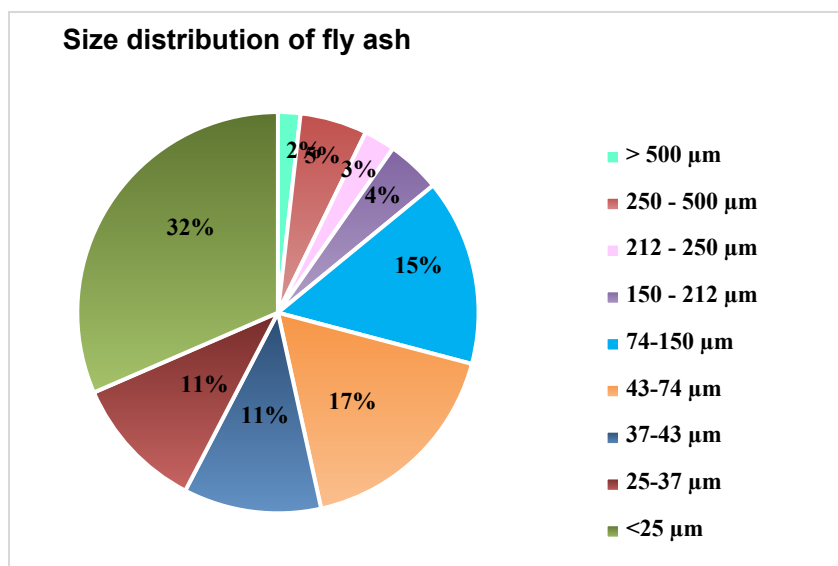


Separation of coal combustion residue for critical element extraction and other bulk uses

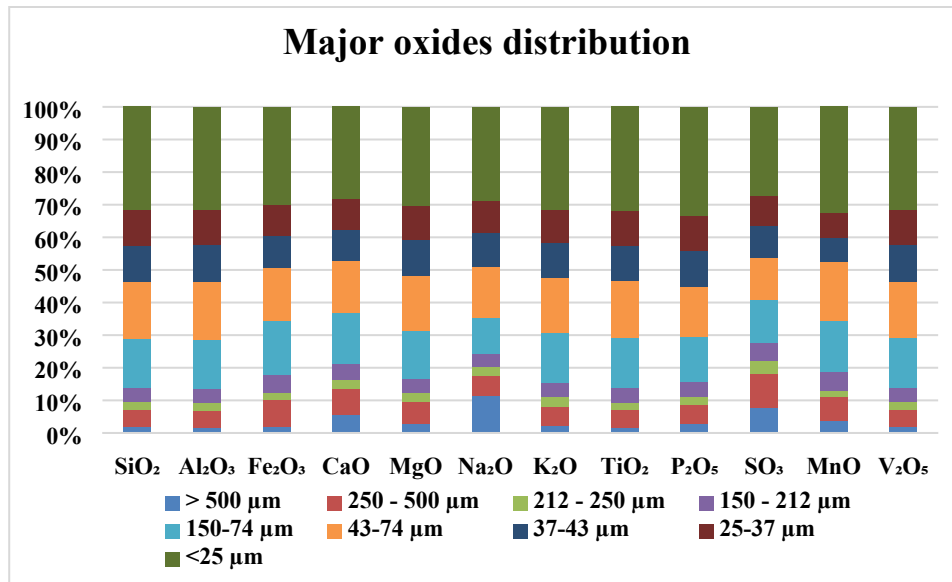
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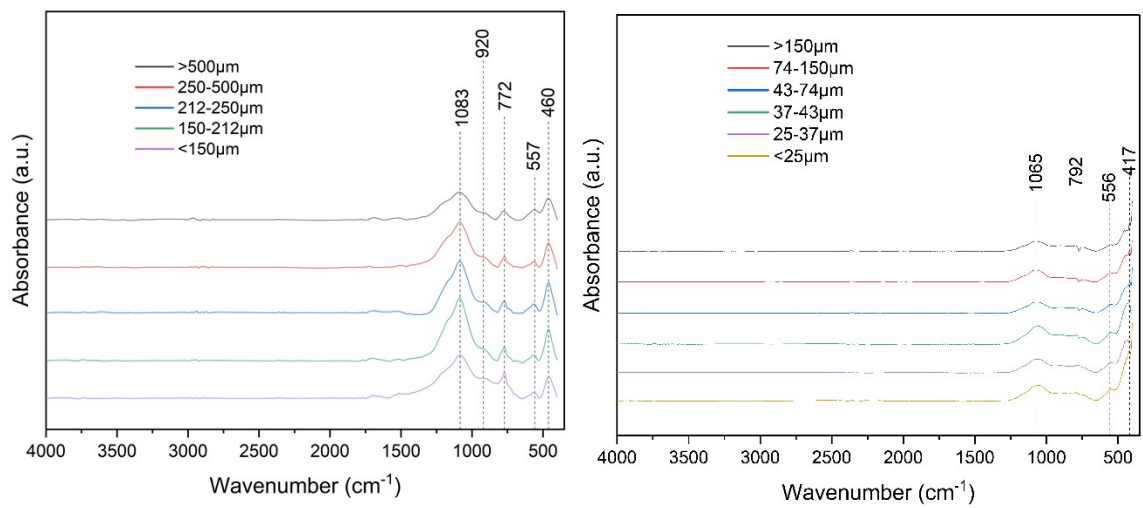
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Suppl. Fig 1. Size distribution of fly ash



Suppl. Fig. 2, Distribution of major oxides in different size fraction of fly ash



Suppl. Fig. 3 FTIR spectra of different size fractions of fly ash

Suppl. Table 1: Day-wise variation of pH, LOI, electrical conductivity and major oxide composition in Talcher fly ash.

	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Day-7	Mean	SD
pH (1:2.5)	6.6	6.14	5.95	6.26	6.18	5.75	6.21	6.16	0.26
EC ($\mu\text{S}/\text{cm}$)	446	759	140.7	355	201	140.4	163	315	228
Major	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Day-7	Mean	SD
Al ₂ O ₃ (%)	26.1	24.6	24.9	25.4	25.1	25.5	26.1	25.4	0.57
CaO (%)	1.53	0.94	1.15	1.08	1.08	0.90	0.94	1.09	0.22
Fe ₂ O ₃ (%)	4.53	4.02	3.83	4.02	3.87	3.91	4.14	4.05	0.24
K ₂ O (%)	1.71	1.41	2.08	2.38	2.19	2.26	1.65	1.95	0.36
MgO (%)	0.58	0.53	0.48	0.50	0.46	0.52	0.58	0.52	0.05
Na ₂ O (%)	0.17	4.05	3.88	3.71	3.69	3.55	3.94	3.28	1.38
P ₂ O ₅ (%)	1.08	0.63	0.74	0.72	0.68	0.59	0.63	0.72	0.17
SO ₃ (%)	0.31	0.20	0.13	0.26	0.14	0.17	0.11	0.19	0.07
SiO ₂ (%)	59.8	59.7	59.3	57.8	59.0	58.7	58.0	58.9	0.78
TiO ₂ (%)	1.80	1.65	1.55	1.52	1.59	1.63	1.59	1.62	0.09
MnO (%)	0.07	0.07	0.06	0.06	0.07	0.07	0.07	0.07	0.00
V ₂ O ₅ (%)	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00
LOI (%)	0.65	0.39	0.31	0.57	0.35	0.48	0.42	0.45	0.12
Total	98.4	98.2	98.4	98.1	98.2	98.3	98.2	98.3	-

Suppl. Table 2: - Day-wise variation of trace elements concentration in Talcher fly ash.

(mg/Kg)	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Day-7	Mean	Stdev	CV (%)	World coal ash
Ba	515	465	712	744	756	654	630	639	113	17.6	940
Co	24.9	32.3	35.3	36.8	35.5	35.0	36.3	33.7	4.10	12.3	32.0
Cr	105	56.8	116	135	118	157	93.8	112	31.8	28.5	100
Cu	70.4	62.0	71.5	77.5	67	76.8	65.8	70.1	5.7	8.1	92.0
Ga	32.4	33.1	34.6	33.5	34.8	35.2	32.7	33.8	1.11	3.28	33.0
Li	50.1	62.0	66.0	74.0	63.5	60.5	65.3	63.1	7.20	11.4	66.0
Ni	33.8	57.0	75.0	73.0	74.3	81.0	60.5	64.9	16.1	24.9	76.0
Sr	165	141	167	172	164	153	157	160	10.5	6.57	740

* World coal ash data from (Ketriss and Yudovich, 2009)

Suppl. Table 3: Day wise variation of REY concentration in Talcher fly ash (BDL, below detection limit, i.e. < 0.25 mg/kg)

	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Day-7	mean	SD
Ce	88.7	58.5	63.8	58.3	70.5	61.3	71.3	67.5	10.7
Dy	5.50	BDL	BDL	BDL	BDL	BDL	6.00	5.75	0.35
Er	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-
Eu	2.1	2.25	2.75	3.25	2.5	2.25	2.00	2.4	0.44
Gd	23.5	23.5	29.5	34.0	30.8	31.3	28.8	28.8	3.95
Ho	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-
La	41.6	71.0	75.3	76.5	75.0	75.0	80.3	70.7	13.1
Lu	1.10	1.75	1.75	1.50	1.25	1.25	1.25	1.41	0.26
Nd	101	75.0	88.3	105	103	97.5	103	96.1	10.8
Pr	54.2	60.8	58.3	54.3	65.8	62.8	73.3	61.3	6.76
Sc	24.0	17.5	18.0	18.5	18.3	17.8	18.8	19.0	2.26
Sm	39.0	76.0	57.5	66.3	61.8	71.8	79.3	64.5	13.6
Tb	16.0	29.3	16.3	17.5	BDL	17.5	13.0	18.3	5.63
Tm	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-	-
Y	38.4	44.5	48.3	49.3	47.8	46.5	48.0	46.1	3.72
Yb	4.80	2.25	3.50	3.25	2.75	2.75	3.50	3.26	0.82
REY	440	462	463	487	479	488	529	478	27.8
LREY	325	341	343	360	376	368	407	360	27.2
MREY	86	100	97	104	81	98	98	94.6	8.20
HREY	5.90	4.00	5.25	4.75	4.00	4.00	4.75	4.66	0.73
Critical	163	151	156	175	153	164	172	162	9.30
Uncritical	158	231	221	231	233	241	262	225	32.1
Excessive	94.6	62.5	69.0	63.0	74.5	65.3	76.0	72.1	11.2
Coutl	1.03	0.65	0.71	0.76	0.66	0.68	0.66	0.72	0.14

Reference

Ketris, M.á., Yudovich, Y.E., 2009. Estimations of Clarkes for Carbonaceous biolithes: World averages for trace element contents in black shales and coals. *International journal of coal geology* 78, 135-148.