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From fly ashes of lignocellulose waste combustion to sustainable activated carbons for VOCs removal

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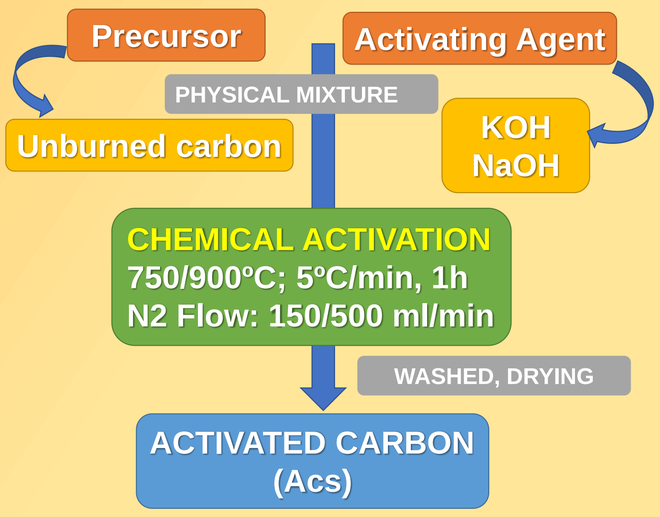
Introduction

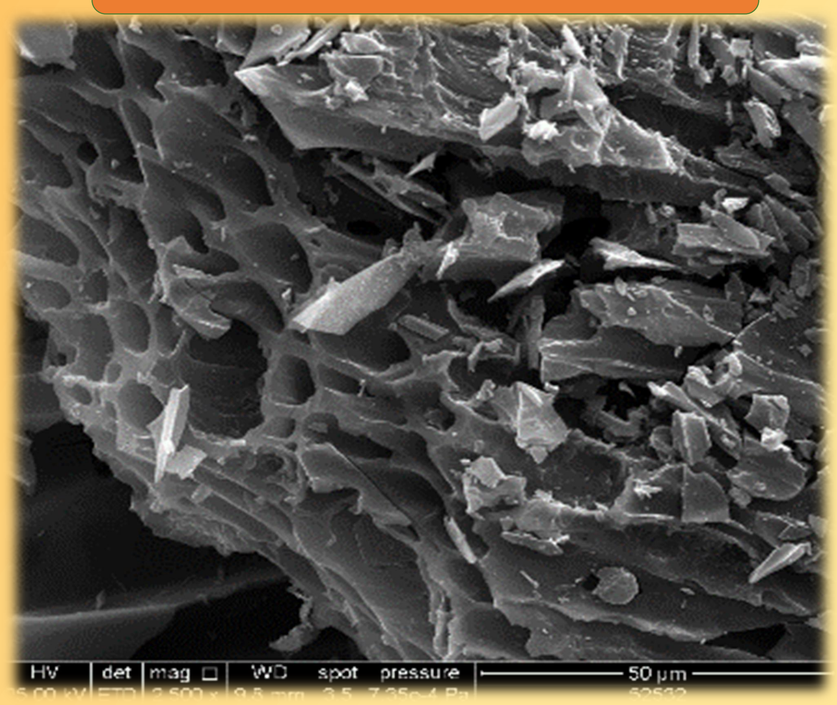
Results & Discussion

Sample	Precursor of ACs	Activating agent	Activating agent/ precursor	N_2 flow gas (ml/min)
Experimental activated carbons				
AC1K150	Fly ash fraction of >500 µm	KOH	1/1	150
AC1K150-950w	Fly ash fraction of >500 µm	KOH	1/1	150
AC3K150	Fly ash fraction of >500 µm	KOH	3/1	150
AC1K500	Fly ash fraction of >500 µm	KOH	1/1	500
AC3K500	Fly ash fraction of >500 µm	KOH	3/1	500
AC1N150	Fly ash fraction of >500 µm	NaOH	1/1	150
AC1N500	Fly ash fraction of >500 µm	NaOH	1/1	500
AC3N500	Fly ash fraction of >500 µm	NaOH	3/1	500
Commercial activated carbons				
WV-A1100	Lignocellulosic wood	H_3PO_4		
Centaur HSV	Bituminous coal	Steam		
Norit RB3	Peat	Steam		

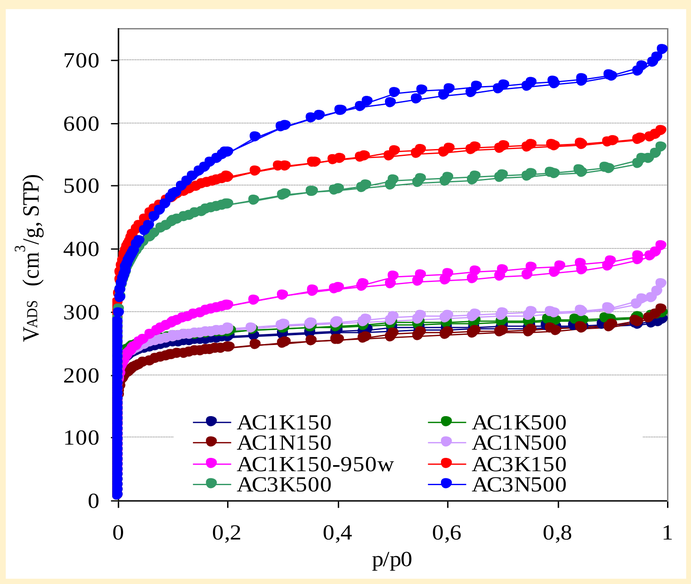


Sample	Ash (wt%)	C (% db)	H (% db)	N (% db)	S (% db)	O* (% db)
Raw fly ash	85.8	3.9	0.3	0.1	2.0	7.9
Fly ash fraction of >500 µm	22.4	59.6	0.7	0.5	0.4	16.3
Experimental activated carbons						
AC1K150	6.1	82.8	0.4	1.0	0.4	9.2
AC1K150-950w	24.6	66.7	0.7	0.7	nd	7.2
AC3K150	6.7	78.5	0.4	0.1	0.3	13.1
AC1K500	4.1	86.9	0.3	0.7	0.3	7.6
AC3K500	14.1	77.3	0.4	0.6	0.3	7.2
AC1N150	10.9	82.9	0.1	0.7	0.5	4.9
AC1N500	11.4	82.1	nd	0.7	0.5	5.2
AC3N500	15.6	76.5	nd	1.0	0.2	6.7
Commercial activated carbons						
WV-A1100	5.2	89.6	1.9	0.1	nd	3.2
Centaur HSV	4.6	88.9	0.2	1.0	nd	5.3
Norit RB3	4.0	90.9	0.1	0.6	0.4	4.0

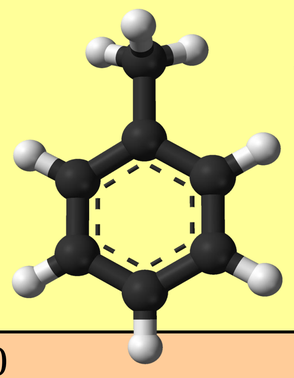
SEM - activated carbon



N_2 Adsorption



Precursor and ACs	Toluene adsorption (mg/g)
Unburned carbons >500 microns	64.8
AC1K150	233
AC3K150	498
AC1K500	332
AC3K500	540
AC1N150	244
AC1N500	266
WV-A1100	206
Centaur HSV	185
Norit RB3	394



Conclusions

- Alkaline chemical activation is a good method to obtain ACs from unburned carbons of biomass fly ash waste.
- The ACs obtained have high BET surface areas (up to 2035 m^2g-1) and total pore volume (up to 1,055 cm^3g-1), comparable to commercial ACs.
- Unburned carbon-based ACs were used for toluene adsorption, demonstrating their ability to remove VOCs from the gaseous effluent.
- The better unburned carbon-based AC obtained showed higher toluene uptake (up to 540 mg/g) than commercial AC tested under the same conditions (up to 400 mg/g).
- Sustainable adsorbents produced from the fly ash waste can be used to remove VOCs from gaseous effluents.

Acknowledgements

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