### High Shear Wet Granulation Of Geopolymer

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#### 1. Introduction

- 2. Screening Phase
- 2.1 Composition
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- 3. Granulation Process
- 3.1 Liquid-Solid Ratio
- 3.2 Granules Obtained
- 4. Granules Characterization

- 4.1 Sauter Mean Diameter
- 4.2 Compressive strength
- 4.3 B.E.T
- 4.4 S.E.M Images
- 4.5 Breakthrough Curves
- 4.6 Breakthrough Curves of granules with APTES addition
- 4.7 Breakthrough curves comparison
- 5. Conclusions

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#### PURPOUSE OF THIS STUDY

## $\begin{array}{l} \mbox{Production and charcaterization of the geopolymer granules for $CO_2$} \\ \mbox{adsorption test inside fluidized-bed column system} \end{array}$

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SAMPLE	AL2O3	SIO2	K20	H20
SS2H16	1	2	1	16
SS2.2H16	1	2.2	1	16
SS2.4H16	1	2.4	1	16
SS3.8H16	1	3.8	1	16
SS2H18	1	2	1	18
SS2H20	1	2	1	20
SS2H22	1	2	1	22
SS2H25	1	2	1	25
SS1.96H18	1	1.96	1	18
SS2K0.9H18	1	2	0.9	18
SS2.5K0.8H18	1	2.5	0.8	18
SS3.8H25	1	3.8	1	25

Table 1: Geopolymer compositions tested

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Figure 2: Different views of the geopolymer monoliths prepared to conduct the screening phase

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#### Screening Phase Properties Tested



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(C) Mean Compression Values

Figure 3: Properties tested during the screening phase

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#### Granulation Process Liquid-Solid Ratio



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Figure 4: Size distribution of the granules for different Liquid-Solid Ratio

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#### Granulation Process Granules Obtained





1000 µm





(a)





(c)



Figure 5: Images of the granules obtained

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SAMPLE	SAUTER DIAMETER [mm]
>2.8	3.2958
2.8 - 1.4	1.9413
1.4 - 0.8	1.2232
0.8 - 0.6	0.7660
0.6 - 0.4	0.4237
0.4 - 0.3	0.3602

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Table 2: Sauter Mean Diameter from a mastersizer 2000

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Figure 6: Mean Compressive strength values for different granules dimensions

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SAMPLE	SURFACE AREA [m^2/g]
>2.8	24.281
2.8 - 1.4	20.750
1.4 - 0.8	18.187
0.8 - 0.6	16.975
0.6 - 0.4	15.354
0.4 - 0.3	14.957
Initial powder	82.718

Table 3: Surface Area Values

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Figure 7: Surface Area Values

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#### Granules Characterization S.E.M Images









(a)





(d)

Figure 8: SEM images of the external (a,b) and internal (c) surface of the granules and (d) of the initial powder

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#### Granules Characterization Breakthrough Curves

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Figure 9: Breakthrough curves of different C/CO Ratio and (d) the comparison

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#### Granules Characterization Breakthrough Curves with APTES addition

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(a)





#### (c)

Figure 10: Breakthrough curves of different C/CO Ratio and (d) the comparison

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	10 %	<b>℃</b> CO <sub>2</sub>	15 %	<b>%</b> CO <sub>2</sub>	20 %	<i>CO</i> <sub>2</sub>
[ <u>cm</u> ]	u1	u2	u1	u2	u1	u2
	5	7.4	5	7.4	5	7.4
<u>CO2</u> Kg <sub>ads</sub>	5.4	6.2	7.4	9.1	10.4	12
$t_b[s]$	18	16	17	14	15	14
$t_s[s]$	22	22	22	20	22	22

10% CO2	Zeolite 13x	Si + APTES	Geo	Geo + APTES
<u>CO2</u> kgada	15.2	10	5.4	8.7
t <sub>b</sub> [s]	50	26	18	26
t <sub>s</sub> [s]	56	30	22	32

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#### ► Good *CO*<sub>2</sub> Adsorption Capability

Other Applications:

- Polluttant adsorption
- Water Purification

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# THANK YOU FOR YOUR ATTENTION!

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