Focus on HERA
Bottom Ash Treatment

Milano, November 14th, 2008
SUMMARY

✓ HERA Group & E.D.
✓ HERA’s Waste To Energy Plants
✓ Bottom Ashes Production
✓ Bottom Ashes Recovery System
✓ Bottom Ashes Landfilling
HERA GROUP

✓ Business

ENERGY

ENVIRONMENT

WATER
HERA GROUP – ENVIRONMENT DIVISION

HERA is the Italian Leader in the Waste Management Business

Treatment of about 5.5 million tons of both “Urban” and “Special” waste in 72 running plants

Italy has currently a structural deficit in waste management capacity.
HERA GROUP – ENVIRONMENT DIVISION

✓ HERA’s WTE Power Plants

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Bologna (FEA)</td>
<td>210</td>
<td>22</td>
<td>140</td>
<td>CIP6/11</td>
<td>Operating</td>
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<tr>
<td>Rimini</td>
<td>120+65</td>
<td>11+10</td>
<td>74+18</td>
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<tr>
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<td>11</td>
<td>74</td>
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<tr>
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<td>180 + 60</td>
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<tr>
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<td>73+10</td>
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<td><strong>105</strong></td>
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<tr>
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<td>12</td>
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<td>7</td>
<td>30</td>
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<tr>
<td>Ferrara</td>
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<td>3</td>
<td>10</td>
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<td>32</td>
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<td>18</td>
<td>CIP6/07</td>
<td>Operating</td>
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<tr>
<td><strong>Totale impianti attuali</strong></td>
<td><strong>663</strong></td>
<td><strong>58</strong></td>
<td><strong>277</strong></td>
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</table>
HERA GROUP – WTE MASS BALANCE

- **MSW** 120,000 t/y
  - **WTE - Forlì**
    - Urea 40% 750 t/y
    - Sorbalit 450 t/y
    - Sodium Bicarbonate 1,950 t/y
  - Flue gas 1,000,000 t/y
  - Electric power 75,600 MWh/y
  - Internal consumption 17,200 MWh/y
  - To electrical net 58,400 MWh/y
- **Bottom ash** 32,500 t/y 27%MSW
  - Fly ashes 3,000 t/y
  - P.S.R. 1,600 t/y
  - Landfill
  - Recovery
- **By product** 22,750 t/y
  - Recovery 70% B.Ash
- **Waste** 6,500 t/y
  - Landfill 20% B.Ash
- **Iron** 3,250 t/y
  - Recovery 10% B.Ash

**Recovery** 70% B.Ash

**Landfill** 20% B.Ash

**Recovery** 10% B.Ash
## HERA GROUP – BOTTOM ASH PRODUCTION

### Bottom ash production  year  2007

<table>
<thead>
<tr>
<th>WTE Plant</th>
<th>M.S.W. t / y</th>
<th>Bottom ash t/y</th>
<th>% M.S.W.</th>
<th>To Landfill t</th>
<th>To recovery t</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rimini</td>
<td>121.333</td>
<td>34.844</td>
<td>28,72</td>
<td>31.226</td>
<td>3.618</td>
<td>Grid furnace</td>
</tr>
<tr>
<td>Modena</td>
<td>104.199</td>
<td>27.431</td>
<td>26,33</td>
<td>21.166</td>
<td>6.265</td>
<td>Grid furnace</td>
</tr>
<tr>
<td>Forlì</td>
<td>44.800</td>
<td>12.349</td>
<td>27,56</td>
<td>11.187</td>
<td>1.162</td>
<td>Grid furnace</td>
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<tr>
<td>Ferrara</td>
<td>43.188</td>
<td>10.579</td>
<td>24,50</td>
<td>-</td>
<td>10.579</td>
<td>Grid furnace</td>
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<tr>
<td>Bologna &quot;FEA Srl&quot;</td>
<td>206.676</td>
<td>50.260</td>
<td>24,32</td>
<td>50.260</td>
<td>-</td>
<td>Grid furnace</td>
</tr>
<tr>
<td>Ravenna</td>
<td>47.695</td>
<td>339</td>
<td>0,71</td>
<td>-</td>
<td>339</td>
<td>Fluid bed plant feed with CDR</td>
</tr>
</tbody>
</table>

| Total amount t     | 567.891      | 135.802        | 113.839  | 21.963        |               |                               |

### Ravenna "Ecologia Ambiente Srl"

- 31.210 4.987 15.98 4.987 -  
  - Rotary kiln for industrial waste too liquid

### Total amount t

- 599.101 140.789 118.826 21.963 15.6% to recovery
<table>
<thead>
<tr>
<th>YEAR</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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</thead>
<tbody>
<tr>
<td>MATERIAL RECOVERY - HERA's PLANTS</td>
<td>0</td>
<td>0</td>
<td>30.000</td>
<td>75.000</td>
<td>75.000</td>
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<tr>
<td>MATERIAL RECOVERY - OTHER's PLANTS</td>
<td>21.963</td>
<td>40.000</td>
<td>104.035</td>
<td>87.410</td>
<td>92.932</td>
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<tr>
<td>RECOVERY %</td>
<td>16%</td>
<td>29%</td>
<td>67%</td>
<td>71%</td>
<td>72%</td>
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<tr>
<td>LANDFILLING - HERA's PLANTS</td>
<td>118.826</td>
<td>100.000</td>
<td>66.689</td>
<td>66.349</td>
<td>66.349</td>
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<tr>
<td>TO LANDFILL</td>
<td>84%</td>
<td>71%</td>
<td>33%</td>
<td>29%</td>
<td>28%</td>
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<tr>
<td>TOTAL AMOUNT</td>
<td>140.789</td>
<td>140.000</td>
<td>200.724</td>
<td>228.759</td>
<td>234.281</td>
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</table>

**BOTTOM ASH DESTINATION**

- **RECOVERY %**
- **TO LANDFILL**
- **TOTAL AMOUNT**
HERA GROUP – BOTTOM ASH TREATMENT

HERA’S PLANT FOR RECOVERY BOTTOM ASH AFTER SIEVE SEPARATION AND IRON SEPARATION.

➢ Recovery of bottom ashes is possible only after sieve and separation of ferrous material.
➢ After extraction of voluminous material (>150 mm), laboratory tests confirmed that ferrous material is 10% of bottom ash dry.
➢ If moisture of bottom ash is 20% with sieve to 20 mm, the extraction of ferrous material is 20%.
➢ If moisture is 40% sieve is little effective and there are problem of cloggage.
➢ For recovery of bottom ash in cement factory standard qualification are:
   - absence of ferrous material
   - Moisture < 30%
   - absence unburned substances
   - Check the size
## HERA GROUP – BOTTOM ASH TREATMENT

<table>
<thead>
<tr>
<th>Tests</th>
<th>Clinker</th>
<th>Clinker + 15% bottom ash</th>
<th>Clinker + 30% bottom ash</th>
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</thead>
<tbody>
<tr>
<td>Water demand</td>
<td>28.5</td>
<td>28.7</td>
<td>29.3</td>
</tr>
<tr>
<td>Spreading</td>
<td>84</td>
<td>93</td>
<td>84</td>
</tr>
<tr>
<td>Beginning set</td>
<td>2h37’</td>
<td>4h48’</td>
<td>8h10’</td>
</tr>
<tr>
<td>End set</td>
<td>3h20’</td>
<td>6h18’</td>
<td>9h40’</td>
</tr>
<tr>
<td>Resistance to flexion</td>
<td>Mpa</td>
<td>Mpa</td>
<td>Mpa</td>
</tr>
<tr>
<td>2 days</td>
<td>4.9</td>
<td>3.4</td>
<td>2.4</td>
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<tr>
<td>7 days</td>
<td>6.6</td>
<td>4.6</td>
<td>3.4</td>
</tr>
<tr>
<td>28 days</td>
<td>6.6</td>
<td>5.3</td>
<td>4.1</td>
</tr>
<tr>
<td>Resistance to compression</td>
<td>Mpa</td>
<td>Mpa</td>
<td>Mpa</td>
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<tr>
<td>2 days</td>
<td>25.1</td>
<td>14.2</td>
<td>9.2</td>
</tr>
<tr>
<td>7 days</td>
<td>40.2</td>
<td>23.3</td>
<td>16.2</td>
</tr>
<tr>
<td>28 days</td>
<td>50.3</td>
<td>30.1</td>
<td>20.6</td>
</tr>
</tbody>
</table>

### Resistance Compression Graph

![Graph showing resistance compression](image)

- **X-axis**: % of Bottom Ash
- **Y-axis**: MPa
The pilot plant installed at WTE Rimini in the last years had two concentric rotary roller with different sieves.

The roller are slopped for discharge on a conveyor belt the sieved material.

Bottom ash feed the hopper of sieve with a crane.

A first horizontal sieve with square mesh of 100 mm separate voluminous material (iron and unburned substances).

The remaining across the hopper feed the roller. The effective sieving area is 36 m², length of the roller 3000 mm, capacity 40-160 m³/h.

The sieve of external roller is 80 mm. The internal 30 mm.

Three conveyor belt pick up voluminous material, the material keep on internal roller that come disposal to landfill and final by-product that come sending to cement factory.

On conveyor belt of by-product is installed a magnetic roller for to separate fine fraction of ferrous matter.
HERA GROUP – BOTTOM ASH TREATMENT

Physical-mechanical process for separation with sieve and iron separation.

Ferrous materials

By product to recovery
Experimentation carried out by:

- Meta spa (now HERA spa)
- Italcic srl
  - HERA spa (Bologna)
  - Pescale spa-Reggio Emilia
  - S.M.I.A. srl Società di Monitoraggio e Ingegneria Ambientale- Rome
- University of Rome “La Sapienza”, Engineering Faculty - Road Construction Department

For detail of experimentation I refer to report of Adelmo Benassi product to prewin May 2006.
I synthesize only objectives of the experimental activity:

- to look for a valid alternative to landfill disposal of MSW incineration bottom ash.
- to produce a material which could:
  - compete on the civil work market;
  - be environmentally sound.
- to verify the economical and technical validity of the process which uses exclusively “poor” materials such as:
  - Bottom ashes from MSW incinerators
  - inert matter from treatment of building demolitions
  - slag from iron metallurgy produced by blast furnaces
And the conclusions

- After the toxicological and ecotoxicological tests the CIC produced with MSW bottom ash of Modena plant is not dangerous neither for the human health (toxicology) nor for the environment (ecotoxicology).

- The risk of damage to the human health and to the environment is proved to be very low.

- CIC can validly replace the materials currently used in road construction, normally excavated in the nature.

- The cost of CIC process is less than half the cost of landfill disposal which is, in Italy, the main way currently adopted to face this problem.

- After positive conclusion of experimental tests a plant was building in Modena, in HERA technological area of via Caruso. The plant starts in the next weeks.
HERA GROUP - MASS BALANCE CIC

Bottom ash
(99 t/g)

Catalysts
(lime, gypsum, soda)
(3.30-6.26 t/g)

Metal's recovery
(5 t/g)

Metal separation

Slag by blast furnaces
11-15%
(18.14-43.86 t/g)

Inert matter
30-55%
(49.47-169.20 t/g)

Blending
(164.91-313.33 t/g)

Conglomerato (conglomerate)
Idraulico (hydraulic)
Catalizzato (catalized)

Check HERA

Check ARPA

Check Province on CIC lay down

Lay down CIC
HERA GROUP – BOTTOM ASH TREATMENT CIC
HERA GROUP – BOTTOM ASH LANDFILLING - SOTRIS

- Capacity landfill: 420000 m³ final height 18,6 m
- Authorized for dangerous and non dangerous waste
- Building with 6 lagoons separated in two part
- The two different part are managed in this way:
  - west part (lagoons 1, 2, 3) for dangerous and non dangerous waste: item 8 DM 03/08/05
  - east part (lagoons 4, 5, 6) for non dangerous waste: item 7 point 1 a DM 03/08/05 (inorganic non dangerous waste with low quantity of organic matter biodegradable)

TREATMENT
- Previously waste can be triturate on Sotris storage centre.
- Dusty waste must be wet or manufactured in big bags.

OMOLOGATION
- Before way in, wastes are homologate according to rigorous procedure of admittance.

CONTROL
- visual on all load way in
- analytical
- radioactivity control on all load way in
THANKS FOR YOUR ATTENTION!