



International Journal of  
**Medicinal Chemistry & Analysis**

[www.ijmca.com](http://www.ijmca.com)

e ISSN 2249 - 7587

Print ISSN 2249 - 7595

**DETERMINATION OF NATURE OF COAL ASH SLURRY WITH  
RESPECT TO PHYSICO-CHEMICAL PARAMETERS FOR  
DIFFERENT COMPOSITION OF COAL**

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**ABSTRACT**

This research paper contains the abstract which is the research work based on Nature of Coal Ash Slurry with respect to physico-chemical parameters, Coal a fossil fuel which is the largest source of energy for the generation of electricity worldwide, as well as one of the largest worldwide anthropogenic sources of carbon dioxide emissions. Gross carbon dioxide emissions from coal usage are slightly more than those from petroleum and about double the amount from natural gas. Coal is extracted from the ground by mining, either underground or in open pits. Coal is the most important and abundant fossil fuel in India. It accounts for 63% of the country's energy need. India now ranks 3rd among the coal producing countries. Most of the coal production in India cumbersome open pit mines contributing over 80% of the total production. Although coal plays an important role in catering to energy needs, it also causes environmental damage during mining, transportation and processing. Here this research work explains that up to what extent coal ash will be acidic or alkaline in nature.

**Keywords:** Coal, Ash Slurry, Nature, Thermal Power Plant.

**INTRODUCTION**

Fly ash, also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. Ash which does not rise is termed bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants, and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide ( $\text{SiO}_2$ ) (both amorphous and crystalline) and calcium oxide ( $\text{CaO}$ ), both being endemic ingredients in many coal-bearing rock strata [1-5]. Toxic constituents depend upon the specific coal bed makeup, but may include one or more of the following

elements or substances found in trace quantities (up to hundreds ppm): arsenic, beryllium, boron, cadmium, chromium, hexavalent chromium, cobalt, lead, manganese, mercury, molybdenum, selenium, strontium, thallium, and vanadium.

In the past, fly ash was generally released into the atmosphere, but pollution control equipment mandated in recent decades now require that it be captured prior to release. In the US, fly ash is generally stored at coal power plants or placed in landfills. About 43% is recycled, often used as a pozzolan to produce hydraulic cement or hydraulic plaster or a partial replacement for Portland cement in concrete production [6-10].

**MATERIAL AND METHOD**

**Study Area**

The samples of coal ash slurry of different composition has been collected from the fly ash area of M/s Bhagwati Power and Steel Ltd. Siltara Raipur.

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This chapter records in a brief, the manifestation of the characterization of coal ash slurry like physical and chemical factors that affect the nature coal ash slurry. Various physico-chemical parameter/properties that affect the coal quality like, pH conductivities, Hardness, Chloride, Alkalinity etc. discussed in this chapter.

Methods of sampling and analysis of water is used as prescribed in Indian standard [11,12].

The purpose of this analysis is to determine the nature of fly ash water property i.e. weather it will be acidic or alkaline for the construction of immerse tank.

**RESULT AND DISCUSSION**

**Table 1. Analysis Report For Fly Ash Water Sample (10 % dolochar + 90 % ROM COAL)**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | Feb.2013         |         | Feb.2013               |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 7.44    | 8.24                   |
| Conductivity           | Micro siemens/cm | 262     | 250                    |
| Total Dissolved Solids | PPM              | 170     | 162                    |
| Total Alkalinity       | PPM              | 52      | 90                     |
| Total Hardness         | PPM              | 92      | 84                     |
| Calcium Hardness       | PPM              | 64      | 62                     |
| Magnesium Hardness     | PPM              | 28      | 22                     |
| Chloride               | PPM              | 30      | 22                     |
| Turbidity              | NTU              | 28      | 8.6                    |

**Table 2. Analysis Report For Fly Ash Water Sample (10 % dolochar + 90 % SOUTH AFRICAN COAL )**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | Feb.2013         |         | Feb.2013               |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 7.40    | 8.21                   |
| Conductivity           | Micro siemens/cm | 274     | 250                    |
| Total Dissolved Solids | PPM              | 181     | 149                    |
| Total Alkalinity       | PPM              | 48      | 86                     |
| Total Hardness         | PPM              | 90      | 82                     |
| Calcium Hardness       | PPM              | 64      | 62                     |
| Magnesium Hardness     | PPM              | 26      | 20                     |
| Chloride               | PPM              | 28      | 20                     |
| Turbidity              | NTU              | 26      | 7.6                    |

**Table 3. Analysis Report For Fly Ash Water Sample (10 % dolochar + 90 % INDONESIA COAL )**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | March.2013       |         | March.2013             |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 7.13    | 8.18                   |
| Conductivity           | Micro siemens/cm | 259     | 234                    |
| Total Dissolved Solids | PPM              | 166     | 154                    |
| Total Alkalinity       | PPM              | 44      | 88                     |
| Total Hardness         | PPM              | 96      | 84                     |
| Calcium Hardness       | PPM              | 66      | 62                     |
| Magnesium Hardness     | PPM              | 30      | 22                     |
| Chloride               | PPM              | 32      | 26                     |
| Turbidity              | NTU              | 24      | 6.6                    |

**Table 4. Analysis Report For Fly Ash Water Sample (20 % dolochar + 80 % ROM COAL)**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | March.2013       |         | March.2013             |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 7.26    | 8.10                   |
| Conductivity           | Micro siemens/cm | 284     | 252                    |
| Total Dissolved Solids | PPM              | 182     | 165                    |
| Total Alkalinity       | PPM              | 46      | 80                     |
| Total Hardness         | PPM              | 90      | 80                     |
| Calcium Hardness       | PPM              | 60      | 60                     |
| Magnesium Hardness     | PPM              | 30      | 20                     |
| Chloride               | PPM              | 34      | 26                     |
| Turbidity              | NTU              | 30      | 7.6                    |

**Table 5. Analysis Report For Fly Ash Water Sample (20 % dolochar + 80 % SOUTH AFRICAN COAL)**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | April.2013       |         | April.2013             |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 7.26    | 8.15                   |
| Conductivity           | Micro siemens/cm | 288     | 262                    |
| Total Dissolved Solids | PPM              | 190     | 171                    |
| Total Alkalinity       | PPM              | 50      | 88                     |
| Total Hardness         | PPM              | 102     | 88                     |
| Calcium Hardness       | PPM              | 68      | 66                     |
| Magnesium Hardness     | PPM              | 34      | 22                     |
| Chloride               | PPM              | 28      | 24                     |
| Turbidity              | NTU              | 24      | 7.5                    |

**Table 6. Analysis Report For Fly Ash Water Sample (20 % dolochar + 80 % INDONESIA COAL)**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | April.2013       |         | April.2013             |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 7.17    | 8.14                   |
| Conductivity           | Micro siemens/cm | 277     | 254                    |
| Total Dissolved Solids | PPM              | 171     | 158                    |
| Total Alkalinity       | PPM              | 46      | 84                     |
| Total Hardness         | PPM              | 98      | 82                     |
| Calcium Hardness       | PPM              | 70      | 58                     |
| Magnesium Hardness     | PPM              | 28      | 24                     |
| Chloride               | PPM              | 32      | 24                     |
| Turbidity              | NTU              | 22      | 5.6                    |

**Table 7. Analysis Report For Fly Ash Water Sample (30 % dolochar + 70 % ROM COAL)**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | May.2013         |         | May.2013               |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 6.99    | 8.05                   |
| Conductivity           | Micro siemens/cm | 282     | 255                    |
| Total Dissolved Solids | PPM              | 178     | 166                    |
| Total Alkalinity       | PPM              | 44      | 82                     |

|                    |     |     |     |
|--------------------|-----|-----|-----|
| Total Hardness     | PPM | 100 | 80  |
| Calcium Hardness   | PPM | 70  | 60  |
| Magnesium Hardness | PPM | 30  | 20  |
| Chloride           | PPM | 38  | 28  |
| Turbidity          | NTU | 24  | 7.6 |

**Table 8. Analysis Report For Fly Ash Water Sample(30 % dolochar + 70 % SOUTH AFRICAN COAL)**

| Observations           |                  | Make up water analysis |          |
|------------------------|------------------|------------------------|----------|
| Month                  | May.2013         |                        | May.2013 |
| Parameters             | Units            | Results                | Results  |
| Parameters             |                  |                        |          |
| Ph                     | ----             | 6.74                   | 7.98     |
| Conductivity           | Micro siemens/cm | 290                    | 262      |
| Total Dissolved Solids | PPM              | 192                    | 168      |
| Total Alkalinity       | PPM              | 44                     | 82       |
| Total Hardness         | PPM              | 104                    | 84       |
| Calcium Hardness       | PPM              | 70                     | 66       |
| Magnesium Hardness     | PPM              | 34                     | 18       |
| Chloride               | PPM              | 40                     | 26       |
| Turbidity              | NTU              | 33                     | 7.6      |

**Table 9. Analysis Report For Fly Ash Water Sample (30 % dolochar + 70 % INDONESIA COAL)**

| Observations           |                  | Make up water analysis |           |
|------------------------|------------------|------------------------|-----------|
| Month                  | June.2013        |                        | June.2013 |
| Parameters             | Units            | Results                | Results   |
| Parameters             |                  |                        |           |
| Ph                     | ----             | 6.64                   | 7.84      |
| Conductivity           | Micro siemens/cm | 288                    | 250       |
| Total Dissolved Solids | PPM              | 186                    | 170       |
| Total Alkalinity       | PPM              | 40                     | 80        |
| Total Hardness         | PPM              | 102                    | 84        |
| Calcium Hardness       | PPM              | 68                     | 66        |
| Magnesium Hardness     | PPM              | 34                     | 18        |
| Chloride               | PPM              | 38                     | 24        |
| Turbidity              | NTU              | 30                     | 7.2       |

**Table 10. Analysis Report For Fly Ash Water Sample (40 % dolochar + 60 % ROM COAL)**

| Observations           |                  | Make up water analysis |           |
|------------------------|------------------|------------------------|-----------|
| Month                  | June.2013        |                        | June.2013 |
| Parameters             | Units            | Results                | Results   |
| Parameters             |                  |                        |           |
| Ph                     | ----             | 6.60                   | 7.80      |
| Conductivity           | Micro siemens/cm | 290                    | 258       |
| Total Dissolved Solids | PPM              | 188                    | 176       |
| Total Alkalinity       | PPM              | 38                     | 70        |
| Total Hardness         | PPM              | 100                    | 82        |
| Calcium Hardness       | PPM              | 60                     | 62        |
| Magnesium Hardness     | PPM              | 30                     | 20        |
| Chloride               | PPM              | 38                     | 24        |
| Turbidity              | NTU              | 30                     | 7.2       |

**Table 11. Analysis Report For Fly Ash Water Sample(40 % dolochar + 60 % SOUTH AFRICAN COAL)**

| Observations |           | Make up water analysis |           |
|--------------|-----------|------------------------|-----------|
| Month        | July.2013 |                        | July.2013 |

| Parameters             | Units            | Results | Results |
|------------------------|------------------|---------|---------|
| Parameters             |                  |         |         |
| Ph                     | -----            | 6.58    | 7.60    |
| Conductivity           | Micro siemens/cm | 274     | 218     |
| Total Dissolved Solids | PPM              | 172     | 162     |
| Total Alkalinity       | PPM              | 36      | 70      |
| Total Hardness         | PPM              | 86      | 70      |
| Calcium Hardness       | PPM              | 60      | 50      |
| Magnesium Hardness     | PPM              | 26      | 20      |
| Chloride               | PPM              | 26      | 20      |
| Turbidity              | NTU              | 42      | 9.2     |

**Table 12. Analysis Report For Fly Ash Water Sample (40 % dolochar + 60 % INDONESIA COAL )**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | July.2013        |         | July.2013              |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 6.28    | 7.58                   |
| Conductivity           | Micro siemens/cm | 270     | 210                    |
| Total Dissolved Solids | PPM              | 170     | 160                    |
| Total Alkalinity       | PPM              | 32      | 66                     |
| Total Hardness         | PPM              | 80      | 58                     |
| Calcium Hardness       | PPM              | 50      | 40                     |
| Magnesium Hardness     | PPM              | 26      | 18                     |
| Chloride               | PPM              | 24      | 18                     |
| Turbidity              | NTU              | 40      | 9.2                    |

**Table 13. Analysis Report For Fly Ash Water Sample(50 % dolochar + 50 % ROM COAL)**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | August.2013      |         | August.2013            |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 7.40    | 7.50                   |
| Conductivity           | Micro siemens/cm | 262     | 210                    |
| Total Dissolved Solids | PPM              | 170     | 160                    |
| Total Alkalinity       | PPM              | 44      | 62                     |
| Total Hardness         | PPM              | 90      | 58                     |
| Calcium Hardness       | PPM              | 60      | 40                     |
| Magnesium Hardness     | PPM              | 30      | 18                     |
| Chloride               | PPM              | 30      | 18                     |
| Turbidity              | NTU              | 42      | 10                     |

**Table 14. Analysis Report For Fly Ash Water Sample(50 % dolochar + 50 % SOUTH AFRICAN COAL)**

| Observations           |                  |         | Make up water analysis |
|------------------------|------------------|---------|------------------------|
| Month                  | August.2013      |         | August.2013            |
| Parameters             | Units            | Results | Results                |
| Parameters             |                  |         |                        |
| Ph                     | -----            | 7.26    | 7.52                   |
| Conductivity           | Micro siemens/cm | 276     | 214                    |
| Total Dissolved Solids | PPM              | 180     | 162                    |
| Total Alkalinity       | PPM              | 48      | 60                     |
| Total Hardness         | PPM              | 92      | 56                     |

|                    |     |    |    |
|--------------------|-----|----|----|
| Calcium Hardness   | PPM | 62 | 40 |
| Magnesium Hardness | PPM | 30 | 16 |
| Chloride           | PPM | 30 | 20 |
| Turbidity          | NTU | 40 | 10 |

**Table 15. Analysis Report For Fly Ash Water Sample(50 % dolochar + 50 % INDONESIA COAL )**

| Observations           |          |         | Make up water analysis |
|------------------------|----------|---------|------------------------|
| Month                  | Sep.2013 |         | Sep.2013               |
| Parameters             | Units    | Results | Results                |
| Parameters             |          |         |                        |
| Ph                     | ----     | 7.16    | 7.62                   |
| Conductivity           | PPM      | 270     | 210                    |
| Total Dissolved Solids | PPM      | 188     | 166                    |
| Total Alkalinity       | PPM      | 52      | 68                     |
| Total Hardness         | PPM      | 86      | 58                     |
| Calcium Hardness       | PPM      | 60      | 40                     |
| Magnesium Hardness     | PPM      | 26      | 18                     |
| Chloride               | PPM      | 28      | 22                     |
| Turbidity              | NTU      | 32      | 8.5                    |

From above results it is clear that the fly ash of almost all coal compositions is acidic in nature since pH of coal ash slurry is lesser than the pH of makeup water.

## CONCLUSION

Fly ash water samples from power station were tested for a series of physico-chemical properties. Most of the fly ashes were primarily fine sand- and silt-sized particles. The pH showed considerable variation as per the different composition of coal of fly ash water sample. The considerable variability in physical and chemical

properties among the fly ash water samples evaluated in the present study supports the notion that field trials are essential to the future development of fly ash amendment strategies. Moreover this lower pH values shows the acidic nature of fly ash water as per the mentioned results in the table in comparison of the makeup water pH.

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