Welcome to the presentation on

Fly Ash
A
Resource Material
For
Construction Industry

World Bank
V.K. Mathur
DGM(AUD)
NTPC/CC

12.04.07
Presentation Overview

- Why Ash utilization?
- What is Ash?
- Types of Ashes
- Areas of Ash Utilization
- MoEF Notification
- Use of fly ash in Road construction
WHY ASH UTILIZATION?

• Ash is an excellent resource material for construction industry.
• Ash utilization helps conserve natural resources like clay, limestone required for making cement—thus saving environment.
• Ash is an excellent fill material for road / rail embankment construction.
• Ash is suitable for reclamation of both Open cast & under ground mines. De-coaled area can be reclaimed for agriculture / floriculture / afforestation.
• Less requirement of land for ash pond.
WHY ASH UTILIZATION?

Fly ash has pozzolanic properties & used in production of Portland Pozzolana Cement (PPC), therefore “Environment Friendly”:

For every 1 tonne of OPC produced, there is

- Release of 1 tonne of Co$_2$
- Use of 0.25 Tonne of coal
- Use of 1 tonne of Lime Stone
- 80 Units of Electricity
<table>
<thead>
<tr>
<th>Types Of Coal Ashes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLY ASH</strong></td>
</tr>
<tr>
<td>Collected in ESP’s.</td>
</tr>
<tr>
<td>Fine in size</td>
</tr>
<tr>
<td>Possess Pozzolanic Properties.</td>
</tr>
<tr>
<td><strong>BOTTOM ASH</strong></td>
</tr>
<tr>
<td>Collected at the bottom of furnace.</td>
</tr>
<tr>
<td>Coarse in size.</td>
</tr>
<tr>
<td>Useful as drainage material.</td>
</tr>
<tr>
<td><strong>POND ASH</strong></td>
</tr>
<tr>
<td>Fly Ash or bottom ash or a mixture of Bottom ash &amp; Fly Ash in any proportion</td>
</tr>
<tr>
<td>Conveyed in the form of water slurry</td>
</tr>
<tr>
<td>Collected in ash Pond.</td>
</tr>
<tr>
<td><strong>MOUND ASH</strong></td>
</tr>
<tr>
<td>Fly Ash or bottom ash</td>
</tr>
<tr>
<td>Conveyed in dry form &amp; deposited dry</td>
</tr>
</tbody>
</table>
TYPES OF ASHES

• Part 1 deals for use as Pozzolana in Cement and Concrete.
• Part 2 deals for use as Admixture in Cement Mortar and Concrete
• Siliceous Pulverized Fuel Ash-PFA with reactive CaO less than 10%-Produced from burning of Bituminous Coal
• Calcareous Pulverized Fuel Ash-PFA with reactive CaO more than 10%-Produced from burning of Lignite or Sub-Bituminous coal
• In India, except from Sikka & Neyveli, all other Power Stations produce Siliceous fly ash.
## CHEMICAL COMPOSITION OF FLYASH

<table>
<thead>
<tr>
<th>Item</th>
<th>Low Calcium FA (&lt; 10% CaO)</th>
<th>High Calcium FA (≥ 10% CaO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO$_2$</td>
<td>45-65</td>
<td>20-50</td>
</tr>
<tr>
<td>Al$_2$O$_3$</td>
<td>20-30</td>
<td>15-20</td>
</tr>
<tr>
<td>CaO</td>
<td>&lt; 10</td>
<td>15-30</td>
</tr>
<tr>
<td>Fe$_2$O$_3$</td>
<td>4-20</td>
<td>5-10</td>
</tr>
<tr>
<td>MgO</td>
<td>1-2</td>
<td>3-5</td>
</tr>
<tr>
<td>Alkalies</td>
<td>≤ 3</td>
<td>≤ 8</td>
</tr>
<tr>
<td>LOI</td>
<td>&lt; 5</td>
<td>&lt; 5</td>
</tr>
</tbody>
</table>
ASH DISPOSAL SYSTEM

There are 3 systems of ash disposal:

- **Wet System** ---- All NTPC Stations except Dadri

- **Dry System** ------ Dadri

- **High Concentration Slurry Disposal (HCSD) System**

---
AREAS OF ASH UTILIZATION
Fly Ash
**Pozzolana**
- Manufacture of Portland Pozzolana Cement
- Part replacement of OPC in Concrete works
- High Volume Fly Ash Conc
- Manufacture of Ash Bricks & other Building products
**Fly Ash**

- **Inert Filler Material**
  - Development of low lying areas
  - Road / Rail Embankments
  - Open cast & underground Mine filling

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Inert Filler Material
- Development of low lying areas
Fly Ash

Inert Filler Material
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Use as Micronutrient & Soil amendment
- Agriculture
- Wasteland Development
**Pozzolana**
- Manufacture of Portland Pozzolana Cement
- Part replacement of OPC in Concrete works
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**Inert Filler Material**
- Development of low lying areas
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- Open cast & underground Mine filling

**Fly Ash**

**Use as Micronutrient & Soil amendment**
- Agriculture
- Wasteland Development

**High Value Applications**
- Cenospheres
- Recovery of Metals
- Manufacture of Ceramics, Paints, synthetic wood
Salient Features of MoEF Gazette Notification
MoEF has issued a Gazette notification dated 14\textsuperscript{th} Sept. 99 and amendment dated 27-08-03 on Ash Utilization.

**PURPOSE:**

- Protect Environment.
- Conserve top soil.
- Prevent dumping of Fly Ash from Thermal Power Stations on land
- Promote utilization of ash in the manufacture of Building Materials and Construction activity.
Salient Features of MoEF NOTIFICATION (DTD.14.09.1999)

In the Gazette Notification, directives are in three parts:

- **Use of fly ash, bottom ash or pond ash in manufacture of bricks or tiles or blocks for use in construction activities**

- **100% utilization of Ash by all thermal power stations in**
  - 15 years for existing stations
  - 9 years for new stations

- **Specifications for use of Ash Based Products**
Salient Features of MoEF NOTIFICATION
(DTD.14.09.1999)

• Use at least 25% Ash in Manufacturing of Clay Bricks or tiles or blocks within a radius of 50 kms from thermal power station.

• Power Plants to issue ash free of cost for ten years.

• All existing power stations to plan for 100% Ash Utilization within 15 years.

• New power stations to plan for 100% Ash Utilization within 9 years.

• Construction Industry to use Ash and ash based products in construction works as per specifications.
Salient Features Of Amendment dtd. 27-08-03 to MoEF Notification

- Radius for Use of ash for brick increased from 50 kms to 100 kms.
- Buildings within a radius of 50 Kms to use ash based bricks / blocks /tiles in phased manner i.e.
  -- 50% by 31st August 2004.
  – 100% by 31st August 2005.
• Buildings within a radius of 50 to 100 Kms to use ash based bricks /blocks /tiles in phased manner i.e.
  - 25% by 31st August 2004
  - 50% by 31st August 2005
  - 75% by 31st August 2006
  - 100% by 31st August 2007

• It is responsibility of the construction agency, either undertaking the construction or approving the design or both to ensure the implementation of the above provision
Salient Features Of Amendment dtd. 27-08-03 to MoEF Notification (Contd.)

- Road / Flyover within 100 kms Radius of a Thermal Power Station to follow IRC SP:58 specifications.
- Soil required for top / side covers for embankments of roads / flyovers shall be excavated from the embankment site.
- Voids of borrowed area to be filled up with Ash.
- Reclamation of low lying areas within a Radius of 100 km of a thermal Power Plant to be done only with Pond Ash.
USE OF FLY ASH IN BUILDING PRODUCTS
Building Products

Major Utilization Areas.

- Clay fly ash bricks
- Ash bricks/blocks *
- Light Weight Aggregates (LWA)
- Cellular Light Weight Concrete Blocks (CLC) *
- Autoclaved Aerated Concrete Blocks (AAC)

* Can be manufactured at site.
Clay-ash Bricks and Fly ash lime / cement bricks.

- Clay ash and fly ash lime / cement bricks / blocks are of better quality than traditional clay bricks
- Fly ash lime / cement bricks / blocks can be manufactured as per the strength requirements and at construction site also
- CPWD has incorporated use of these bricks in their specifications and Delhi Schedule of Rates (DSR)
- To comply with the gazette notification, builders can set up their own fly ash bricks manufacturing plants
Ash Brick Manufacturing Plant - Hydraulic Machine
Hydraulic Press
Vibro Press
DADRI ASH BRICK MANUFACTURING PLANT

Stacks of Fly Ash Bricks
FLOOR TILES
NTPC - Sipat Township contd.

Construction of C-Type Quarters with Ash Bricks

Another View of C-Type Quarters
USE OF
Fly ASH
IN
CEMENT AND CONCRETE
What Is POZZOLANA?

Pozzolona is A Siliceous or Siliceous and Aluminous Material, which in itself possesses little or no cementitious value

but will, in finely divided form and in the presence of moisture,

Chemically react with Calcium Hydroxide at ordinary temperatures to form compounds possessing Cementitious properties
Portland Cement + Water

Cementitious Material

Free Lime

Fly Ash

Addl. Cementitious Material
Fly Ash = Cementitious Material - (Lime + Water)
Fly Ash * = Cementitious Material -(Lime+Water)
Fly Ash * = Cementitious Material -(Lime+Water)
Flyash Particles - Spherical shape
Flyash Particles-Spherical Shape
Fly Ash

Spherical fly ash particles offer ball-bearing effect

Median particle:
OPC 30 μ
Fly ash 20 μ
Use of Fly Ash in Cement & Concrete

- **Advantages of use of fly ash in cement & concrete**
  - Increased Strength
  - Increased Impermeability and Durability
  - Higher Resistance against Chemical Attack
  - Reduction in Cracking, Better Appearance
  - Reduction in Thermal Stress due to low heat of hydration
  - Lower cost
Codal Provisions

• As per Bureau of Indian standard IS-1489, fly ash up to 35% by weight conforming to IS 3812 can be used in manufacture of PPC.

• As per IS 456-2000, fly ash (conforming to IS: 3812) up to 35% by weight of cement can be used as Cementitious content in RCC works.

• Fly ash is, therefore, used in manufacture of Portland Pozzolana Cement (PPC) & as ingredient in concrete with Ordinary Portland Cement (OPC).

• CPWD vide its circular dtd. 13.05.2004 has allowed use of Fly Ash in Structural Concrete obtained from Ready Mixed Concrete (RMC) / batching plants.
EXAMPLES OF USE OF FLY ASH IN RCC WORKS

• Nuclear Power Corporation is using fly ash in construction works including TG Deck.

• DMRC is Using Fly Ash In Concrete of Tunneling Works

• RMC Plants Located In & Around Delhi / Mumbai are Using Fly Ash in Concrete

• DLF & Unitech have Used Fly Ash In Multistory House Building Projects Around Delhi
Fly Ash Processing

ESP Fields
Fly Ash Certification

Blain’s Fineness Apparatus
Fly Ash Transportation
Handling & Transportation of Ash for Cement / Concrete & Building Products

NTPC Badarpur Bagging Plant
Use of Ash
For
Controlled Low Strength Fill Material
(CLSM)
USE OF ASH AS CLSM

- Fly ash can be used in the manufacture of Controlled Low Strength Material (CLSM)

- CLSM is a fluid mixture made of 90-95% fly ash & 5-10% Portland Cement and sufficient quantity of water

- Can be poured in “All difficult to reach” cavities

- Settles within 24 hours

- No settlement after initial settlement
Use Of CLSM at Kahalgaon

NTPC Kahalgaon Switchyard
Use Of CLSM at Kahalgaon

NTPC Kahalgaon Switchyard
Control Low Strength Fill Material (CLSM)

- Flow able Fill (CLSM) being laid in road cut area
  ---Self levelling can be seen
Control Low Strength Fill Material (CLSM)

Applications

• Can be used in place of compacted soil as structural fill

• Restricted areas like narrow trenches, sanitary and storm sewer pipes, trenches of utilities, tunnels etc. wherein placing and compaction is difficult

• NTPC has experimented use of CLSM to control the growth of wild grass in switchyard area at Kahalgaon
<table>
<thead>
<tr>
<th>Year</th>
<th>Total Cement Prod$^n$</th>
<th>PPC Prodtn</th>
<th>% PPC Prodtn</th>
<th>Fly ash Utiliz$^n$</th>
<th>Fly Ash Utiliz$^n$ from NTPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-99</td>
<td>81.67</td>
<td>15.57</td>
<td>19.07</td>
<td>3.9</td>
<td>0.89</td>
</tr>
<tr>
<td>1999-00</td>
<td>94.21</td>
<td>21.30</td>
<td>22.61</td>
<td>5.32</td>
<td>1.19</td>
</tr>
<tr>
<td>2000-01</td>
<td>93.61</td>
<td>24.50</td>
<td>26.17</td>
<td>6.13</td>
<td>1.21</td>
</tr>
<tr>
<td>2001-02</td>
<td>102.40</td>
<td>32.29</td>
<td>31.53</td>
<td>8.07</td>
<td>1.69</td>
</tr>
<tr>
<td>2002-03</td>
<td>111.35</td>
<td>43.08</td>
<td>38.69</td>
<td>10.77</td>
<td>2.16</td>
</tr>
<tr>
<td>2003-04</td>
<td>117.5</td>
<td>52.12</td>
<td>44.36</td>
<td>11.35</td>
<td>3.10</td>
</tr>
<tr>
<td>2004-05</td>
<td>127.57</td>
<td>60.23</td>
<td>47.21</td>
<td>12.07</td>
<td>4.58</td>
</tr>
<tr>
<td>2005-06</td>
<td>141.81</td>
<td>74.04</td>
<td>52.19</td>
<td>16.28</td>
<td>5.82</td>
</tr>
</tbody>
</table>
PPC Production in India

Percentage

Year

92-93 93-94 94-95 95-96 96-97 97-98 98-99 99-00 00-01 01-02 02-03 03-04 04-05 05-06

93-94 95-96 97-98 99-00 01-02 02-03 03-04 05-06
VARIOUS TYPES OF CEMENT PRODUCTION IN INDIA, 2005-06(%)
USE OF ASH IN AGRICULTURE AND WASTELAND DEVELOPMENT
Advantages of FlyAsh Application

- Fly Ash Doses of 50 to 200 tonnes per Hectare every five years helps to:
  - Improve Soil Texture.
  - Reduces bulk density of soil
  - Improves water holding capacity.
  - Optimizes pH value.
  - Improves soil aeration.
  - Reduces crust formation.
  - Provides micro nutrients like Fe, Zn, Cu, Mo, B etc.
  - Provides macro nutrients like K, P, Ca etc.

- Improves the yield by 10 to 40%
Use of Ash in Mines
Mine Filling:

Ash can be gainfully utilized as:

- Stowing material in Underground Mines
- Filling material for reclamation of abandoned mines
- Filler material along-with overburden of an operating mines
Ash Stowing in Underground Mines

Coal Pillars

Ash Stowing

Baricades

Galleries
Mine Filling from NTPC Talcher-Thermal-Jagannath mine
Mine Filling from NTPC Talcher-Thermal -South Balanda

Mine filling going on in Pilot Quarry of South Balanda - Started since 26.09.2006
Mine Filling from NTPC Talcher-Thermal - Jagannath Mine

ASH DISPOSAL IN JAGANNATH MINE QUARRY
Mine Filling from NTPC Talcher-Thermal - Jagannath Mine

ASH DISPOSAL IN JAGANNATH MINE QUARRY
USE OF ASH IN ROADS & EMBANKMENT CONSTRUCTION
Did you know that coal ash is like a type of Soil?
Coal Formation

- Peat
- Lignite
- Coal

Factors:
- Time
- Pressure
- Heat
TYPES OF Soils

- Gravel
- Sand
- Silt
- Clay
- Silty_Clay Etc
<table>
<thead>
<tr>
<th>Parameter</th>
<th>SOIL (%)</th>
<th>Fly ash(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>61.2</td>
<td>61.0</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>14.1</td>
<td>24.8</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>3.2</td>
<td>4.9</td>
</tr>
<tr>
<td>CaO</td>
<td>0.6</td>
<td>1.8</td>
</tr>
<tr>
<td>MgO</td>
<td>0.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>
Roads & Embankments

Ash can be used in the following applications

- Core fill material for road/ rail embankment constructions
- As reinforced fill material
- Stabilization of soil sub-grade
- Sub- base / base course of flexible pavements
- Construction of semi- rigid / rigid pavements
<table>
<thead>
<tr>
<th>Property</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specific Gravity</strong></td>
<td>1.9-2.55</td>
</tr>
<tr>
<td>Plasticity</td>
<td>NP</td>
</tr>
<tr>
<td><strong>Maximum dry Density (MDD) (gm/cc)</strong></td>
<td>0.9 - 1.6</td>
</tr>
<tr>
<td>OMC(%)</td>
<td>38-18</td>
</tr>
<tr>
<td><strong>Cohesion( kN / m 2)</strong></td>
<td>Negligible</td>
</tr>
<tr>
<td><strong>Angle of internal friction (Ø)</strong></td>
<td>30º- 40º</td>
</tr>
<tr>
<td><strong>Coefficient of Consolidation – Cv</strong> (&lt; cm2 / sec)</td>
<td>1.75X10^-5- 2.01X10^-3</td>
</tr>
<tr>
<td>Compression Index Cc</td>
<td>0.05-0.4</td>
</tr>
<tr>
<td>Permeability (Cm/Sec)</td>
<td>8X10^-6 –7X10^-4</td>
</tr>
<tr>
<td>Property</td>
<td>Ash</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Coefficient of Uniformity</td>
<td>3.1 - 10.7</td>
</tr>
<tr>
<td><strong>Particle Size Distribution</strong> (%)</td>
<td></td>
</tr>
<tr>
<td>Clay Size Fraction</td>
<td>1-10</td>
</tr>
<tr>
<td>Silt Size Fraction</td>
<td>8-85</td>
</tr>
<tr>
<td>Sand Size Fraction</td>
<td>7-90</td>
</tr>
<tr>
<td>Gravel Size fraction</td>
<td>0-10</td>
</tr>
</tbody>
</table>
Fly Ash & IRC Specifications

• Indian Roads Congress Special Publication 58 (IRC:SP:58)-2001 details Guidelines For Use Of Fly Ash In Road Embankments.

• Fly Ash denotes any type of coal ash unless specifically mentioned.
Selected Earth Cover

Granular Layer

0.5 m (min)

1 to 3 m

Natural Ground Level

Ash

Typical Cross-Section of Embankment (Height < 3 m)
Pavement layers

Soil cover

Natural Ground Level

MoEF Notification dt 27.08.03
Typical Cross-Section of Embankment (Height > 3m)

- **Selected Earth Cover**
- **Granular Layer**: 0.5m (min)
- **Soil**: 1 to 3 m
- **Natural Ground Level**
Advantages Of Using Ash In Road Embankment

- Lower density than earth resulting in lower over burden pressure, advantageous in weak/ clayey sub-soil
- Hardly any measurable settlement over time due to low compressibility of compacted ash
- Speed of construction is faster as it can be compacted in wide range of moisture content
- Work can be taken up even in rainy season due to quick draining properties of loose ash
- Assured availability free of cost
- Eco- friendly since it replaces soil being taken from agriculture lands
Indian roads congress (IRC) has brought out Special Publication no.58 in March 2001 for use of ash in road embankments.

Ministry of Road Transport and Highways:
1. Has included Pond ash as embankment fill material (30.07.03).
2. Made use of Pond ash mandatory within 100 km radius of thermal Power Station (04.12.03).

IRC has also brought out Rural Road Manual under PM’s GRAMIN SADAK YOJNA which provides for use of ash in road works.

The design of ash embankment is similar to earthen embankment.
EXAMPLES OF USE OF POND ASH

- NHAI is utilizing 67 lac Cum Pond ash from NTPC Unchahar in Allahabad bypass embankment construction.

- About 22 lakh tonnes Pond ash used in Noida-Greater Noida express highway from NTPC Badarpur (Delhi)

- About 1.5 lakh tonnes used in second Nizzamuddin bridge approach road (Delhi)

- 15 lakh tonnes used for Delhi Metro Rail Corporation in Rail Car Depot at Delhi.

- Ash from Badarpur has been used as Reinforced Fill Material in Approach Embankment of Sarita-Vihar fly over at Delhi.
UNCHAHAR ASH POND
UNCHAHAR ASH POND
Reinforced Approach Embankment Using Pond Ash
NTPC Power Stations

[Map of India showing locations of NTPC power stations]
## Availability of Pond ash at NTPC Stations

### Northern Region

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Plant</th>
<th>Area of Ash Pond (Hect)</th>
<th>Qty of Pond Ash Available (Lac Cum) AS on March 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unchahar</td>
<td>303</td>
<td>77</td>
</tr>
<tr>
<td>2</td>
<td>Singrauli</td>
<td>255</td>
<td>420</td>
</tr>
<tr>
<td>3</td>
<td>Rihand</td>
<td>402</td>
<td>86</td>
</tr>
<tr>
<td>4</td>
<td>Tanda</td>
<td>85</td>
<td>66</td>
</tr>
<tr>
<td>4-A</td>
<td>Total NR Stations</td>
<td></td>
<td>649</td>
</tr>
</tbody>
</table>
## Availability of Pond ash at NTPC Stations
### National Capital Region

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Plant</th>
<th>Area of Ash Pond (Hect)</th>
<th>Qty of Pond Ash Available (Lac Cum) AS on March 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Badarpur</td>
<td>358</td>
<td>225</td>
</tr>
<tr>
<td>6</td>
<td>Dadri</td>
<td>---</td>
<td>131</td>
</tr>
<tr>
<td>6-A</td>
<td><strong>Total NCR Stations</strong></td>
<td></td>
<td><strong>356</strong></td>
</tr>
</tbody>
</table>
## Availability of Pond ash at NTPC Stations

### Eastern Region

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Plant</th>
<th>Area of Ash Pond (Hect)</th>
<th>Qty of Ash Available (Lac Cum) AS on March 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Kahalgaon</td>
<td>563</td>
<td>162</td>
</tr>
<tr>
<td>8</td>
<td>Farakka</td>
<td>687</td>
<td>233</td>
</tr>
<tr>
<td>9</td>
<td>Talcher-Kaniha</td>
<td>349</td>
<td>245</td>
</tr>
<tr>
<td>10</td>
<td>Talcher-Thermal</td>
<td>215</td>
<td>67</td>
</tr>
<tr>
<td>10-A</td>
<td>Total ER Stations</td>
<td></td>
<td>707</td>
</tr>
</tbody>
</table>
## Availability of Pond ash at NTPC Stations Western Region

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Plant</th>
<th>Area of Ash Pond (Hect)</th>
<th>Qty of Ash Available (Lac Cum) AS on March 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Vindhyachal</td>
<td>538</td>
<td>429</td>
</tr>
<tr>
<td>12</td>
<td>Korba</td>
<td>293</td>
<td>580</td>
</tr>
<tr>
<td>12</td>
<td><strong>Total WR Stations</strong></td>
<td></td>
<td><strong>1009</strong></td>
</tr>
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</table>
# Availability of Pond ash at NTPC Stations
## Southern Region

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Plant</th>
<th>Area of Ash Pond (Hect)</th>
<th>Qty of Ash Available (Lac Cum) AS on March 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Ramagundam</td>
<td>607</td>
<td>564</td>
</tr>
<tr>
<td>14</td>
<td>Simhadri</td>
<td>92</td>
<td>58</td>
</tr>
<tr>
<td>14-a</td>
<td>Total SR Stations</td>
<td></td>
<td>622</td>
</tr>
<tr>
<td>15</td>
<td>Total ash Pond Available in NTPC Stations As on 31-03-07</td>
<td>3343</td>
<td></td>
</tr>
</tbody>
</table>
MAGNITUDE OF PROBLEM IN INDIA

- The problem of Ash Management (Disposal & Utilization) in India is complicated due to the sheer amount of ash content in our coal.

COMPARISON OF COAL QUALITY

<table>
<thead>
<tr>
<th>Coal Data</th>
<th>India</th>
<th>USA / European Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash content</td>
<td>35-45%</td>
<td>8-10%</td>
</tr>
<tr>
<td>Calorific value</td>
<td>3000-4000</td>
<td>6000- 7000</td>
</tr>
<tr>
<td></td>
<td>(Kcal / Kg)</td>
<td></td>
</tr>
<tr>
<td>Ash production</td>
<td>220 gms</td>
<td>40 gms</td>
</tr>
<tr>
<td></td>
<td>(per unit of electricity)</td>
<td></td>
</tr>
</tbody>
</table>

*Ash Production in India is 5-6 times more per Kwh.*
Fly Ash is an Excellent Resource Material useful in Construction Industry.
THANK YOU
## What Is POZZOLANA?

Pozzolona is

A Siliceous or Siliceous and Aluminous material,

which in itself possesses little or no cementitious value

but will, in finely divided form and in the presence of moisture,

chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing **Cementitious properties**
Cenospheres are lightweight, inert, hollow sphere comprising largely of silica and alumina and filled with air and / or gases.
CENOSPHERES
Pavement layers

Soil cover

Soil cover

Ash

Natural Ground Level

MoEF Notification dt 27.08.03
 Particle size of Pond ash was not found as given in specifications.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Parameter</th>
<th>Range in LOA</th>
<th>Range in IRC SP:58</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clay size fraction(%)</td>
<td>2.7-4.5</td>
<td>1-10</td>
</tr>
<tr>
<td>2</td>
<td>Silt size fraction(%)</td>
<td>6.5-10</td>
<td>8-85</td>
</tr>
<tr>
<td>3</td>
<td>Sand size fraction(%)</td>
<td>67-90</td>
<td>7-90</td>
</tr>
<tr>
<td>4</td>
<td>Gravel size fraction</td>
<td>0-1</td>
<td>0-10</td>
</tr>
</tbody>
</table>
Handling / Transportation of Bottom Ash
Transportation of ash in Ash Pond
Transportation of ash in Ash Pond
NTPC DADRI ASH MOUND
NTPC Dadri Ash Mound
NTPC DADRI ASH MOUND
MDD = 1.34 gm/c.c
OMC = 21%

MDD = 2.05 gm/c.c
OMC = 9.2%