t, 50% RA → 276,000 €
- 30,000 t, 70% RA → 386,400 €

110,400 €
Cost decreasing versus RAP%
Properties of reclaimed bitumen

- **Penetration**

<table>
<thead>
<tr>
<th>RA temp. / Hot gas temp.</th>
<th>160°C / 650°C</th>
<th>163°C / 655°C</th>
<th>164°C / 630°C</th>
<th>190°C / 780°C</th>
<th>162°C / 577°C</th>
<th>175°C / 799°C</th>
<th>183°C / 749°C</th>
<th>120°C / 767°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration [1/10 mm]</td>
<td>31</td>
<td>26</td>
<td>26</td>
<td>25</td>
<td>23</td>
<td>31.2</td>
<td>30.4</td>
<td>15.1</td>
</tr>
<tr>
<td>Verringerung der Penetration</td>
<td>50%</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Erhöhung der Temperatur R&amp;K</td>
<td>8°C</td>
<td>6.5°C</td>
<td>6.5°C</td>
<td>6.5°C</td>
<td>6.5°C</td>
<td>6.5°C</td>
<td>6.5°C</td>
<td>6.5°C</td>
</tr>
</tbody>
</table>
RAP-Feeder

RAP feeder designed to fit the purpose
Recycling Drum (Parallel flow)
RAC Feeding and dosing in Mixer

Belt weighing unit
Recycling Drums (Parallel flow)
Recycling Drum
RAR RAP Feeding via Ring
RAP Feeding via Ring