

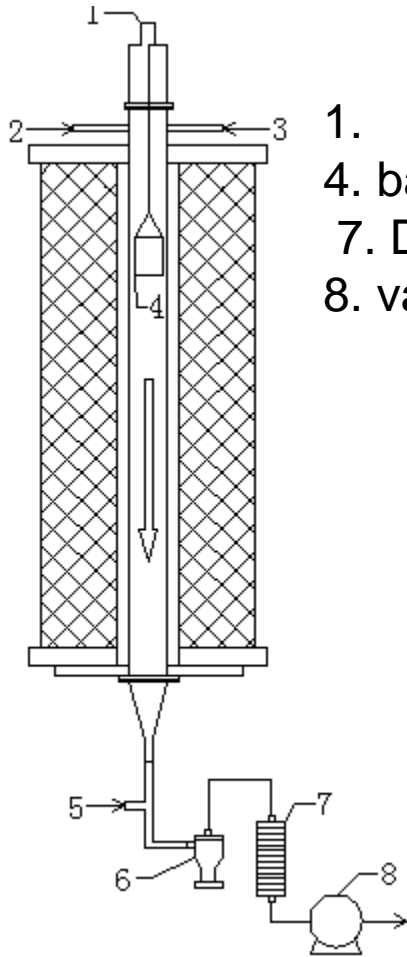
The effects of binder and additives on the emission of particulate matter from biomass pellet combustion

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06-04-2017

1. Experimental section

2. Results and discussion

3. Follow-up arrangement



1. feed inlet, 2 and 3. air inlet,
4. basket, 5. dilution air, 6. cyclone,
7. Dekati low pressure impactor
8. vacuum pump

Temperature: 1123 K

The stove height: 100 cm

The height of basket: 80 cm

the bottom of the basket:

Staggered arrangement, 2 mm

$N_2/O_2=80/20=2L/0.5L$

Interval feed, 0.1g/min, 20min

Semi-circular biomass pellet

砂光粉成型块: wood dust pellet, **WDP**

棉杆成型块: cotton stalk pellet, **CSP**

竹屑成型块: bamboo dust pellet, **BDP**

自制棉杆成型块: 无添加剂, 120MP, Self-made cotton stalk pellet, **SMCS**

自制棉杆成型块: 木质硫酸钙 (Calcium lignosulfonate), 5%, 120MP, **SMCS-CL**

自制棉杆成型块: 羧甲基纤维素钠 (CMC), 5%, 120MP, **SMCS-CMC**

自制棉杆成型块: 膨润土 (bentonite), 5%, 120MP, **SMCS-BT**

自制棉杆成型块: 氢氧化钙 (calcium hydroxide), 5%, 120MP, **SMCS-CH**

自制棉杆成型块: 高岭土 (kaoline), 5%, 120MP, **SMCS-KL**

自制棉杆成型块: 硅藻土 (diatomite), 5%, 120MP, **SMCS-DM**

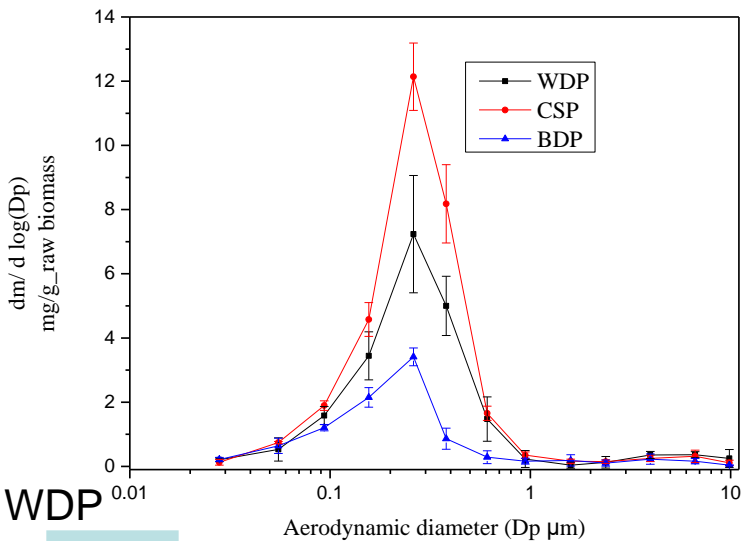
Fuel properties

	Ultimate analysis ad (wt.%)					Proximate analysis ad (wt.%)			
	N	C	H	S	O	M	A	V	Fc
WDS	1.97	28.08	4.73	0.14	37.18	4.75	23.15	66.19	5.90
CSP	0.99	45.29	5.95	0.19	32.88	8.10	6.60	69.54	15.76
BDS	0.22	48.35	6.22	0.14	39.13	5.00	0.94	80.56	13.50
SMCS	1.04	43.64	5.69	0.23	42.23	4.55	2.62	75.03	17.80

XRF results of different sample ash (wt.%)

	Mg	Al	Si	P	S	Cl	K	Ca	Mn	Fe
WDS	25.89	3.19	12.57	1.28	0.65	0.66	3.28	52.04	0.04	0.38
CSP	8.94		8.02	13.49	4.20	2.43	24.00	36.34	0.15	2.43
BDS	10.88	2.75	14.98	6.80	4.24	1.81	43.69	11.9	1.55	1.39
SMCS	9.06	2.24	3.87	11.59	11.74	2.37	30.51	27.94		0.58

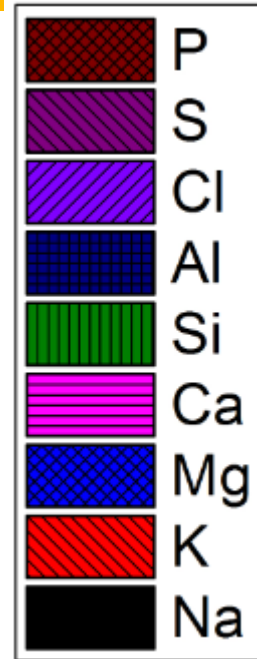
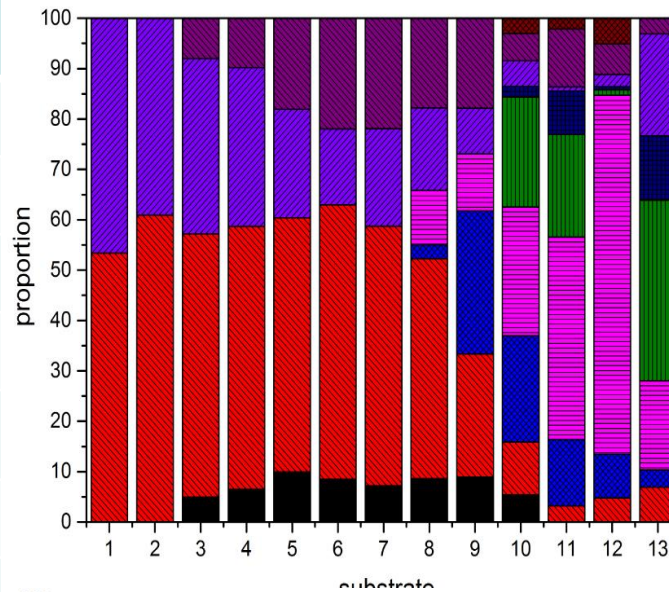
Particle size distributions (PSDs) of PM₁₀ from the combustion of three industrial pellet



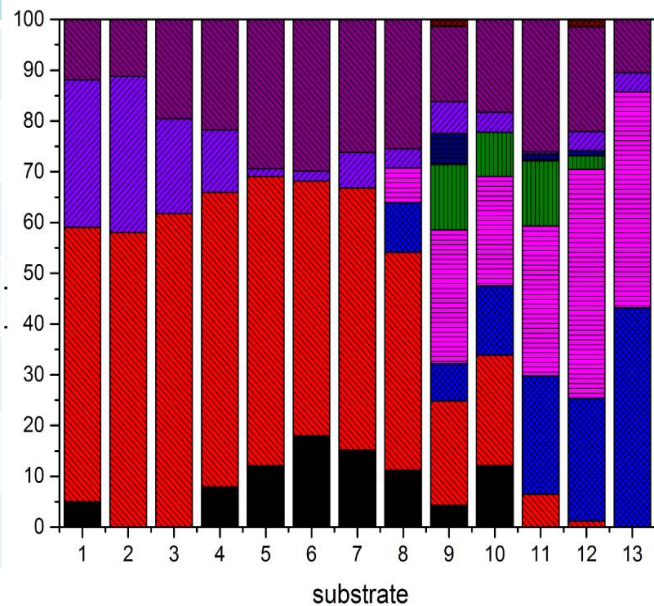
CSP



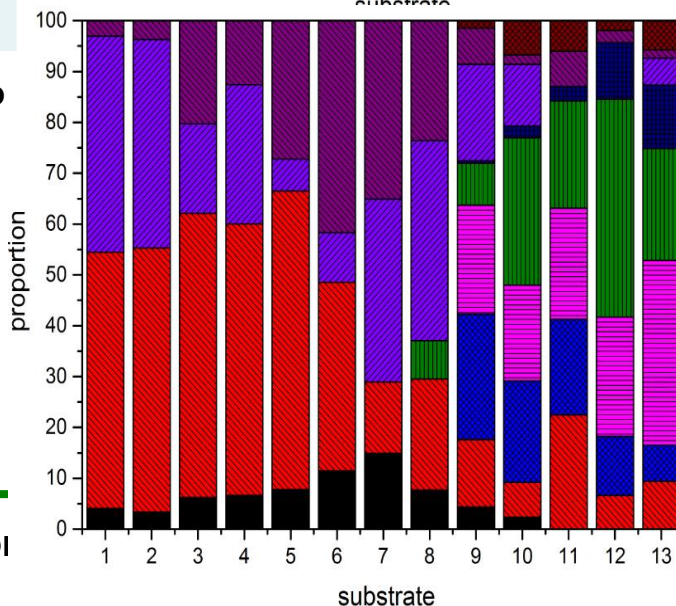
Elemental composition of PM₁₀ of three industrial pellet



WDP

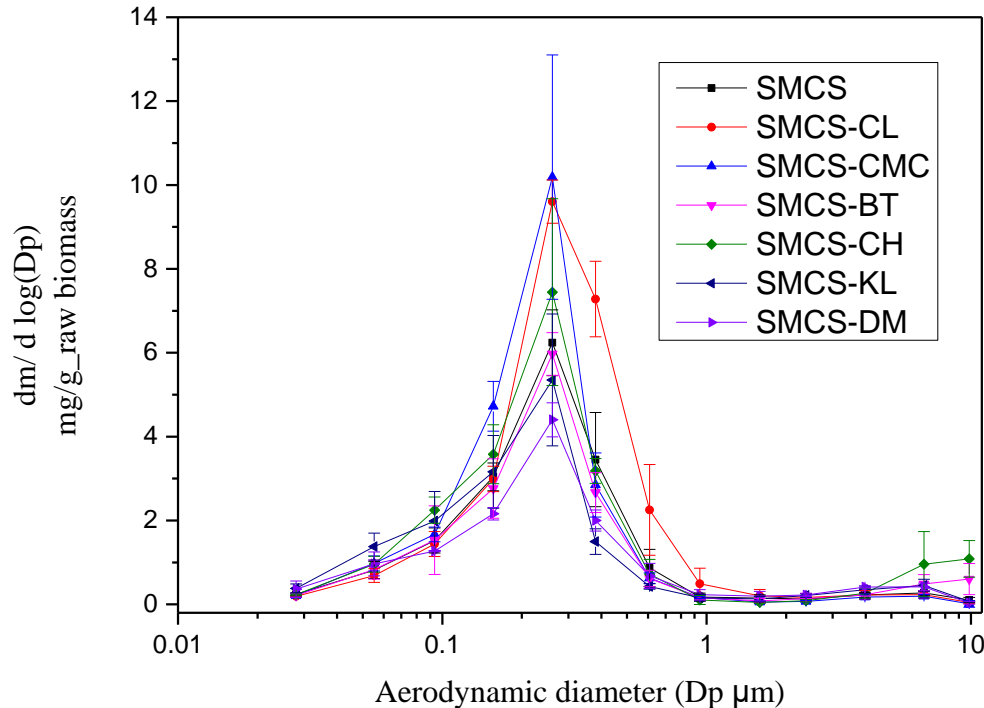


BDP



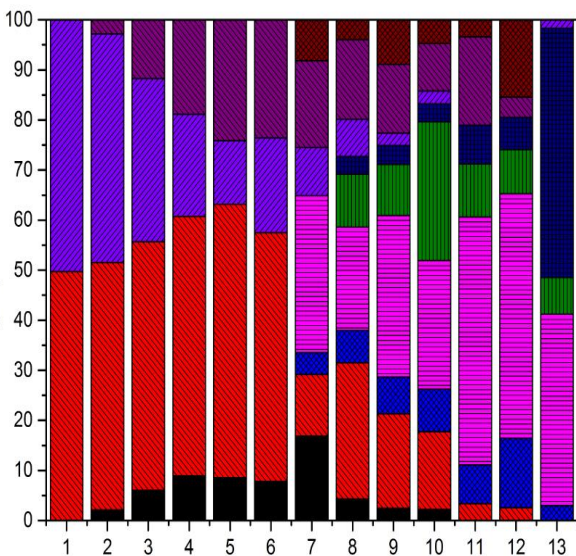
nd Bio

Particle size distributions(PSDs) of PM₁₀ from the combustion of self-made cotton stalk pellet with different additives

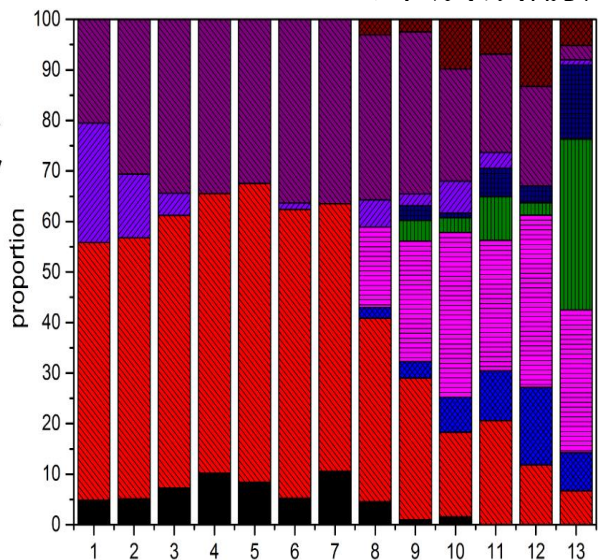


After mixing, the yield of PM **increased**:
 Calcium lignosulfonate (木质磺酸钙), CMC
 (羧甲基纤维素钠), calcium hydroxide (氢氧化钙)
 Almost **no changed**: bentonite(膨润土)
Decreased: kaoline(高岭土), diatomite(硅藻土)

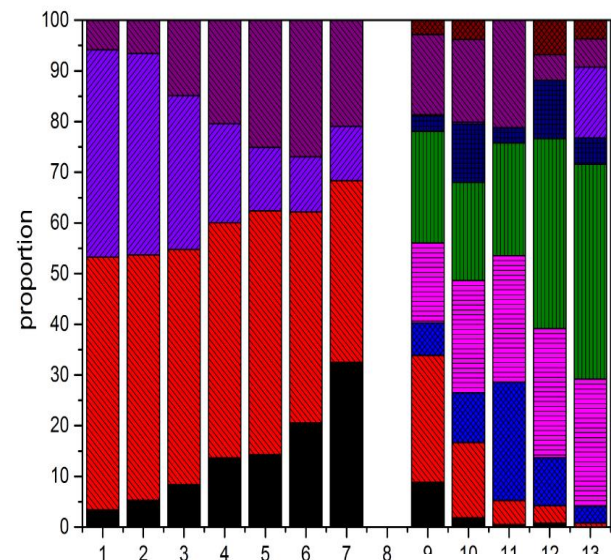
SMCS



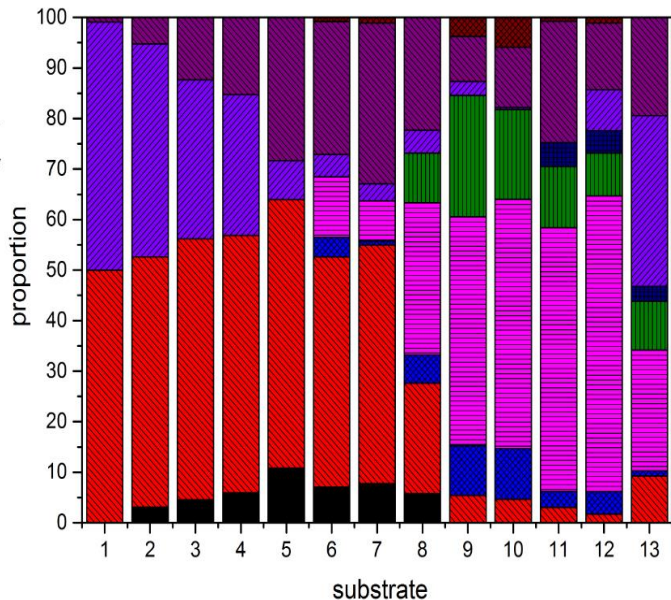
SMCS-BL (木质磺酸钙)



SMCS-CMC



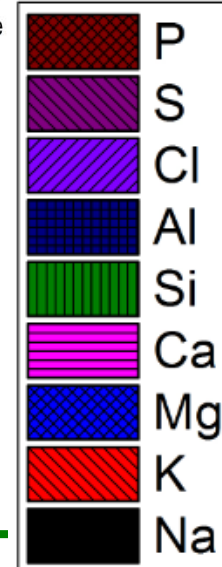
SMCS-CH Ca(OH)₂



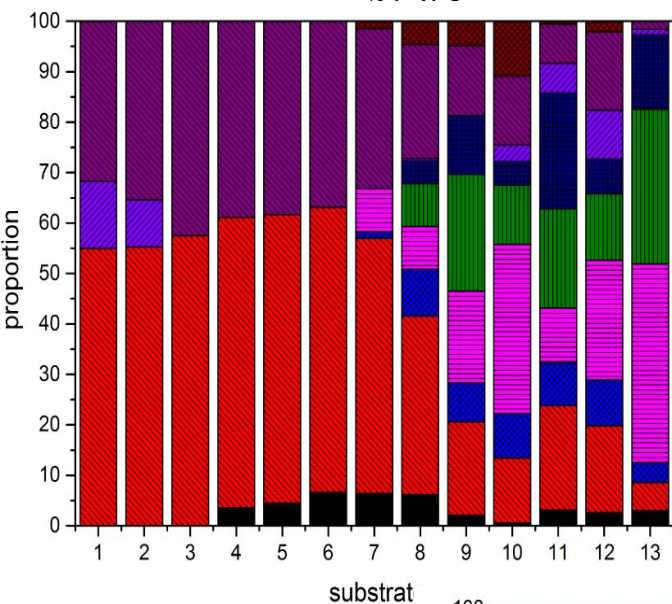
strate

substrate

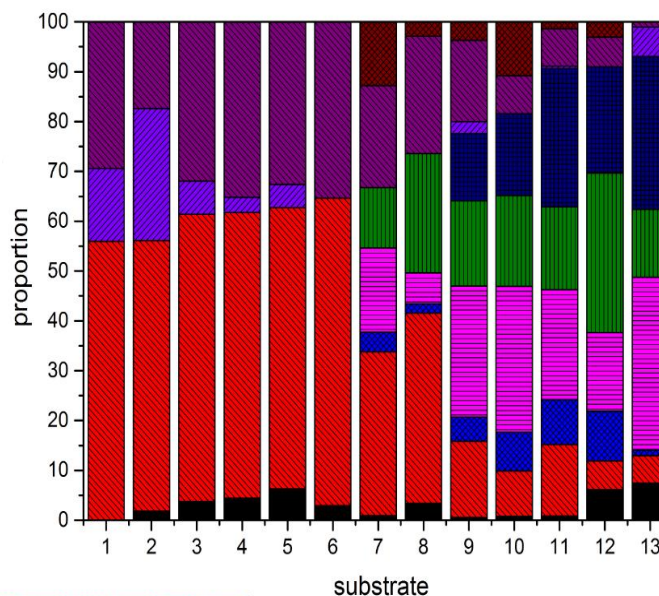
木质磺酸钙: $C_{20}H_{24}CaO_{10}S_2$
 CMC: $C_8H_{16}NaO_8$
 氢氧化钙: Ca



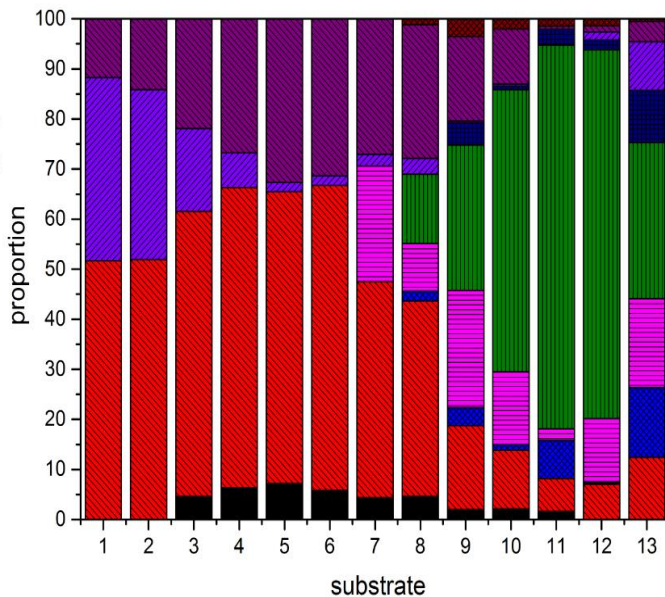
SMCS-BT 膨润土



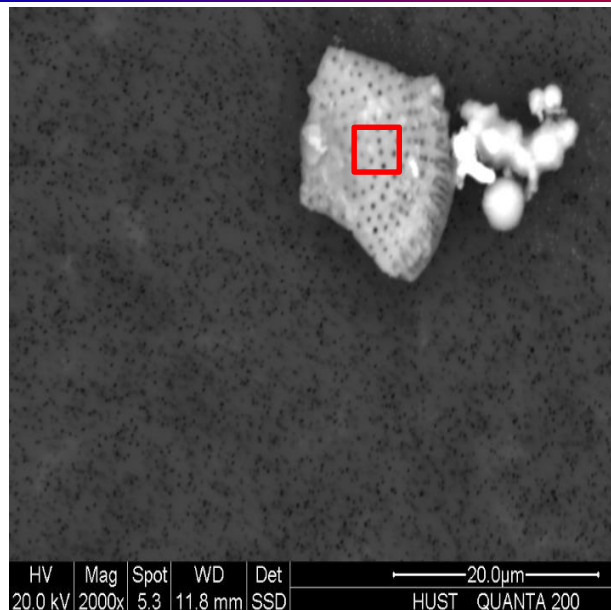
SMCS-KL 高岭土



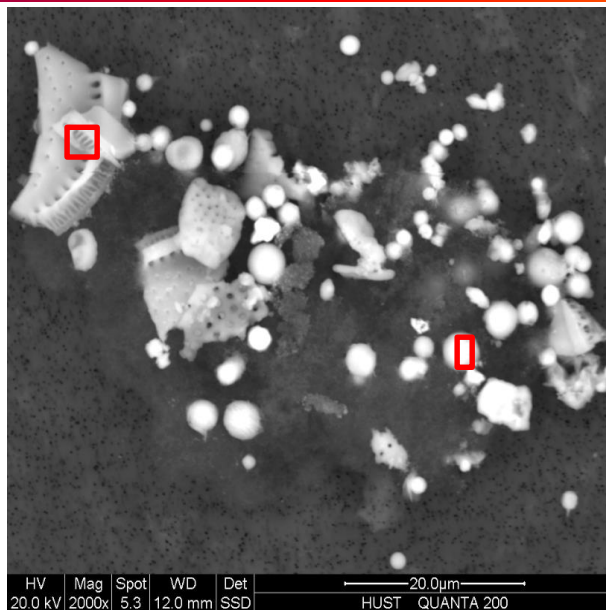
SMCS-DM 硅藻土



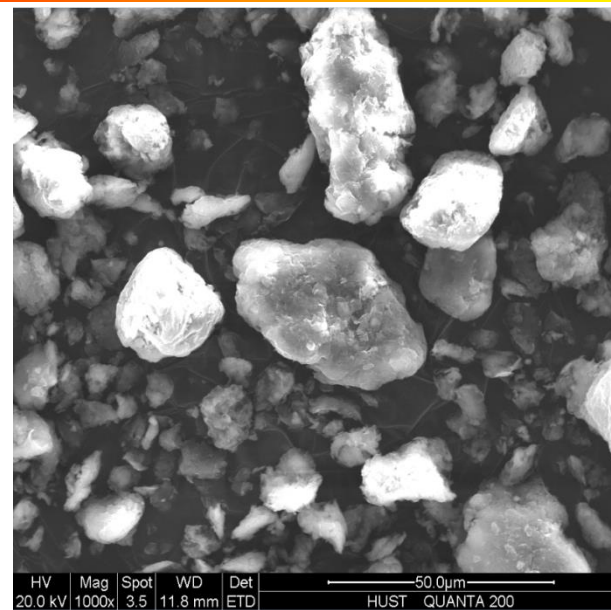
膨润土: $Al_2O_3 \cdot 4(SiO_2) \cdot H_2O$
 高岭土: $Al_2Si_2O_7$
 硅藻土: SiO_2



第十二级: Si, S, K

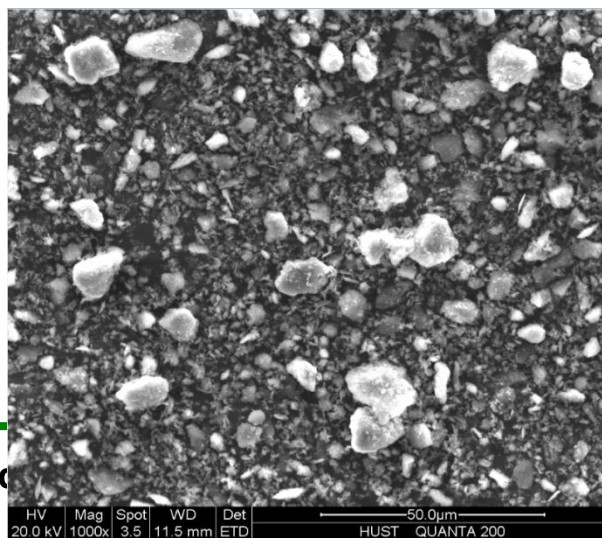


第十级: Si, K
Si, K, Ca, S,



膨润土

高岭土



The existing data need to be further analyzed to explore the reaction mechanism of reducing particulate matter emissions.

a comprehensive analysis is needed to combine with the characteristics (weight, elemental composition, morphology and structure) of ashes inside the basket.

Designing the next test scheme, compound additives or others?



Thank You!