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—

Na_2O 1 050 ℃
30 min Na_2O 80 g/L 90 min L/S=8 mL/g
4. 08 17. 98 77. 31%
94. 56% - X
—
SiO_2

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Experiment on Pre-desilication of a Low Grade High Iron Bauxite by Roasting-Alkali Leaching

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Abstract: In view of the characteristics of low aluminum high silicon and high iron in a bauxite ore in Yunnan province a high aluminum-silicon ratio aluminum concentrate was obtained by roasting-alkali leaching pre-desilication process. The effects of roasting temperature roasting time Na_2O concentration alkali leaching time and liquid-solid ratio on pre-desilication were investigated. Under the optimal pre-desilication conditions including roasting temperature of 1 050 ℃ roasting time of 30 minutes concentration of leaching agent Na_2O of 80 g/L leaching time of 90 minutes and liquid-solid ratio of L/S=8 mL/g the Al-Si ratio of low-grade bauxite can be increased from 4. 08 to 17. 98 and the desilication rate is up to 77. 31% the relative dissolution rate of alumina in pre-desilicated concentrate can reach 94. 56% and the dissolution effect is ideal. Combined with thermogravimetric differential scanning calorimetry X-ray diffraction analysis infrared spectroscopy and other characterization methods the mechanism of pre-desilication by roasting-alkali leaching was analyzed. The results show that improvement of the Al-Si ratio of bauxite is due to the fact that the kaolin-type silicate minerals in the raw ore can be first converted into alkali-soluble amorphous SiO_2 by roasting and the efficient separation of aluminum-

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silicon can be achieved by atmospheric pressure alkaline leaching and aluminum concentrate with high aluminum-silicon ratio can be obtained.

Key words: bauxite roasting alkaline leaching pre-desilication

2023 4 159 t

3.7% [1] —

70% [2]

[3]

—

“

” X XRD -

— TG-DTA IR

20 40 —

- —

[4]

1 试验

SiO_2 α-Al_2O_3 [5] **1.1**

— 970～

1 020 ℃ 10 min

10.02～11.25 −3 mm

51.12%～56.05% [6] −0.074 mm>85%

1 050～1 100 ℃ 15～20 min 1 2

9.92 1 Al_2O_3 39.88%

55.61% [7] SiO_2 9.74% 4.09 TFe

21.73% TiO_2 7.04% 2

1

Table 1 Chemical composition of raw material /%

Al_2O_3	SiO_2	TiO_2	TFe	S
39.88	9.74	7.04	28.73	0.048
MgO	CaO	Ga*	Sc*	A/S**
0.044	0.058	85.9	56.8	4.09

*Ga Sc g/t **A/S

2

Table 2 Analysis results of aluminum silicon and iron phase /%

				—
Al_2O_3	31.37	1.29	7.22	—
	78.66	3.23	18.10	—
				—
SiO_2	7.21	1.85	0.60	—
	74.41	19.09	6.50	—
Fe_2O_3	0.22	21.34	0.27	0.23
	0.98	95.23	1.20	1.03

WHFS－2 2 L

1. 3

1

1. 2 24 h 200. 0 g

DX－2000 X

Cu 35 kV 30 mA

5°/min TG-DTA

TG / 2

0 2 0/35 000 mg 40～1 300 ℃

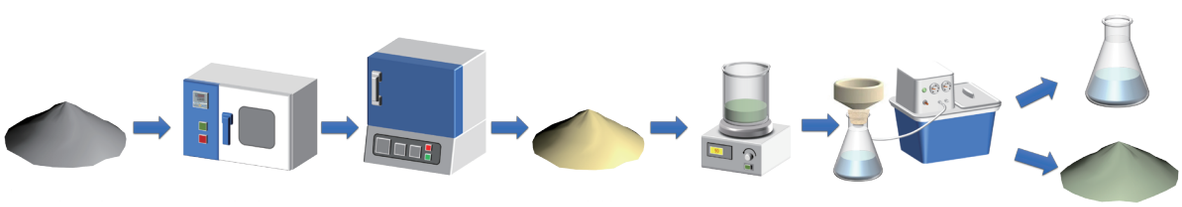
10 ℃/min

ICP-AES

ICP-MS F6030CM－33 50. 0 g

5 ℃/min JB3A

1



1

Fig. 1 The principle process flow

2 结果与讨论

2. 1

[8]

50. 0 g Na_2O 100 g/L L/S=6

mL/g 120 min

90 ℃

2. 1. 1

200. 0 g 600～1 100 ℃

2 h 2

900 ℃

1 050 ℃

900 ℃

γ-Al_2O_3 SiO_2 [9]

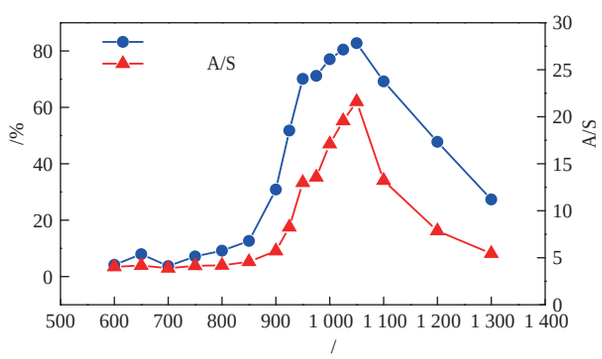
1 050 ℃

1 050 ℃

82. 76% 21. 60

2. 1. 2

200. 0 g 1 050 ℃ 15



2

Fig. 2 Effects of roasting temperature on desilication

30 45 60 60 90 min

3 3

75 min

1 050～

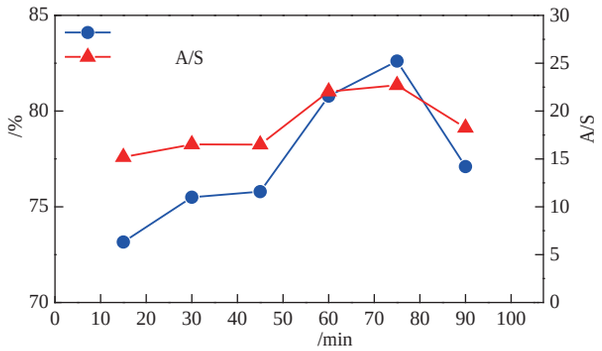
1 100 ℃ γ-Al_2O_3

SiO_2 [4]

α-Al_2O_3

Al_2O_3

[10-11] 30 min



3

Fig. 3　Effects of roasting time on desilication

75. 50 %　　16. 52

2. 2

2. 2. 1

1 050 ℃

30 min　　90 ℃

120 min　L/S=6　　Na_2O

60～160 g/L　　4

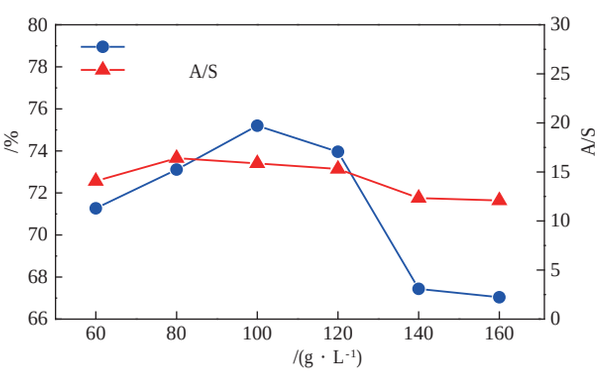
4　　60 g/L　　80 g/L

SiO_2

OH^-　　[12]

80 g/L　　SiO_2

75. 11%　　16. 40



4　　Na_2O

Fig. 4　Effects of pre-desilication Na_2O concentration on desilication

2. 2. 2

50. 0 g　　Na_2O　　80 g/L

90 ℃　L/S=6　　30～

150 min　　5

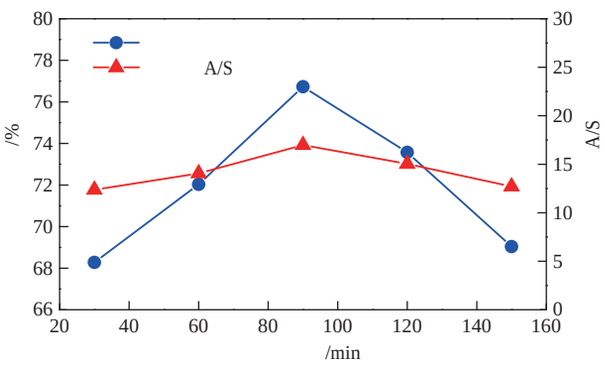
5

90 min

76. 73%　　16. 98

[13]

90 min



5

Fig. 5　Effects of alkali leaching time on desilication

2. 2. 3

50. 0 g　　Na_2O　　80 g/L

90 ℃　　90 min

L/S=4～10

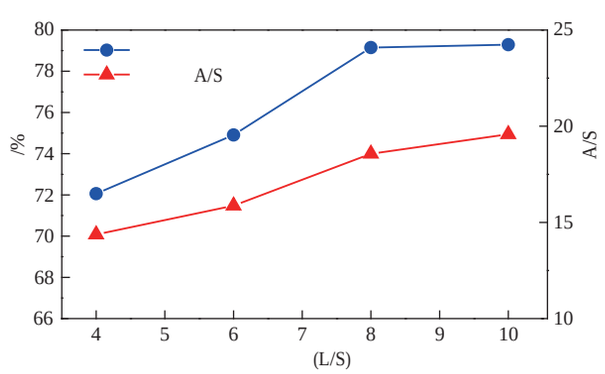
6　　6

8　　10

79. 15%　　79. 29%

18. 57　　19. 58

L/S=8



6

Fig. 6　Effects of pre-desilication liquid-solid ratio on desilication

2. 3

—

1 050 ℃　　30 min

90 ℃　　Na_2O 80 g/L

90 min L/S=8

3 —

3

Table 3 Test results of alkali leaching pre-desilication under comprehensive conditions

	/%	/%	/%	A/S
1	77.25	1.96	90.6	17.60
2	77.34	2.27	90.6	17.61
3	77.34	2.74	90.6	17.52
	77.31	2.32	90.6	17.58

3

77.25%～77.34% 77.31%

17.52～17.61 17.58

2.4

“ ” 11 14

α_k=1.40

280 ℃ 40 min 260 g/L

7%

94.56%

4 4

85.8 g/t

— 15

4

Table 4 Quantitative results of multiple analyses of red mud samples /%

	Al_2O_3	SiO_2	Sc*	TFe	TiO_2	ZrO_2	CaO	MgO
	7.65	4.01	85.80	34.84	9.08	0.13	12.94	0.19

2.5 —

— XRD TG-DTA IR

—

4 10 16-17

$$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O \xrightarrow{450\sim600\ ℃} \alpha\text{-}Al_2O_3 \cdot 2SiO_2 + 2H_2O \quad (1)$$

$$2(Al_2O_3 \cdot 2SiO_2) \xrightarrow{925\sim1\,050\ ℃} 2Al_2O_3 \cdot 3SiO_2 + SiO_2(\text{无定型}) \quad (2)$$

$$3(2Al_2O_3 \cdot 3SiO_2) \xrightarrow{\geqslant1\,050\ ℃} 2(3Al_2O_3 \cdot 2SiO_2) + 5SiO_2(\text{无定型}) \quad (3)$$

$$SiO_2(\text{无定型}) \xrightarrow{\geqslant1\,200\ ℃} SiO_2(\text{方晶石型}) \quad (4)$$

$$2AlO(OH) \xrightarrow{\geqslant300\ ℃} Al_2O_3 + H_2O \quad (5)$$

$$FeS_2 \xrightarrow{\geqslant550\ ℃} FeS + S \quad (6)$$

$$FeO(OH) \xrightarrow{\geqslant300\ ℃} Fe_2O_3(\text{赤铁矿}) + H_2O \quad (7)$$

7 396.0～674.6 ℃

541.1 ℃

18-19 TG

541.1～1 100 ℃

1 186.6 ℃

8

9 1 050 ℃ 30 min XRD

Al_2 Si_2O_5 OH_4 AlO OH FeS_2 FeO OH

Al_2O_3

OH^- O^{2-}

Al_2O_3 13

20 Si—O

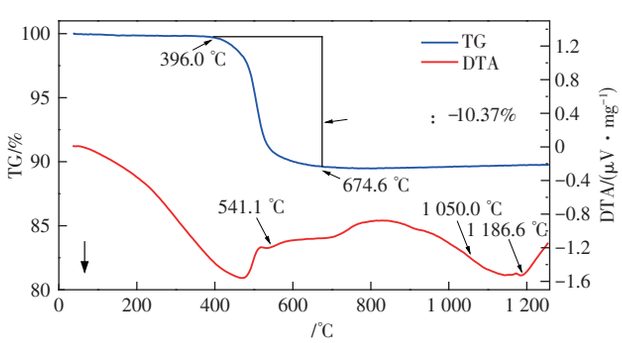
1 092.8 cm^{-1}

SiO_2 8 XRD

α-SiO_2

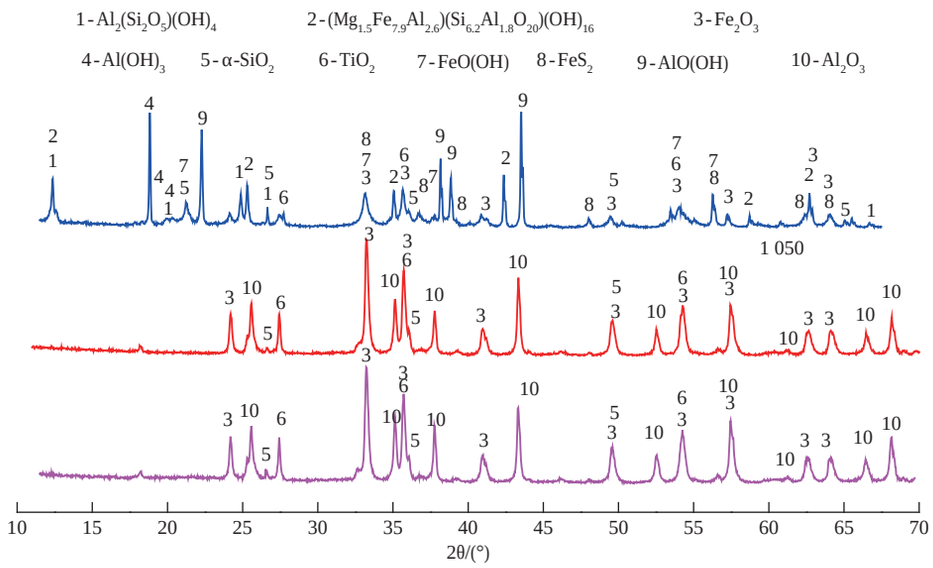
9 1 050 ℃ Si—O

1 092.8 cm^{-1} —



7 TG-DTA

Fig. 7 TG-DTA curves of bauxite



8　　1 050 ℃　30 min　　XRD

Fig. 8　XRD patterns of bauxite raw ore roasted at 1 050 °C for 30 minutes and pre-desilication products

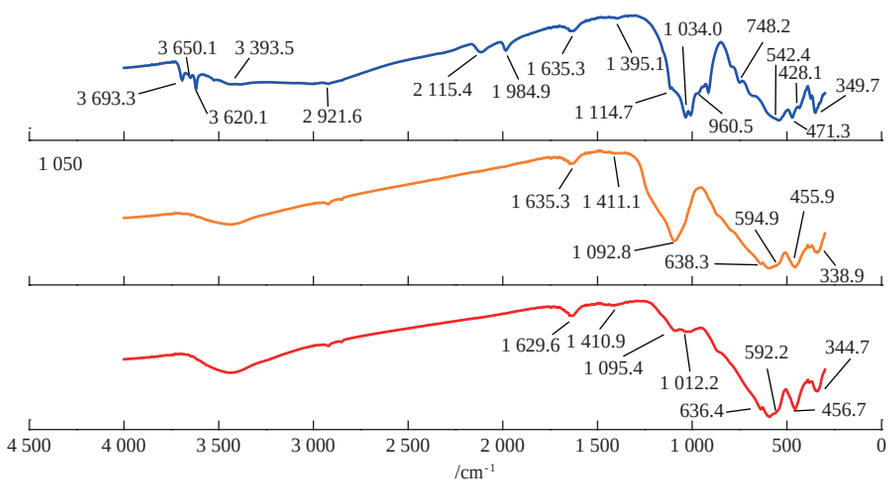


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Fig. 9　Infrared spectra of raw ore　roasted product and leaching residue　aluminum concentrate

SiO_2　　3　　—

α-SiO_2

3　结论

1　　1 050 ℃　　30 min

Na_2O　　80 g/L　　90 min

L/S=8 mL/g　　SiO_2

77.31%　Al_2O_3　　2.32%

17.58

94.56 %

2

TFe　　34.84%　　9.08%　TiO_2

85.80 g/t　Sc

SiO_2

Al_2O_3

SiO_2

A/S　　α-SiO_2

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