APPLICATIONS FOR HIGH CARBON PULVERISED FUEL ASH

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Outline

- Background
- Aim
- Project plan
- Experimental work
- Conclusions
- Acknowledgements

Background

- Coal Combustion by-Products (generation)
- Alternative fuels & Marketability
- High carbon pulverised fuel ash

Aim

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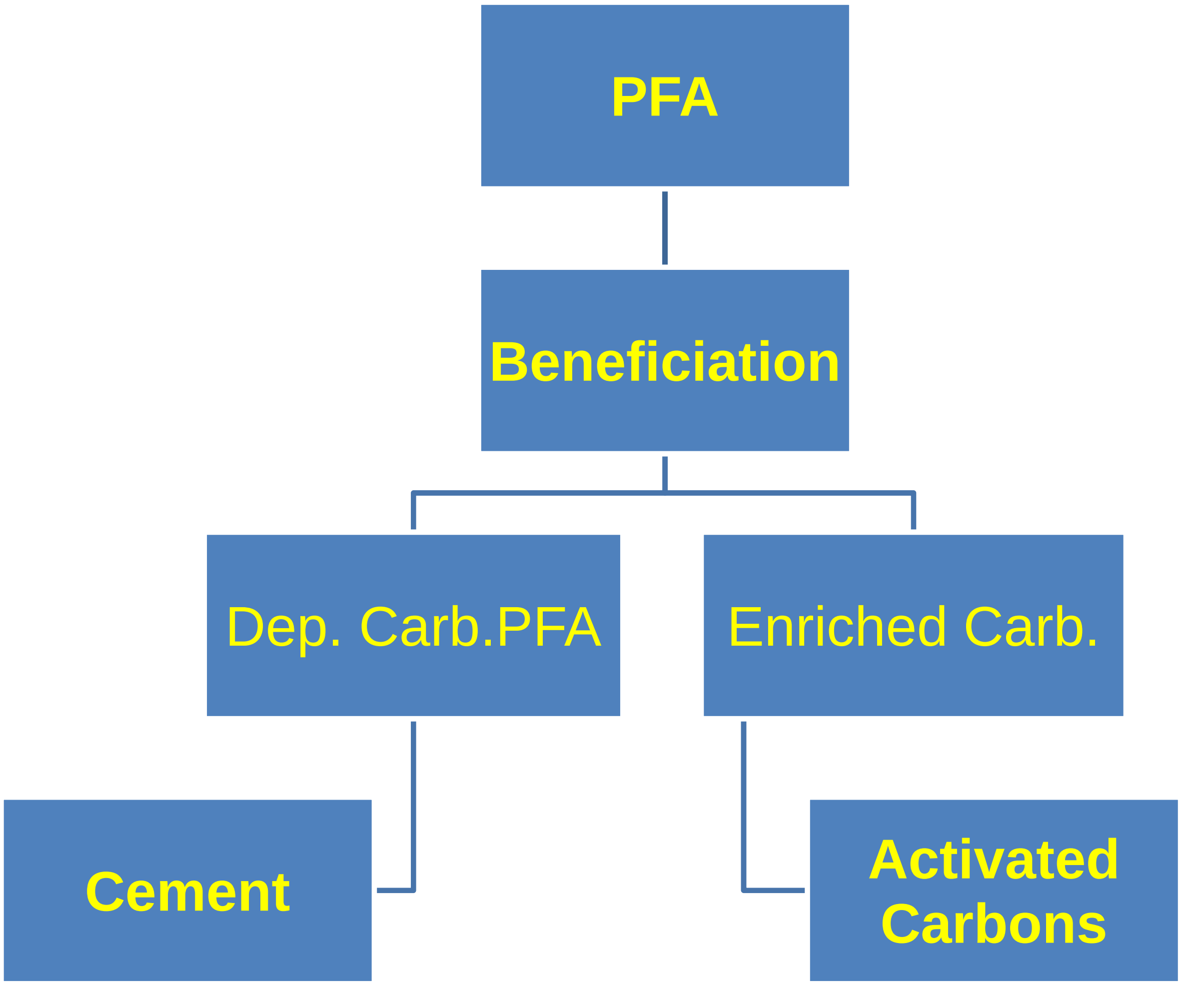
- Characterise high carbon PFAs produced from biomass and import coals.

- Identify applications for carbon-rich material produced by PFA beneficiation of biomass and import coals.

Project plan



EXPERIMENTAL WORK

Samples details

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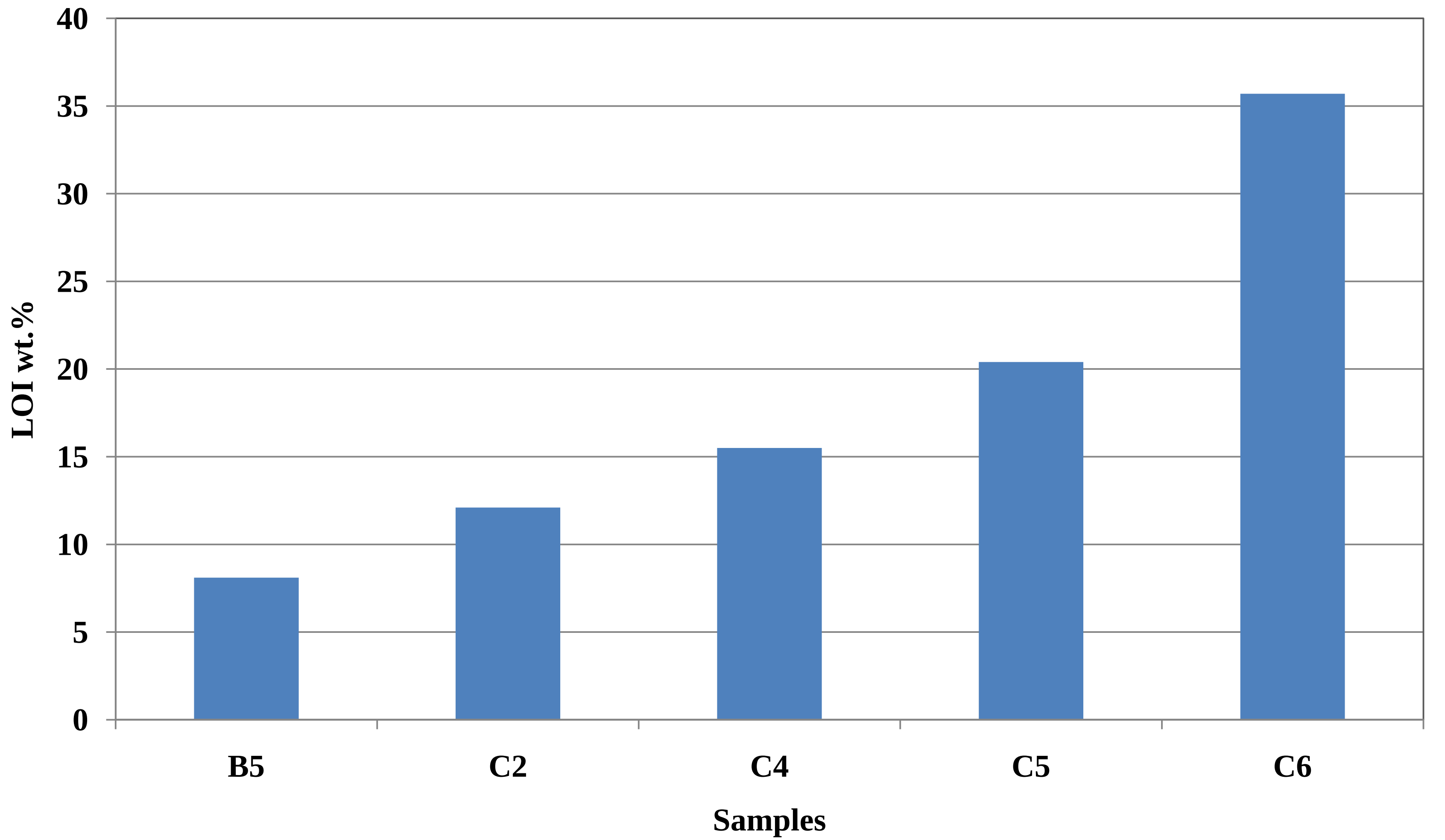
Samples	Collection device	Fuel type	LOI wt. %
P.S-1			
C1	Electrostatic Precipitator	Coal (La Loma-Colombian	3.6
C2	Mechanical Separator	Coal (La Loma-Colombian	12.1
B1	Electrostatic Precipitator	S.F 7% + Coal (Russia)	5.7
P.S.-2			
C3	Electrostatic Precipitator	Coal (Pittsburgh-US)	8.8
C4		Coal (Pittsburgh-US)	15.5
C5		Coal (Pittsburgh-US)	20.4
C6		Coal (Pittsburgh-US)	35.7
C7		Coal (Pittsburgh-US)	8.6
C8		Coal (Pittsburgh-US)	9.5
P.S.3			
C9		Coal (Russia)	8.2
C10		Coal (Russia)	5.0
B2	Electrostatic Precipitator	Oat 3%+ Coal (Russia)	6.1
B3	Economiser	Oat 5%+ Coal (Russia)	5.8
B4	Economiser	Oat 5%+ Coal (Russia)	3.9
B5	Electrostatic Precipitator	Oat 5%+ Coal (Russia)	8.1
B6		Oat 5%+ Coal (Russia)	5.4

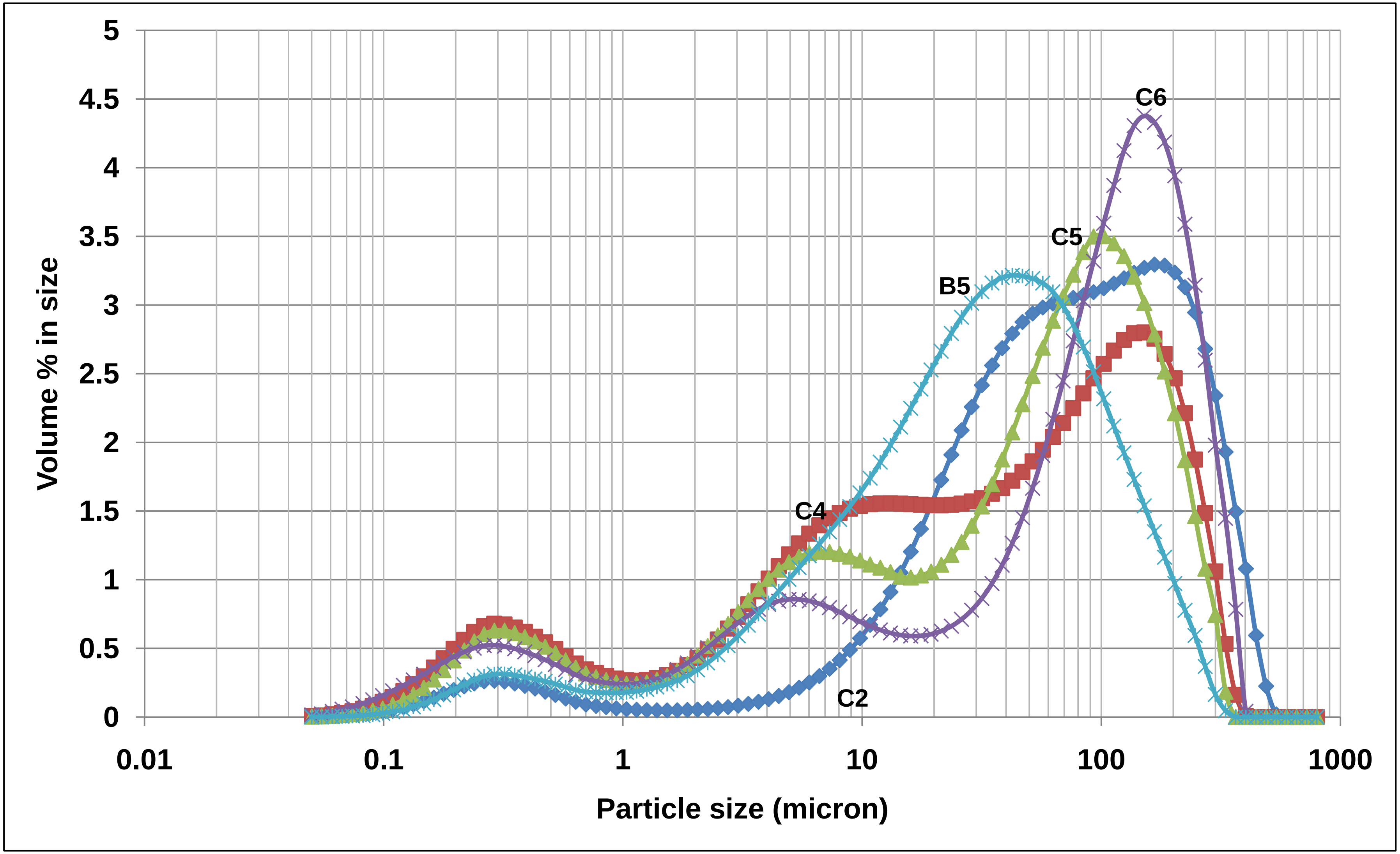
LOI analyses



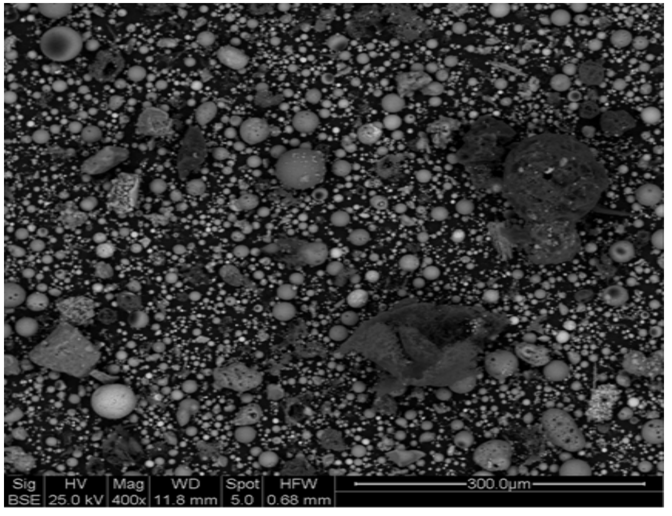
Surface area (BET)

Samples	LOI wt.%	BET m^2/g
C10	5.0	6.6
B2	6.1	9.7
B3	5.8	10.2
B4	3.9	7.2
B5	8.1	17.0
B6	5.4	10.6

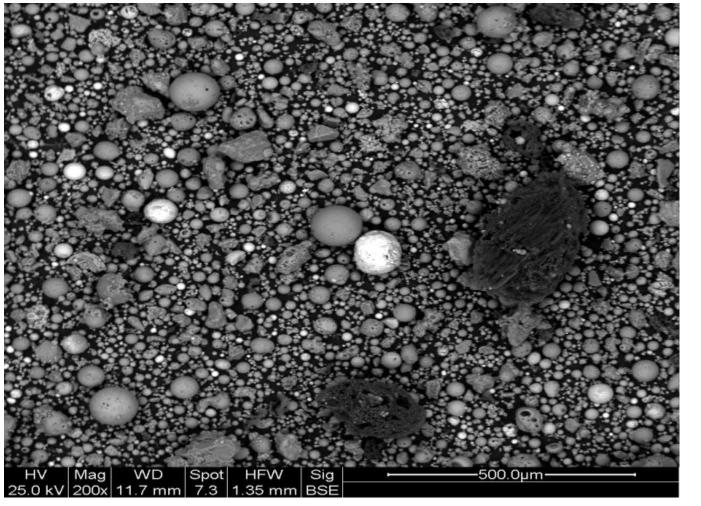
Particle size distribution-Water



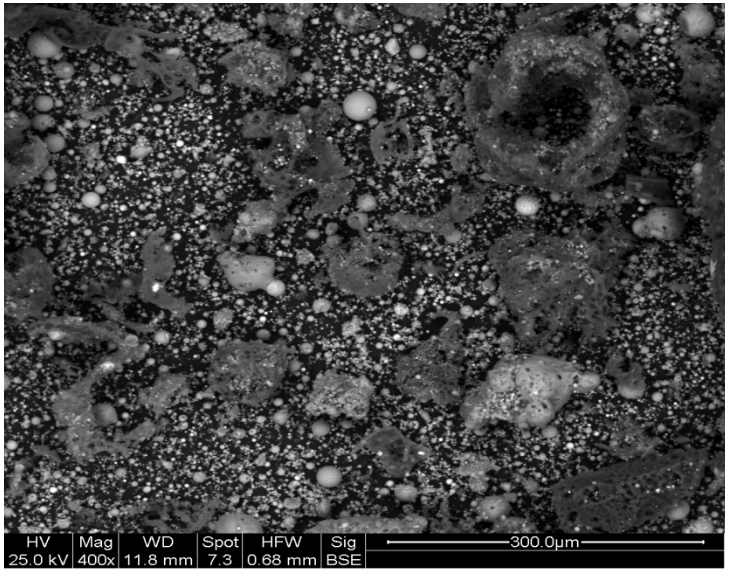
SEM studies



B5



C2

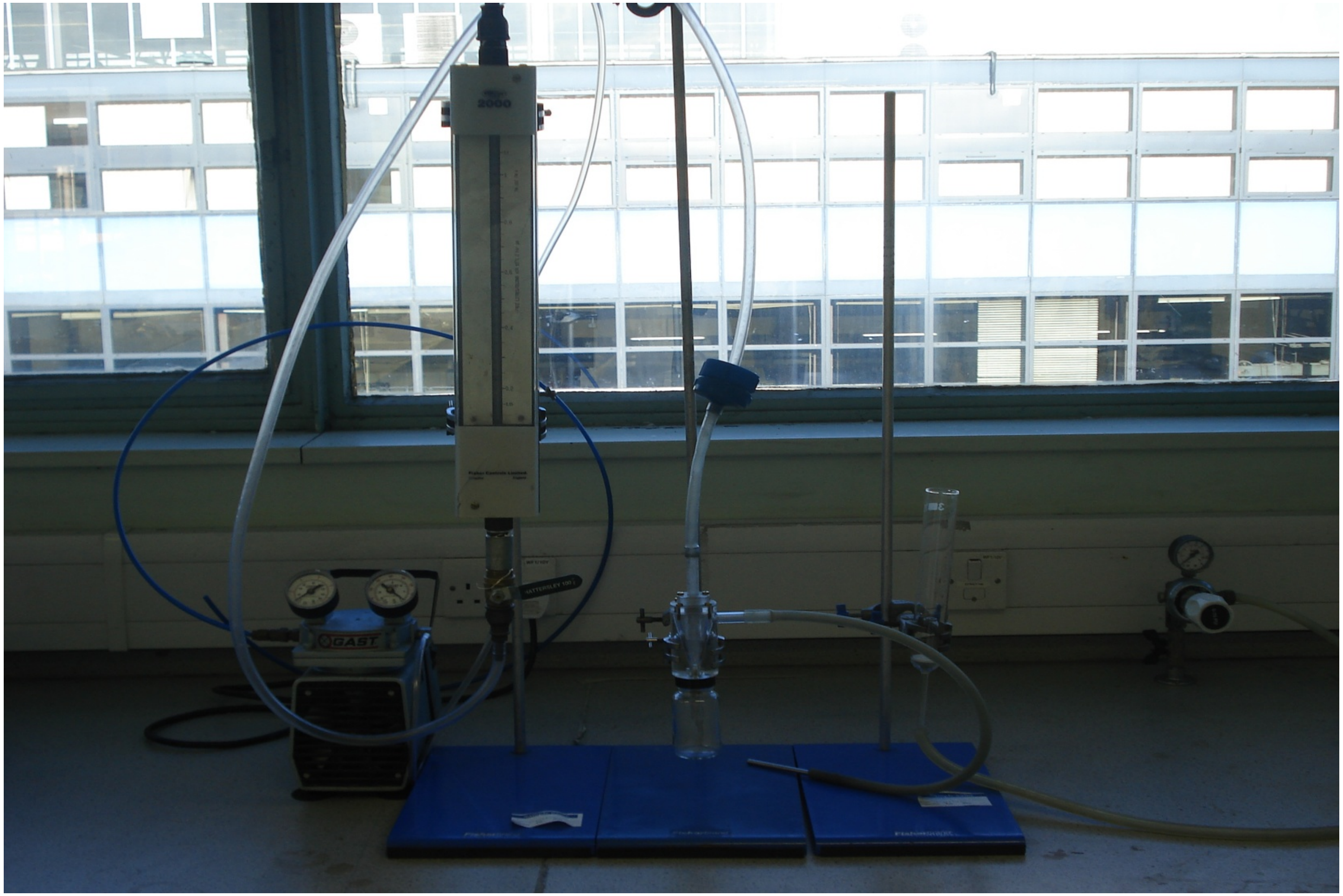


C6

High carbon PFA utilisation

1. PFA beneficiation
   – Incipient fluidisation
   – Thermal treatment using microwave (vitrification)
2. Cement tests
3. Carbon activation

Incipient fluidisation



I.F. results

Samples	LOI (wt.%) parent fly ash	LOI (wt.%) for ash stream	Efficiency %	Yield % for fly ash	LOI (wt.%) for carbon stream	Yield % for carbon
B5	8.1	4	51	49.4	60.5	50.6
C2	12.1	1.5	88	12.4	81.5	87.6
C4	15.5	5.3	66	34.2	37.2	65.8
C5	20.4	8.5	58	41.7	40.2	58.3
C6	35.7	11.7	67	32.8	55.2	67.2

Microwave treatment

B1

LOI wt.%= 5.7

B3

LOI wt.%= 5.8

Cement tests

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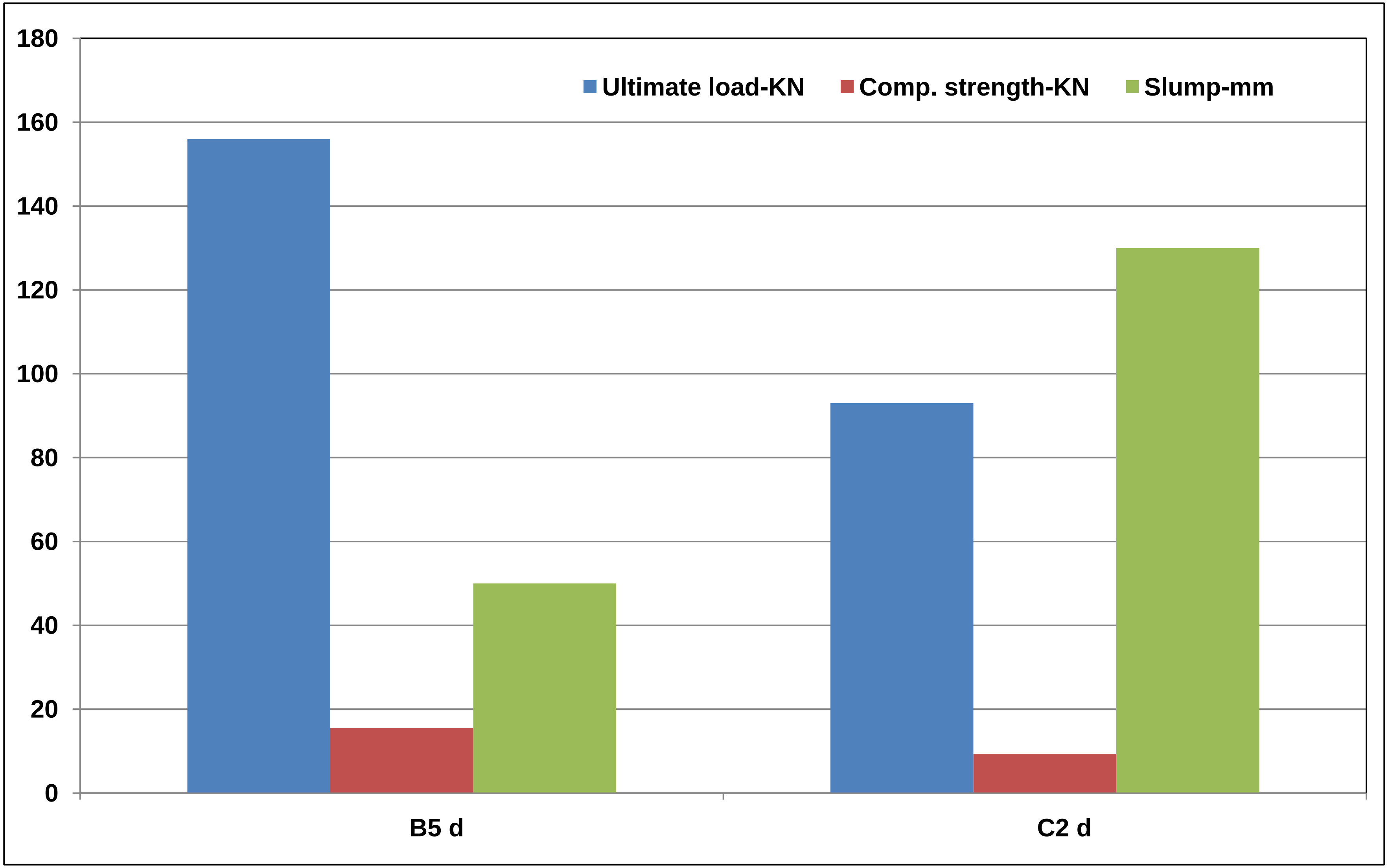
Material	Kg-(10%-mixture)
Cement	1.7
Coarse aggregates	6.86
Fine aggregates	6.3
PFA-B5d & C2d	0.189
H_2O	1400 ml
AEA	9.5 ml

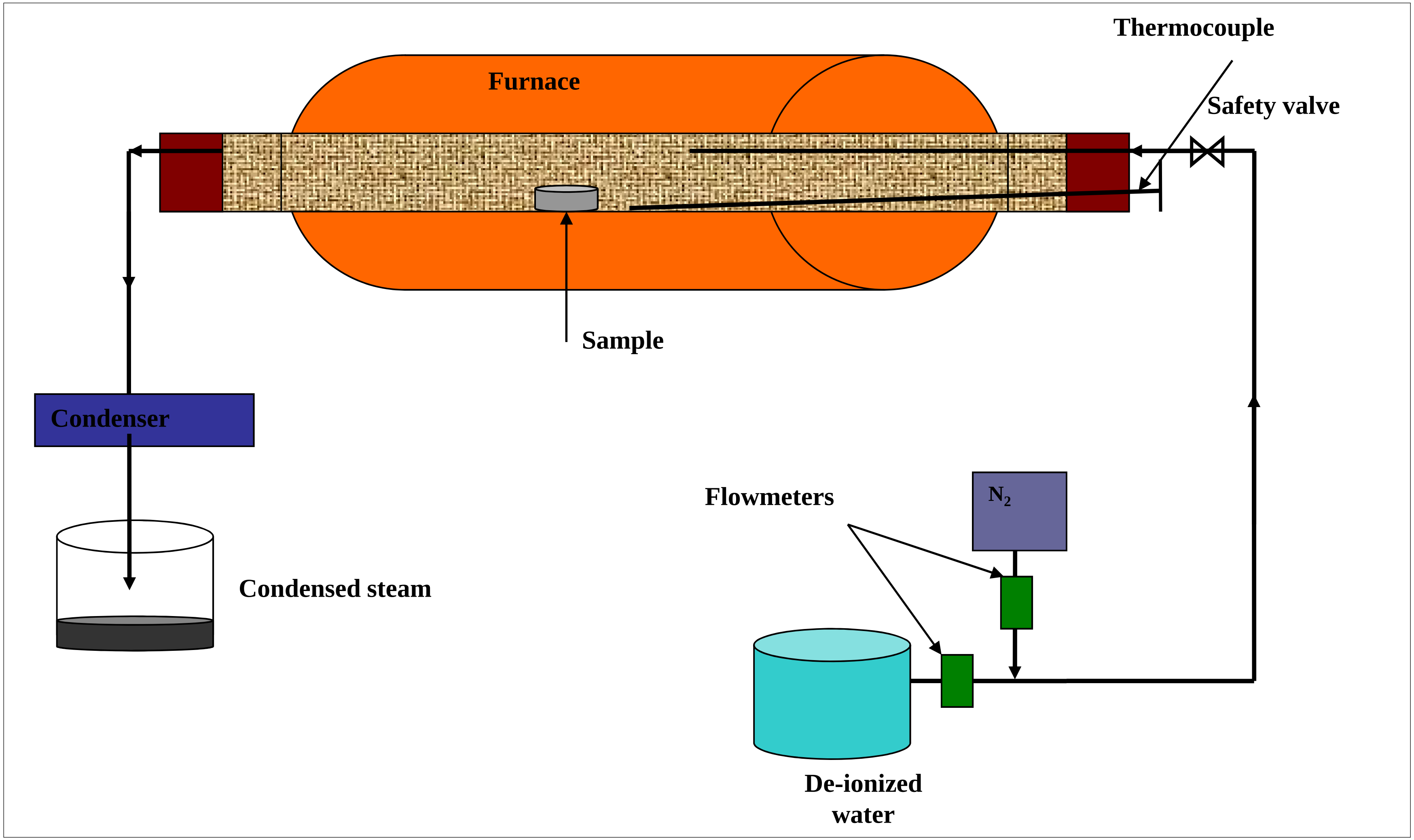
Cement results



ICP-AES analyses

Minerals oxides	B5	C2	C4	B5d	C2d	C4d
Fe 273.955	8.20	14.89	12.22	8.82	12.78	13.66
Al 396.153	19.92	15.49	20.70	20.20	16.87	24.94
Mg 280.271	2.33	2.41	1.52	2.54	2.24	1.73
Mn 257.610	0.11	0.16	0.10	0.11	0.11	0.10
Mn 294.920						
Ti 334.940	0.88	0.66	0.92	0.93	0.77	1.11
Ca 317.933	5.83	3.17	3.86	6.12	3.08	4.36
Ca 422.673						
Ca 315.887						
S 180.669	0.56	0.60	1.36	0.63	0.48	1.45
P 178.221	0.59	0.86	0.49	0.72	0.64	0.53
P 177.434						
Na 589.592	1.36	0.84	0.95	1.33	0.86	1.11
K 766.490	2.01	1.42	1.91	2.02	1.56	2.16
S 181.975						
Si 251.611	57.12	58.31	48.09	56.83	61.17	51.90
Si 212.412						
	98.90	98.80	92.14	100.26	100.56	103.04

Carbon activation



Carbon activation

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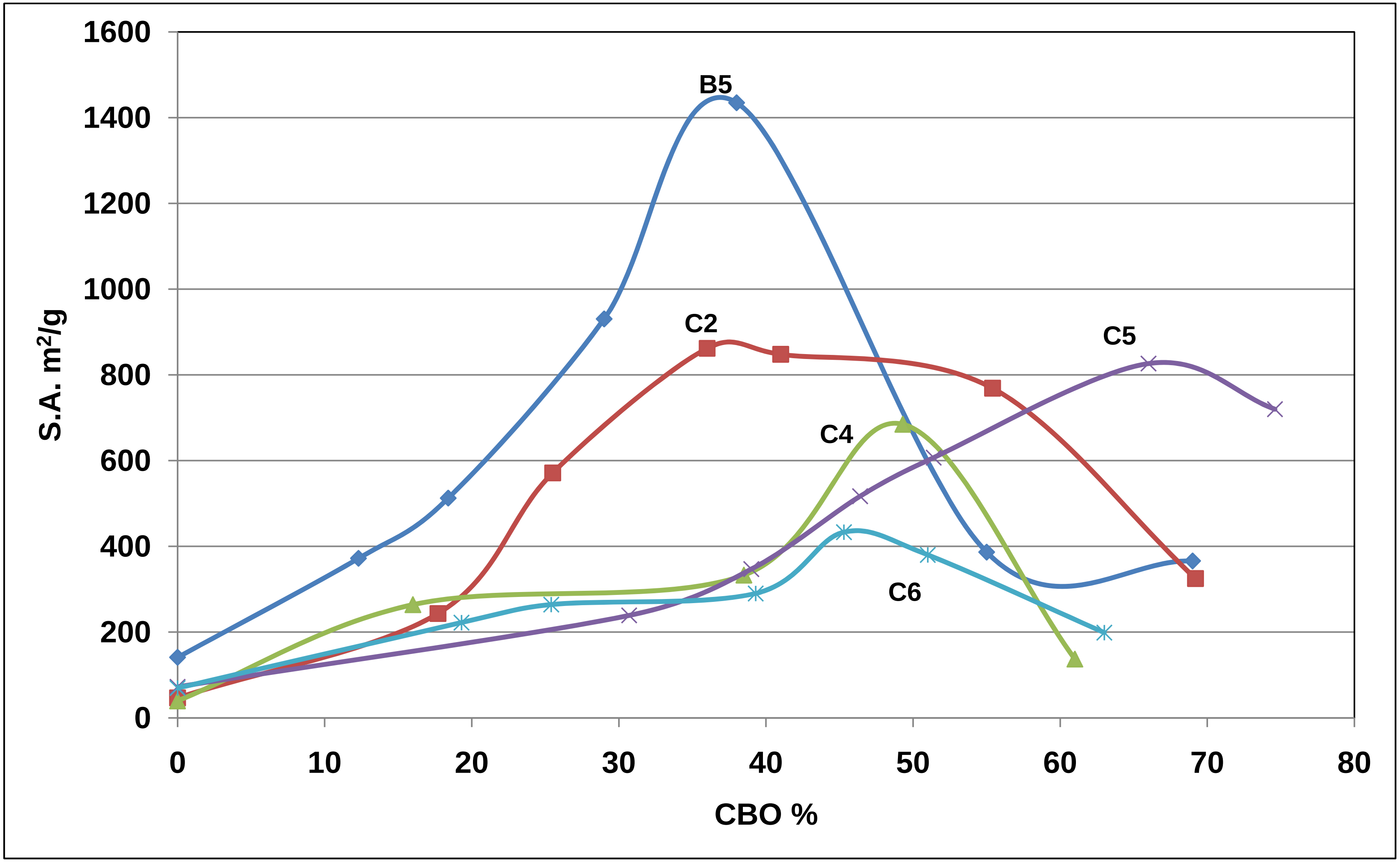
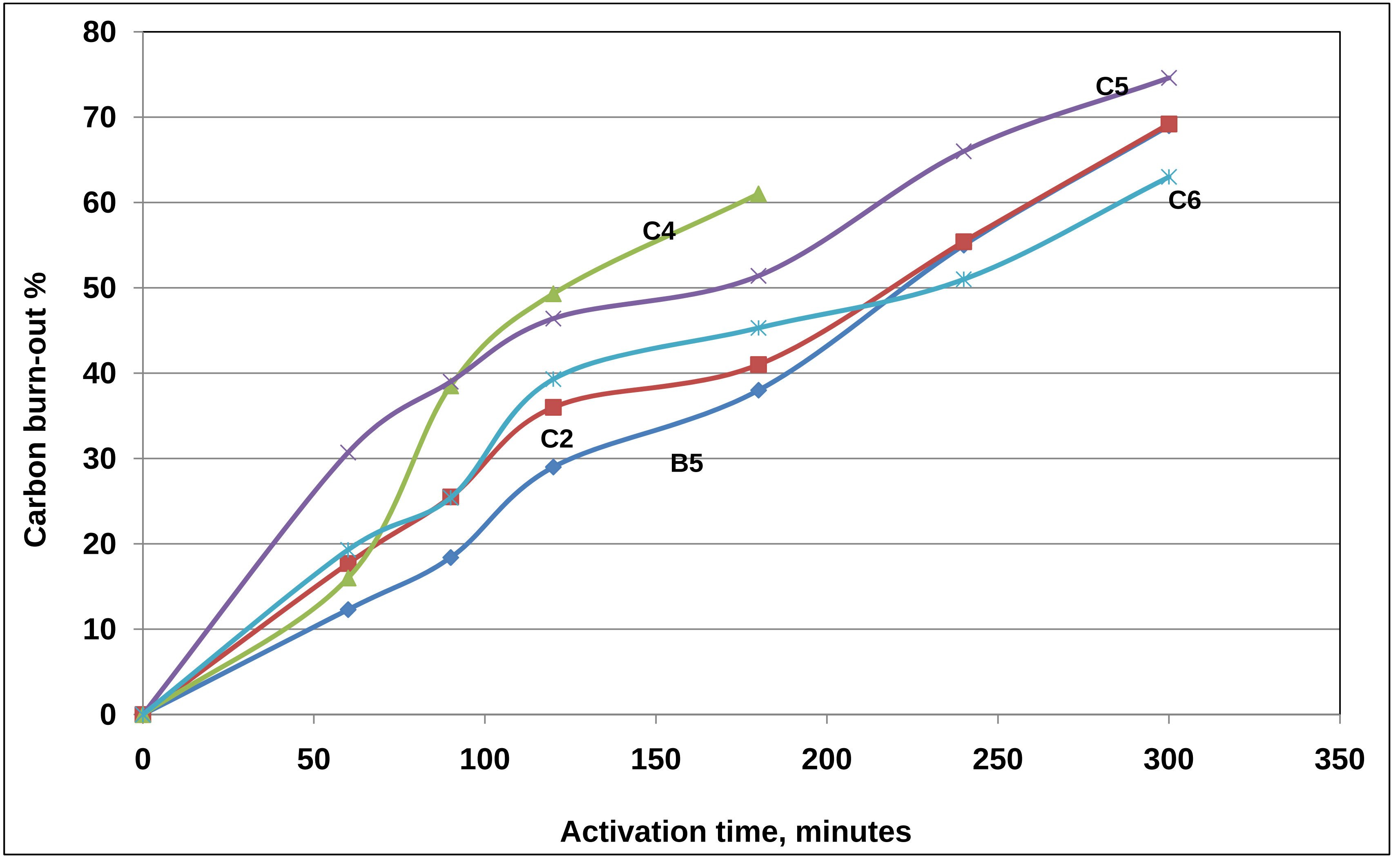
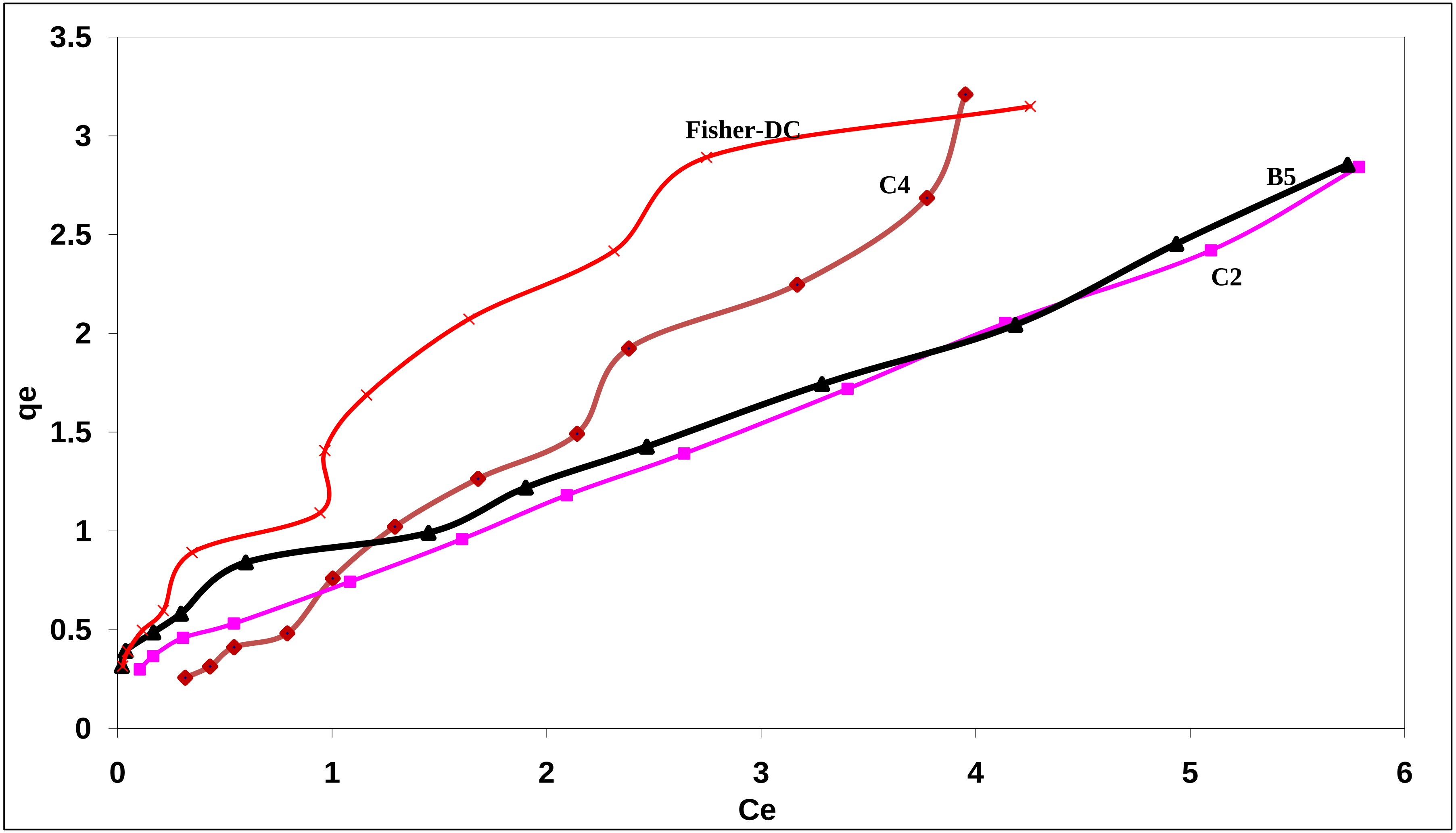


Carbon activation



Comparison with commercial carbons: Methylene blue adsorption tests



Conclusions

- LOI value for the PFA samples varies from power plant to another.
- The carbon content in PFA samples collected from back rows increases compared with the samples collected from front rows of ESP units.
- PFAs derived from biomass co-firing showed higher S.A. compared with PFAs coal.
- PFAs derived from biomass co-firing need more water in cement tests in order to increase the workability.
- Enriched carbon stream is considerably utilised as a precursor for carbon materials.
- Enriched activated carbon materials have similar adsorption properties as commercial carbons.

Acknowledgements

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Thank you