# **Characterization Report**

Sample Description: Fly Ash Samples from Kharia and VindNagar

## a. X-Ray Fluorescence Spectroscopy



## Fly ash Composition - Kharia

Compound	Na	Mg	AI	Si	P	S	CI	K	Ca	Ti	V	Cr	Mn
Conc	0.000	0.000	16.385	43.820	1.527	0.035	1.321	3.535	2.294	4.807	0.105	0.075	0.269
Unit	%	%	%	%	%	%	%	%	%	%	%	%	%

Compound	Fe	Ni	Cu	Zn	Ga	As	Rb	Sr	Y	Zr	Nb	Ba	Eu
Conc Unit	23.519	0.075	0.085	0.083	0.038	0.000 %	0.081	0.233	0.069	0.481	0.041 %	0.823	0.182

Compound	Yb	Re	Ir	Pb	Th
Conc	0.031	0.005	0.000	0.049	0.032
Unit	%	%	%	%	%

#### Fly ash Composition - VindNagar

Compound	Na	Mg	AI	Si	P	S	CI	K	Ca	Ti	V	Cr	Mn
Conc	0.000	0.000	14.548	38.787	2.977	0.000	2.343	2.970	3.239	5.141	0.123	0.070	0.273
Unit	%	%	%	%	%	%	%	%	%	%	%	%	%

Compound	Fe	Ni	Cu	Zn	Ga	As	Rb	Sr	Y	Zr	Nb	Ba	Eu
Conc	25.334	0.118	0.143	0.144	0.077	0.000	0.101	0.395	0.104	0.621	0.068	1.995	0.221

Compound	Yb	Re	Ir	Pb	Th
Conc	0.044	0.015	0.000	0.100	0.048
Unit	%	%	%	%	%

## **Remarks:**

The concentration of calcium content in both samples is below <10%, indicating a **Class F Fly Ash**. The sources of this class are generally Bituminous or Anthracite coal. Class F fly ash shows pozzolanic properties in the presence of an activator. Some of the detected rare earth elements are : **Europium (Eu)** [0.182% to 0.221%], **Yttrium (Y)** [0.069% to 0.104%], **Ytterbium (Yb)** [0.031% to 0.044%].

b. Scanning Electron Microscopy (SEM) and Energy Dispersive X-Ray Spectroscopy (EDS)



SEM Image Fly Ash: Kharia



SEM Fly Ash: VindNagar

EDS - Kharia (Spectrum 1-3 including Carbon and 4-5 excluding Carbon)





EDS - VindNagar (Spectrum 1-3 including Carbon and 4-5 excluding Carbon)



**Remarks:** Fly Ash Particles are spherical in nature. Most of the particles were observed to have a diameter below 10  $\mu$ m. EDS spectrum of individual particles shows signals of Al,Si,Fe,Ti, Ca, and K as major elements with Oxygen (O), suggesting the presence of possible oxides of those elements.

## c. X-Ray Diffraction



**Remarks:** The signals confirm the presence of Mullite (3Al<sub>2</sub>O<sub>3</sub>.2SiO<sub>2</sub>), Quartz (2SiO<sub>2</sub>), Magnetite (Fe<sub>3</sub>O<sub>4</sub>) and Hematite (Fe<sub>2</sub>O<sub>3</sub>).

#### **Conclusion:**

- Class F Fly Ash
- Major elements are Si, Al, Fe and Ti.
- Trace amount of rare earth elements Europium (Eu) [0.182% to 0.221%],
  Yttrium (Y) [0.069% to 0.104%], Ytterbium (Yb) [0.031% to 0.044%].