Session Ⅰ-2
(11:00~12:00 Ȳ B204)

ɔ й ה ц ՜ ה o Ặ ѿ ƙ ں Ȅ δ M o Ὦ

Application of Wet and Dry Oxidation to Abate Nitrogen Oxides in Air

ـ[1] ′ Ế ተ[2*] β X Ӂ[3]

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Ư Ặ ᵾ ᴧ Ȳ Ӱ o Ŋ Ӣ Ặ Ȅ δ Ð ╫ Ὦ ẃ ̤ ʯ Ẕ M o Ὦ (NOx) ɔ ʊ o ц Ȳ ″H ѿ˚ ̬ ڿ w Ч ݗ ′O Ặ ạ ʯ˚ o Ὦ Ặ ӧ ậ ᶾ M Ȳ Ṽ ◕ Ꝁ и Ł › ȳ M ц ∟ Ȳ Ẕ M˚ ∟ M Ặ o - ɬ ǀ Ặ Ł Ă ‖ ש ṅ Ặ ӛ ʯ Ö ủ o Ὦ M Ặ 90-95% Ł ʕ o (NO) Ȳ˚ Ѭ M Ặ ⇔ ª Ȳ ″H ѿ ˜ ɔ й ى o ں Ẕ o Ͻ ʖ o (NO2) ű ủ Ѭ Ặ o Ὦ զ Ғ ѿ ɬ ǀ ʯ

Ă ש ṅ M ש ṅ Ꝫ ה ц ՜ ה Ặ o Ȳ и ᵑ Ł ц ʖ o ʯ˚ ה o Ặ M ╥ 0.0% ȳ 2.5% ȳ 5.0% ȳ 7.5% ȳ 10.0% Л΄ ⇔ Ặ ﻨ ẃ ڹ ؚ o ⇔ ƙ ں Ặ Ȳ ụ Ḃ Ŋ o Ὦ ⇔ (12 ȳ 24 ȳ 36 mL/min) ẃ ש ṅ o Ὦ ⇔ o ƙ ں Ặ ʯ˚ ՜ ה o Ặ M Ⅵ Л˚ ⅍ ȳ 100-600 ʕ Л΄ ⇔ † ᴘ Ȳ ꝑ Ṿ Ặ ч ⇔ ʯ ﺓ ˚ ⇔ † ש ṅ Л΄ ⇔ (0% ȳ 30% ȳ 50% ȳ 70% ȳ 90%) Ặ ʖ o ƙ ں Ặ Ȳ ∟ Ḃ Ŋ o Ὦ ⇔ (12 ȳ 24 ȳ 36 mL/min) ẃ ש ṅ o Ὦ ⇔ o ƙ ں Ặ ʯ Ὠ ˠ ꝑ Ȳ˚ ה o Ặ M Ȳ o Ὦ Ặ o í o ⇔ c ؤ ᵔ Ғ Ȳ ⇔ ؤ ủ 10.0% ∟ Ẕ o í o Л Є ȷ ᵔ˚ Ḃ ☼ Ặ o Ὦ ⇔ ∟ ˠ ˜ Ȳ o Ὦ o í ☼

 o Ὦ ⇔ Ặ ٦ ª ᵔ c ؤ ʯ˚ ՜ ה o Ặ M Ȳ ʖ o ˚ 300 ʕ₁ ȳ ʖ o ⇔ 70% o í ̖ Ȳ ᵔ o Ὦ o í Ӽ ☼ o Ὦ ⇔ Ặ ٦ ª ᵔ c ؤ ʯ

ȸ o Ὦ ȳ o ȳ ʖ o ȳ

ӯ › ṕ

1.שׁ ṅ ٍٍ

ץ ╥Ϛ Ⴗ Ա Ą ڿ Ո Ÿ ụ Ա ڦ ٍ ץ Ą ɔ ȴ ᵔ ụ Ա ˚ ڦ ٍ ɔ Ą ́ ₁ Ÿ Þ ɔ Ą Ÿ Z̲ M Ѐ δ Ð ╬ ╥ Ϛ Ⴗ ڼ ő Ą ڨ ȴ Ѐ δ Ð ╬ Ҕ ╖ o Ὼ ӯ o Ὼ ӯ o Ὼ ѿ ц Ը Ÿ ụ Ð ╬ Ὼ ^ Ꞁ Ą ɔ Ո Ÿ Ẃ ⅍ í ӯ ӯ ט o ӯ ᵔ ᑌ ♂ ѿ ц Ո ȴ ụ ^ Ꞁ˚ ڀ Ḗ ɔ Ą ́ ₁ Þ˜ ᾆ Ą ' Ÿ И ə Л[1,2] ȴ

˚ ụ Ð ╬ Ὼ П M Ÿ o Ὼ Ą Ð ╬ Ҝ Ә Л Њ Ą ӎ Ẃ ȴ o Ὼ ╥ Ա M ڼ ő Ą δ Ÿ ڼ ╥ Ŋ ∟ ̋Н Ӣ Ą ȴ Є δ M Ą o Ὼ(NO$_x$)Є ̂ ϱ Ö Ϛ o ế ȝ o ɔ Ÿ Ϛ o ╥ Ϛ ᴥ Ǻ ӯ Л Ҡ ȣ ẓ צ ◖ ἥ Ą δ ȷ ᵔ ȝ o ⁄ ╥ Л Ҡ ȣ צ ى Ն ᾅ ἥ Ą מ ᴥ δ Ÿ ˚ ؤ ⇔ Ą M Ш צ Є Ą Ո[3] ȴ ̃ שׁ ṅ ╥ ϸ Ÿ o Ὼ Є δ M Ą Z̲ ́ δ ч Ӣ ט o Ÿ Л ᵀ ṿ Є δ ő ⇔ † Ⴗ Ÿ ^ Ꞁ Ą ȓ ȴ o Ὼ Þ Ѐ δ M Ą Ӿ ɔ Ÿ ᑌ Ё ц Ӿ Ÿ ᵂ Ὼ ц ٍ Ὼ[4] ȴ Ö ὐ ѿ ϱ Ո Ÿ ̋Н ѿ ╜ Ά ں o Ὼ w Ч Ð ╬ Ὼ ڂ Ὸ Ą ạ ȴ

˚ o Ὼ Ą ӧ ạ ³ M Ÿ Ҡ ѿ и Ł › ӯ M ӯ ∟ Ą [5,6] ȴ˚ ∟ Ą ◕ M Ÿ ӛ › ڼ ṿ ӣ Ą Ѡ ה ╥ ٽ ה Ą̃ M Ą ἥ Ⴗ Ą̃(SCR) ѿ ц ἥ Ⴗ Ą̃(SNCR) Ÿ ụ Ѡ Ą̃ Ą o Ὼ ƙ ں ؤ Ÿ ᵀ ɔ Ă ű Ÿ Њ ₤ Ą ɢ Ҡ Ą̃ [7] ȴ ᵔ ṿ ӣ ה Ą̃ M Ą o - ɟ | Ą̃ ц Ҡ ѿ Ⴄ ª ɔ Ă ȴ Ö ὐ o Ὼ M Ϛ o Ą ӎ Ẃ ؤ Ÿ ȣ Ϛ o Л ű ὐ Ӿ Ÿ ̋Н ѿ Ϛ Ⴗ ى o ں Ϛ o ɔ ű ὐ Ӿ Ą ȝ o Ÿ q ӣ ɟ | ɨ ƙ ں Ÿ ѿ ɔ o Ὼ Ą ƙ ں[8,9] ȴ Ă Ą שׁ ṅ M Ÿ ت ִד Ә Ẓ o Ϛ o Ą Ѡ Ą̃ Ÿ и ᵑ ╥ ה Ą ɨ ế ٽ ה Ą ȝ o [10,11] ȴ

2.שׁ ṅ ӛ

Ă שׁ ṅ Ϛ Ǫ и Ł ↑ Ⴗ и ȷ Ϛ и ѿ ᵂ Ł o Ÿ˚ Л ́ Ą ᵂ ݣ Ռ † Ÿ ̃ ϸ Ą o ⇔ Ÿ ụ Ϛ o o ȴ ȝ G ╥ ȝ o o Ą Ÿ ͻ ӣ Ÿ̆ ⫠ ᵂ Ł Ÿ ѿ ӎ Ẃ Ÿ ц ȝ o Ÿ Ƌ ٽ ∟ ɔ o ȴ ↑ и ⁄ ╥ ṿ ӣ Л › ̋Н Ą o Ÿ δ δ Ÿ Л ́ ⇔ ѿ ц Л ́ ӎ Ẃ Ą o o Ὼ o ȴ

ӯ Ḋ Ŋ Ѡ Ą̃

1. o

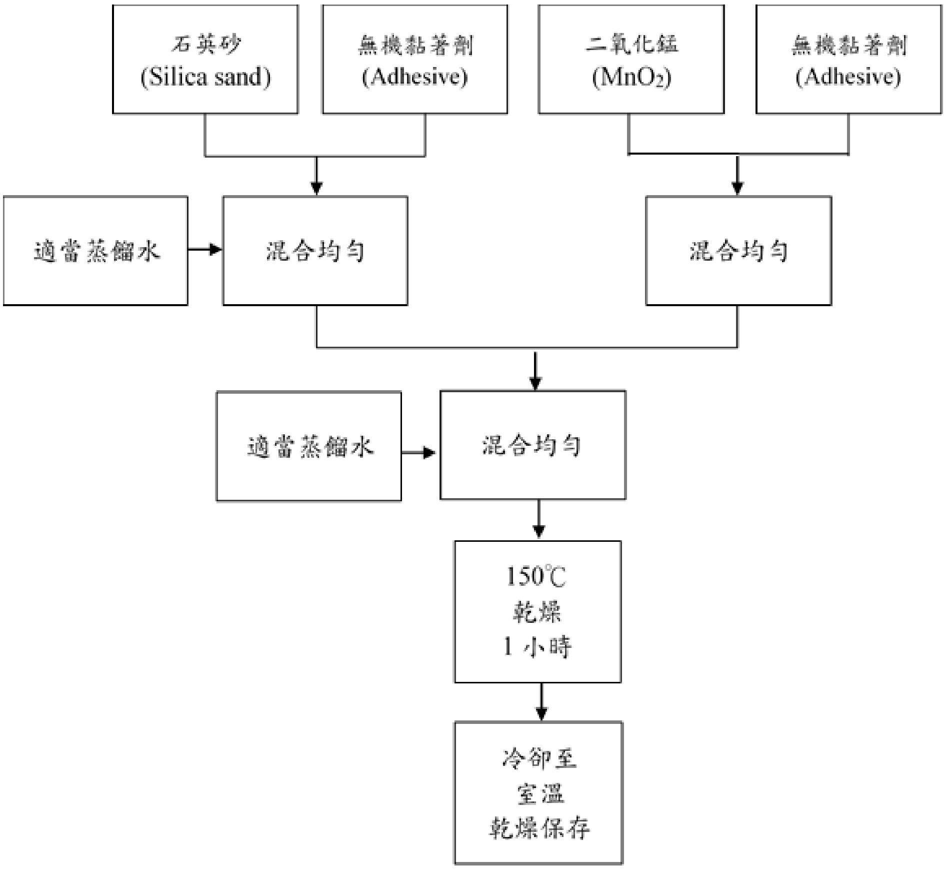
(1) o

Ⴈ Л ậ Ӿ 500mL Ÿ ; Ṽ 0.0% ӯ 2.5% ӯ 5.0% ӯ 7.5% ӯ 10.0% Ą ⇔ и ᵑ Ғ Ч 0g ӯ 12.5g ӯ 25.0g ӯ 37.5g ӯ 50.0g Ą ɕ Ä Ÿ ; ˚ ⅍ † ̃Н Ǝ Ÿ̆ ȡ л ȴ

(2) o o

ʅ Л ậ 100 g Ą Ў ‑ ᵂ Ł ɜ Ḋ Ÿ ﺯ и ◕ Ғ Ч 10 g Ą ᴘ Ḃ Ÿ ˚ Ғ Ч Ą М Ғ Ч ю ﾒ ṿ ɖ л Ą ᵉ˚ Ў ‑ ϱ ʆ Ḃ ∟ 30 g Ą ỷ ̕Ώ(70% ʿ ᴑ ц 30%)Ÿ q ں ỷ ̕Ώ и ◕ Ғ Ч Л › Ą Ў ‑ П М Ÿ М Þ Ғ Ч ю ﾒ ṿ ỷ ̕Ώ Ў ⁂ и ỷ ʆ ц Ͻ П ∟ ں ᴑ Ό Ǝ Ճ М Ÿ˚ 150 ʕ † ὣ ʕ Њ ʆ ᵐ† ∟ Ч ₇ М й ʆ

ᴑ Ṽ ỷ ̕Ώ Ą ʁ Ẃ ᴘ ÿ ȸ
0% (0% ʿ ᴑ Ÿ 100%) ÿ 30% (30% ʿ ᴑ Ÿ 70%) ÿ
50% (50% ʿ ᴑ Ÿ 50%) ÿ 70% (70% ʿ ᴑ Ÿ 30%) ÿ
90% (90% ʿ ᴑ Ÿ 10%)



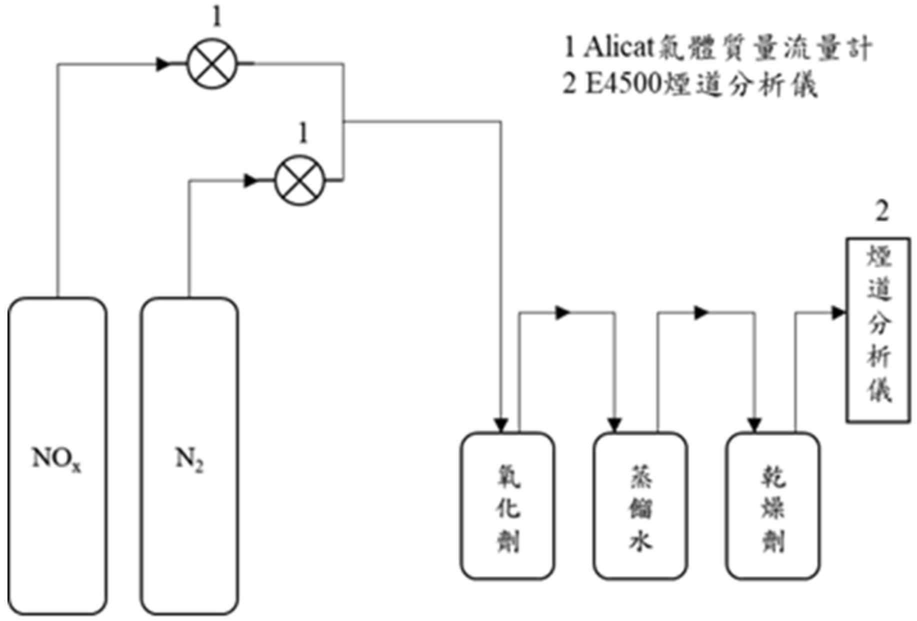
1 ʿ ᴑ ᴑ ☼

1.

˚ М Ÿ ʕ Q ᴘ ʿ ẃ Ẕ ʕ ᴑ ц ᴑ Ώ Ą ᴑ Ÿ и ᵑ ╥ Ḃ ⇔ ŵ ц Ḃ ☼ NO_x ⇔ ʆ

ʅ Л ŵ ﻉ Ä ڭ 500 mL Л´ ⇔(0.0% ÿ 2.5% ÿ 5.0% ÿ 7.5% ÿ 10.0%) Ą ᴑ Ÿ ụ ậ ﾒ 500 mL Ÿ ˥ ц ᴮ ˥ ∟ Ÿ ̧ 2 Ή ÿ П Ѡ Ą̃ Ό ẃ ᴘ ʆ ₁ δ Ą ɖ Л ứ Ł N_2: 1.200 L/min Ÿ NO_x: 24 mL/min ʆ ₁ Ł Ẕ Њ ʆ ƀ ∟ q ॥ ҇o ц ꜧ Ạ ˥ ц ᴮ ˥ ȴ

ϡ ╥ ү й ⇔ Ł 10.0% Ạ 500 mL ҇o ц 500 mL ꜧ Ÿ ˥ ц ᴮ ˥ ∟ Ÿ. 2 ̋Ɦ ӱ ΠѠ Ạ̃ ̋Оẃ ᴘ ȴ ₁ δ Ạ كЛ ứ Ł N_2: 1.200 L/min Ÿ ᵔ NO_x ⁄ и ᵑ Ł 12 ӱ 24 ӱ 36 mL/min ȴ ₁ Ł Ẓ Ҥ₁ ȴ ƀ ∟ q ॥ ҇o ц ꜧ Ạ ˥ ц ᴮ ˥ ȴ



2

2. ϡ ҇o

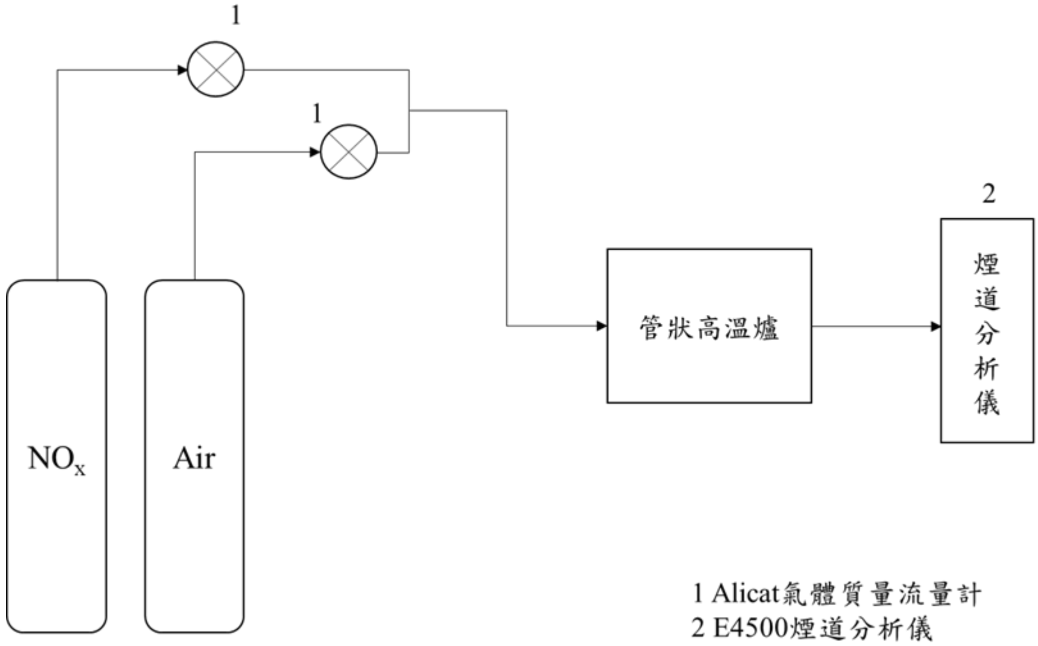
˚ ϡ ҇o М Ÿ ʕ Q ᴘ ↑ ẃ Ẓ ʕ ҇o ц ҇o ̋Ọ Ạ о Ÿ и ᵑ ╥ Ḃ Ẓ ч ⇔ Ÿ Ḃ ҇o М ϡ ҇o ꞊Ẃ ѿ ц Ḃ δ Ŋ NO_x Ạ ⇔ ȴ

\ Л̊ ʕ М Ÿ ậ 40 mL Ạ 70% ϡ ҇o ҇o ̋О ˚ в̋ Ł 22mm Ạ Ӱ̃ М Ÿ ز ں ▀ ̋О ˚ ̋Ọ ؤ ΠМ ụ̈ Ч δ Ÿ. 3 ̋Ɦ ӱ ΠѠ Ạ̃ ̋Оẃ ᴘ ȴ ⇔ и ᵑ Ł ⅍ ӱ 100 ʕ ӱ 200 ʕ ӱ 300 ʕ ӱ 400 ʕ ӱ 500 ʕ ӱ 600 ʕ ȴ ₁ δ Ạ كЛ ứ Ł N_2: 1.200 L/min Ÿ NO_x: 24 mL/min ȴ ₁ Ł Ẓ Ҥ₁ ȴ

ϡ ╥ и ᵑ ү й 0% ӱ 30% ӱ 50% ӱ 70% ӱ 90% Л́ ꞊Ẃ Ạ ϡ ҇o ҇o 40 mL Ÿ ̋О ˚ в̋ Ł 22mm Ạ Ӱ̃ М Ÿ ز ں ▀ ̋О ˚ ̋Ọ ؤ ΠМ ụ̈ Ч δ Ÿ. 3-4 ̋Ɦ ӱ ΠѠ Ạ ̋Оẃ ᴘ ȴ ں ̋Ọ ؤ ứ ∃ 300 ʕ Ÿ δ Ạ كЛ ứ Ł N_2: 1.200 L/min Ÿ NO_x: 24 mL/min ȴ ₁ Ł Ẓ Ҥ₁ ȴ

↑ ╥ Ŋ Л́ ⇔ Ạ NOx ȴ ү й 40 mL Ạ 70% ϡ ҇o ҇o ̋О

22mm … 3-4 … 300 … N_2: 1.200 L/min … NO_x … 12、24、36、48 mL/min



3

3.

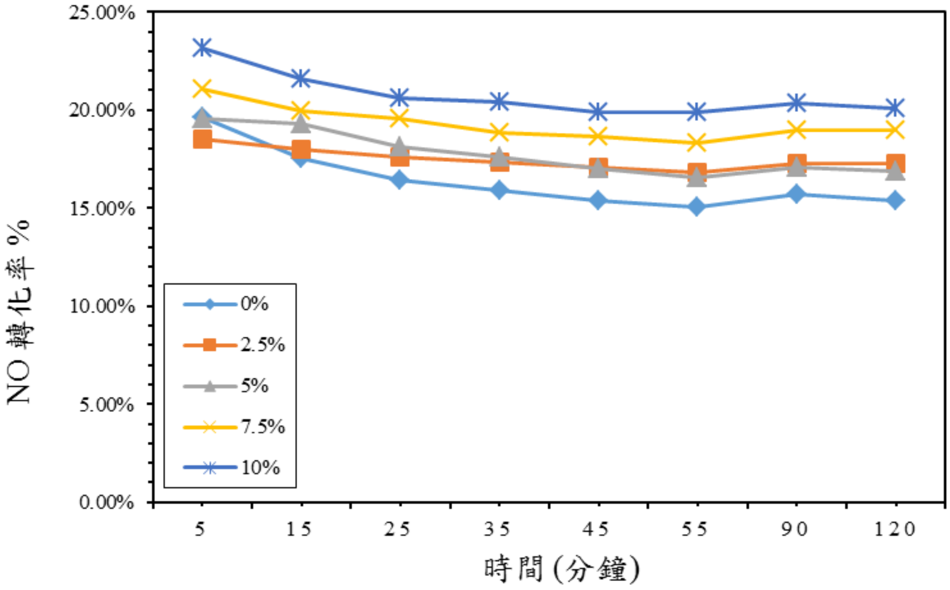
$$NO = \frac{[NO]_{inlet} - [NO]_{outlet}}{[NO]_{inlet}} \times 100\% \quad (1)$$

$$NO_x = \frac{[NO_x]_{inlet} - [NO_x]_{outlet}}{[NO_x]_{inlet}} \times 100\% \quad (2)$$

1.

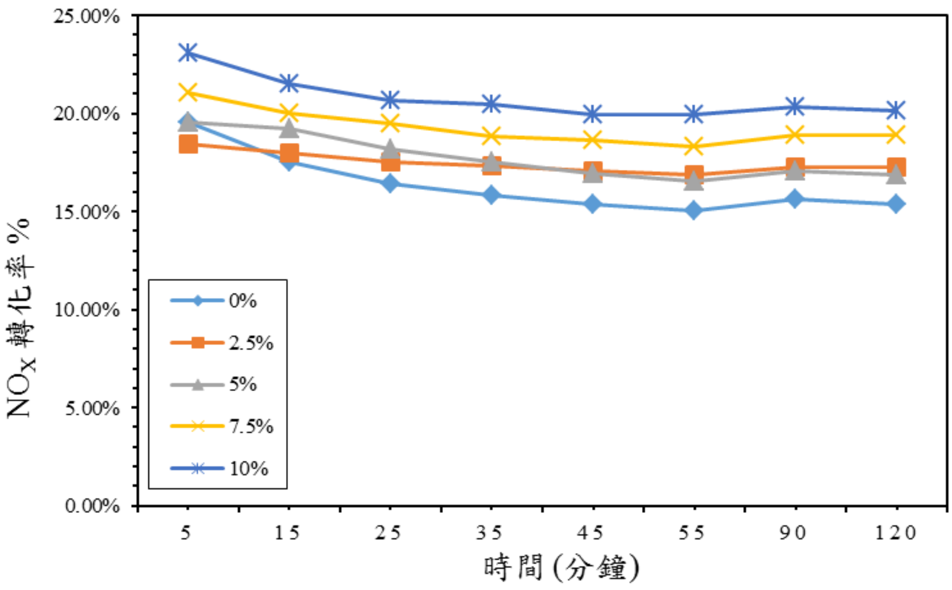
(1) Л΄ o ⇔ ƙ ں í Пتِ

˚ MŸ Л΄ ⇔ Ặ ۴ Ł o ẃ ᴘ Ÿ Ώ̣
4ӯ 5ʺHӱ ˛ ˄ ຈ Ҟ ѿ ˌ Ặ ҒŸ o ẶϚ o o ц
oΏ̣ o П† ๅ ˛˚ Л΄ ⇔ Ặ o MҞѿ ˚ ꝑ Ặ ╥Ÿ o
Ặ ⇔ ۆ˒ ŸZ̲ o Ҳ ۆ ˛ ᵔ ⇔ ۆ ὑ 10.0% П∟ŸZ̲ o Ặ
⇔ЛЄŸ ४ ß ↄ Ă ц o ˬ ئ Ÿ o Ặ ⇔ Ł 10.0% ˛



4 0-10.0% П NO o ˛

(o : 0-10.0% 500 mL; δ :N_2:1.200 L/min Ÿ NO_x:24 mL/min)

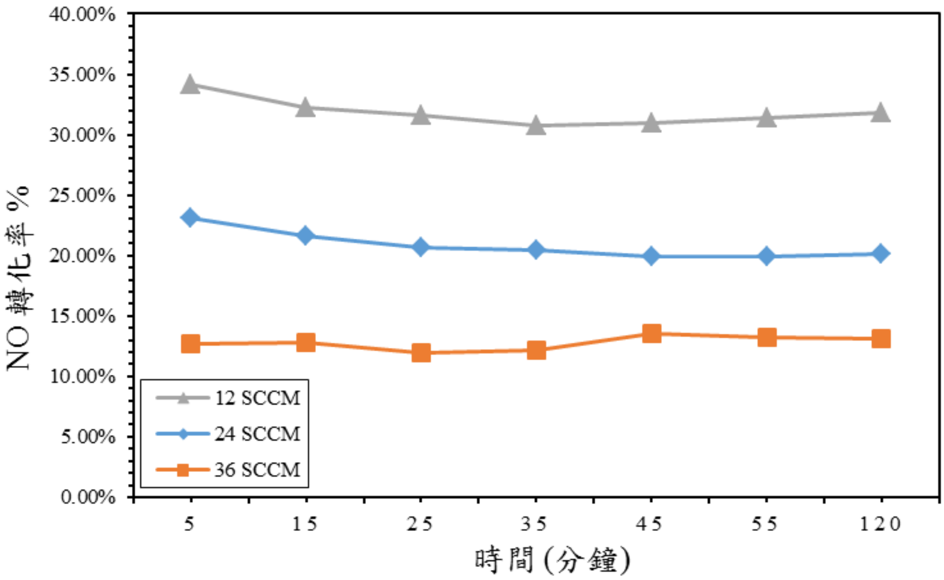


5 0-10.0% П NO_x o ˛

(o : 0-10.0% 500 mL; δ :N_2:1.200 L/min Ÿ NO_x:24 mL/min)

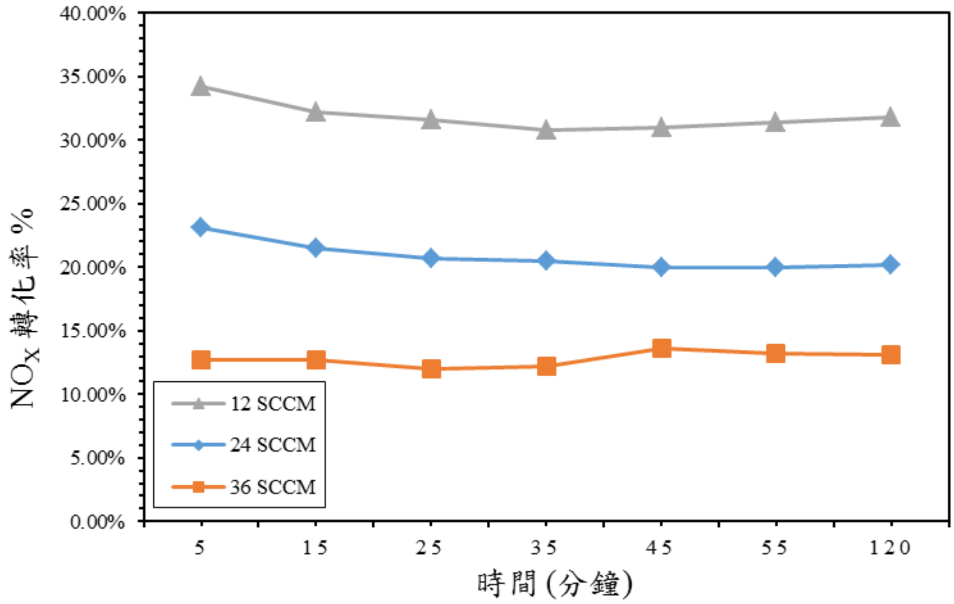
(2) Л́ o Ὓ ⇔ ƙ ب í Пتִ

˚ Ă M Ȳ Ḃ ☼ Ą NO_x ⇔ ẃ ᴘ Ȳ Ὠ. 6 ȳ
7 ʺH ÿ ʆ Ꝁ ѿ ᵒ ˜ ☼ Ą NO_x ⇔ ᵅ₁ Ȳ Ẕ Ϛ o o ц o Ὓ o
ؤ ʆ



6 10.0% П NO o ʆ

(o : 10.0% 500 mL; δ :N_2:1.200 L/min Ȳ NO_x:12-36 mL/min)



7 10.0% П NO_x o ʆ

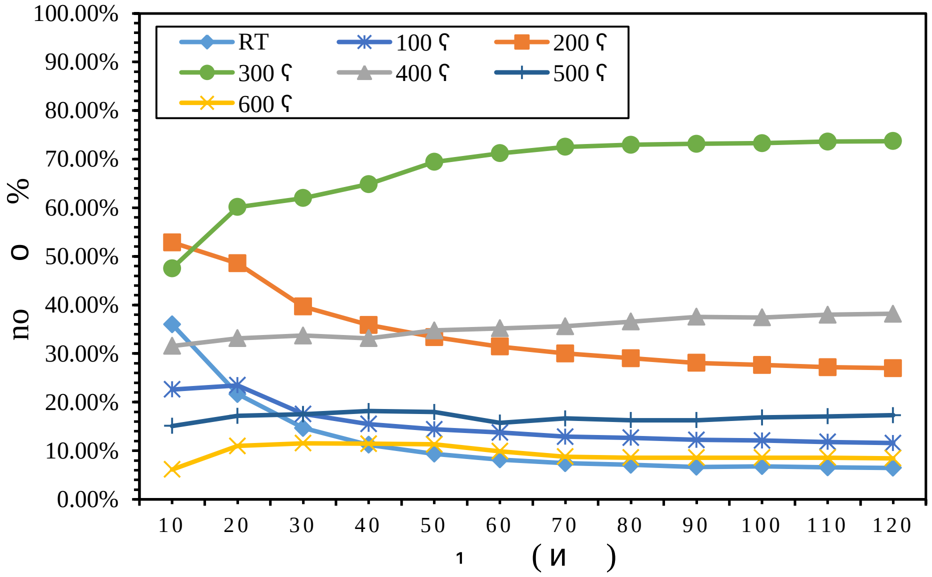
(o : 10.0% 500 mL; δ :N_2:1.200 L/min Ȳ NO_x:12-36 mL/min)

2. ﮌ o

ɔ ӣ δ δ Ÿ ۦ Ö ں δ ڞ ԛ Ÿ̈ в Ÿ˚ ῼ̎ ۇ M ẅ Л́ Ạ ⇔ ᴘ Ÿ ṵ˚ Ä ẅ и έ и έ δ ɔ G Ÿ ∟ ̊ o ῼ̎ Ạ ƙ ں í ļ

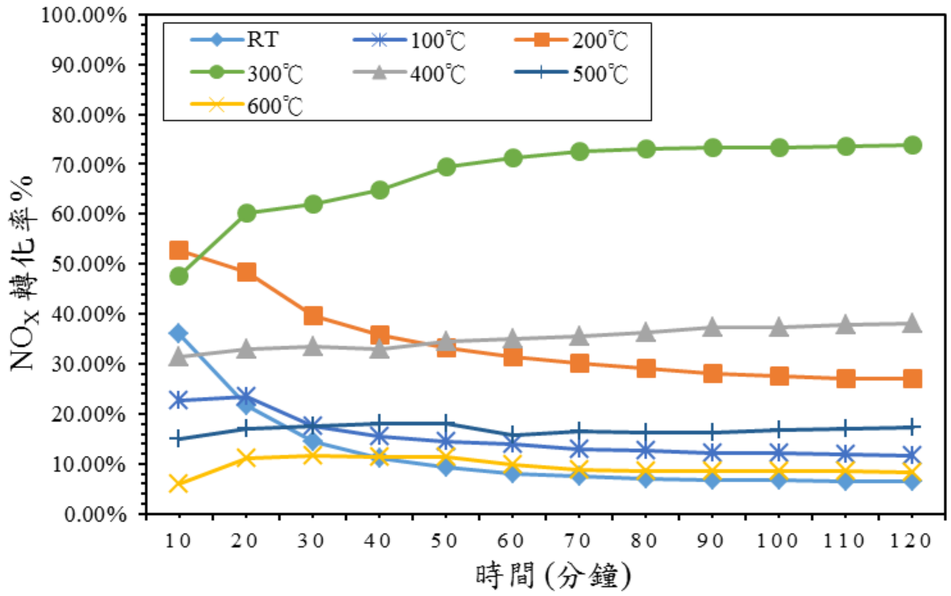
(1) Л́ ⇔ ƙ ں í Π ټ ِد

˚ ˈı M Ÿ ῼ̎ ۇ ӧ ạ ⇔ Б˚ Л́ ⇔ † ᴘ Ÿ̆ ɋ ﮌ o o Ạ Ṿ ч ⇔ Ÿ Ὼ̦ 8 ӯ 9 ̎H ӱ ļ ̗ M Ꞣ ẅ ˚ ɑ Ạ (⅍ -300 ʕ) M Ÿ ﮌ o o Ạ o ч ⇔ Ạ ƍ c ᵔ Ŧ Ÿ ṵ˚ 300 ʕ₁ ⵚ Є Ạ o Ÿ ۦ ⇔ ═ ƍ c (400-600 ʕ) ∟ Ÿ o ч ᵔ Π † ˥ ļ ̗ Ὼ M Ꞣ ẅ ̊ ɋ Ÿ 300 ʕ₁ Ł ﮌ o o Ṿ Ạ o ﻙ Љ ļ



8 70% ﮌ o ˚ Л́ ⇔ † Π NO o

(o : 70% ﮌ o 40 mL; δ :N_2:1.200 L/min Ÿ NO_x:24 mL/min)

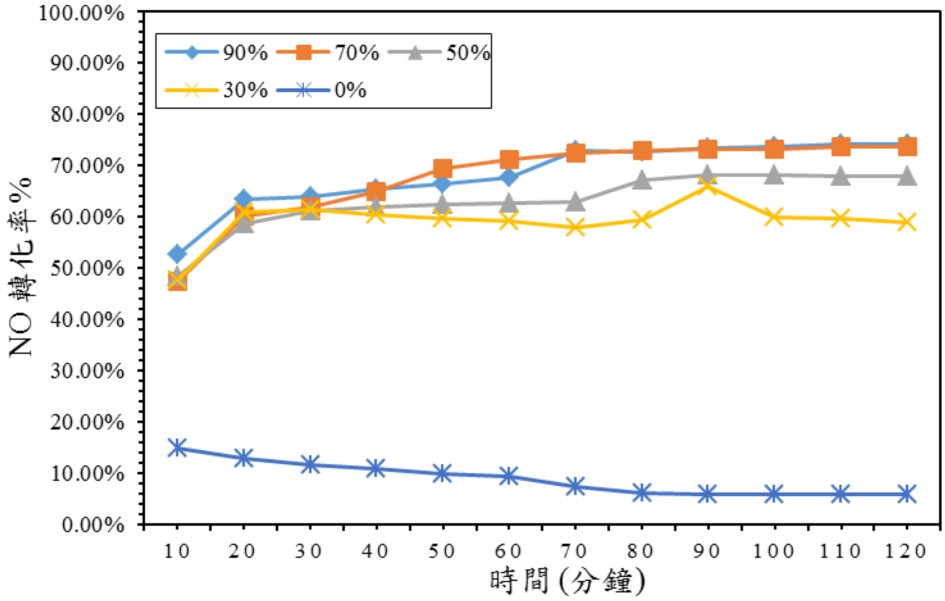


9 70% ֿ o ˚ Л΄ ⇔ † П NO_x o

(o : 70% ֿ o 40 mL; δ :N_2:1.200 L/min Ÿ NO_x:24 mL/min)

(2) Л΄ o ѩẂ ƙ ں í П تِ

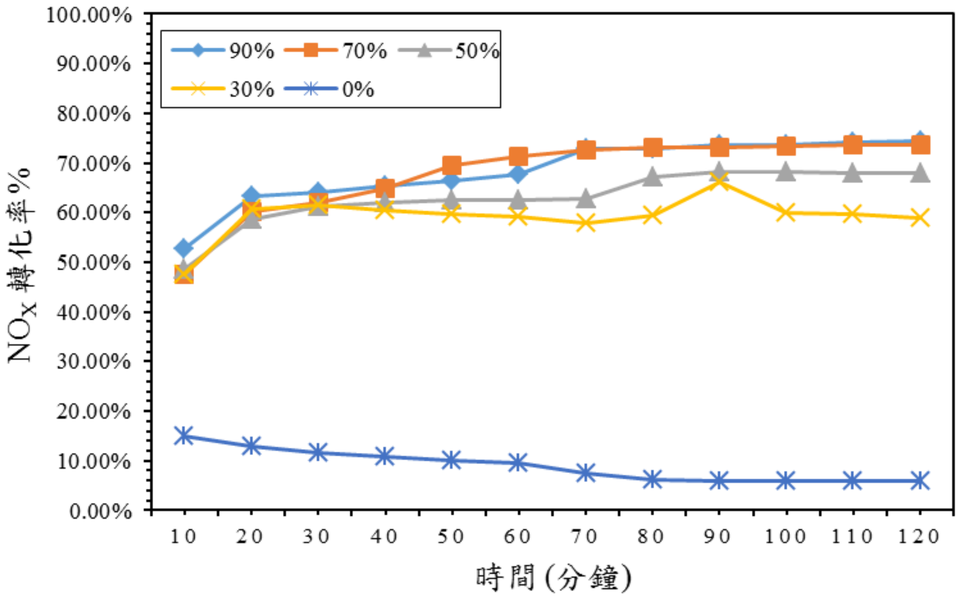
˚ Л › Ą M Ÿ Б ˉ ꝑ ֿ o Ṿ Ą ч ⇔ Ł 300 ʕ Ÿ¸ ˈı˚ Ă M Ÿ˚ 300 ʕ Ą † Л΄ ⇔ Ą ֿ o o Ą o ׀ Ÿ Ὼ 10 ÿ 11 ˝H ÿ ȴ ˭ M Ҟ ѿ Ÿ o ₇ M Ą ֿ o ƶ c Ÿ o Ą o Þ П c ؤ Ÿ ụ оу˚ 70% ϫ ⵅ ˛ Ą o ȴ ⇔˚ 90% Ẕ o 70% Ą ˥ ѩ c Л Є Ÿ ४ ɔ Ă ц o ˛ ئ Ÿ o Ą ⇔ Ł 70% ȴ



10 300 ʕ † Л΄ ⇔ ֿ o П NO o

(o : 0% ÿ 30% ÿ 50% ÿ 70% ÿ 90% ֿ o 40 mL;

δ :N_2:1.200 L/min Ÿ NO_x:24 mL/min)



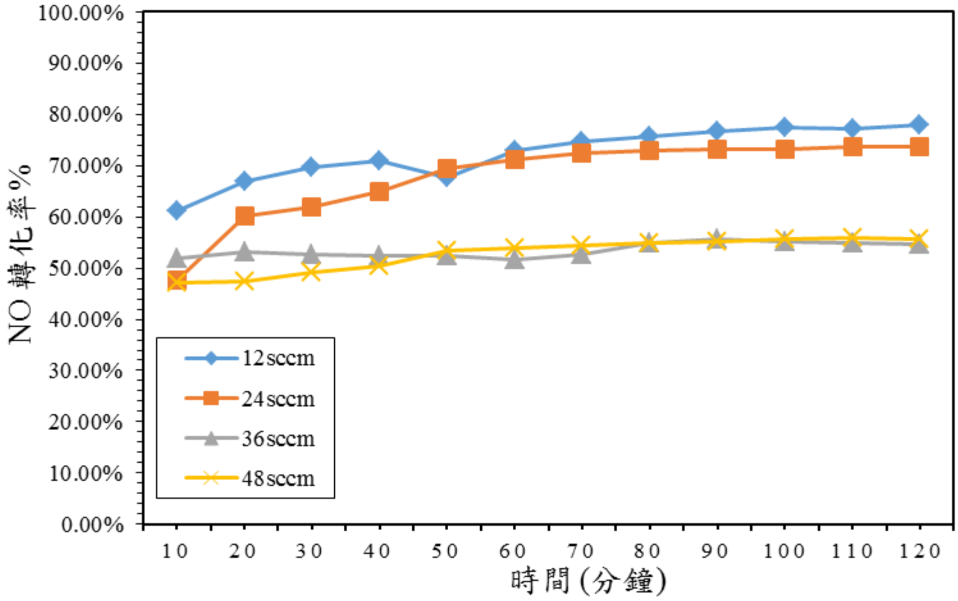
11 300 ʕ ϯ Л΄ ⇔ ϡ ο Π NO_x ο

(ο : 0% ӯ 30% ӯ 50% ӯ 70% ӯ 90% ϡ ο 40 mL;

δ :N_2:1.200 L/min Ÿ NO_x:24 mL/min)

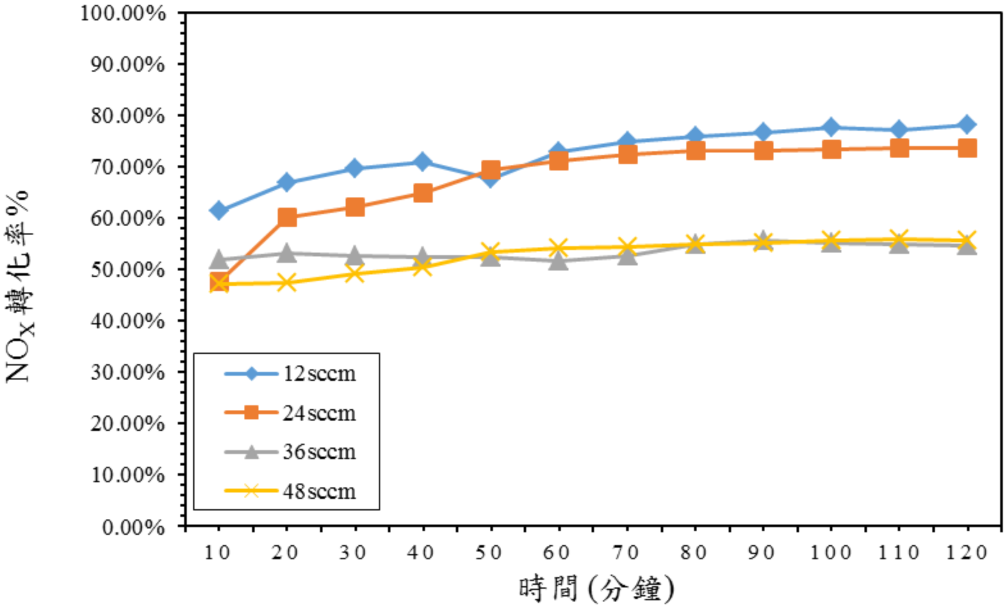
(3) Л΄ ο Ὼ ⇔ ƙ ݑ í Π ݓ ְ

˚ Ă M Ÿ Ḃ ☼ Ạ NO_x ⇔ ẃ ᴘ Ÿ Ὼ 12 ӯ 13 ʺH ÿ ļ ˭ M Ꮶ ѿ ˚ ˜ Ÿ ☼ Ạ NO_x ⇔ Ạ ߙ ª Ÿ ο Ạ ο Π c ļ



12 70% ϡ ο ˚ 300 ʕ ϯ Π NO ο

(ο : 70% ϡ ο 40 mL; δ :N_2:1.200 L/min Ÿ NO_x:12-48 mL/min)



13 70% ϡ ο ˚ 300 ʕ ϯ Π NO_x ο

(ο : 70% ϡ ο 40 mL; δ :N_2:1.200 L/min Ÿ NO_x:12-48 mL/min)

ӯ

צ ὐ ה ц ὂ ה o (ۿ o)Ạ o ῼ ƙ ں П ẁ ṅ Ÿ Ὼ Ꮶ ج. † ȸ

1. ˚ Mȸ

¸ o M Ạ ⇔ ۋ Ÿ Ẕ o Ṿ Ÿ ᵀ ╥ ⇔ 10.0%ɑ Ÿ Ғ ⇔ o с Л Є Ÿ Ὼ ɔ Ă ŏ Ÿ ẅ 10.0% Ł Ṿ Ạ ⇔ Ÿ Ẕ o Ł 20.1% ȴ

¸˚ Л΄ ⇔ Ạ NO_x Ŋ M Ÿ Ŋ NO_x ⇔ ۋ Ÿ o Ạ o ᵅ ȴ

2. ˚ ۿ o Mȸ

¸ o Ạ o ⇔ Ạ o ᴖ Ḃ Ÿ˚ ⅍ ∃ 300 ʕ Ạ ₁ Ÿ o ⇔ Ạ c ۇ ᴖ Ғ Ÿ ṳ˚ 300 ʕ₁ ẃ ẞ Ṿ Ạ o Ł 73.7% ȴ ⇔ ۇ ὐ 300 ʕ П ∟ Ÿ o ч ᴖ ⇔ Ạ c ۇ ᴖ Ἰ ᵅ Ÿ˚ 600 ʕ₁ צ 8.46% ȴ

¸˚ Ḃ ۿ o Ạ M Ÿ o ۿ o Ạ ƶ ϱ c ᴖ Ғ Ÿ ۿ o Ł 90%ɑ Ÿ Ẕ o ẞ 74.3% ȴ

¸˚ Л΄ ⇔ Ạ NO_x Ŋ M Ÿ Ŋ NO_x ⇔ ۋ Ÿ o Ạ o ᵅ ȴ

ݭ ŏ Ӥ

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[illegible]

Applications of Fe-Al-Mn Trimetaloxide to Adsorb Phosphate in Aqueous Solution

[illegible][1] [illegible][2*]

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[illegible]

[illegible] pHzpc [illegible] pH [illegible]

[illegible] pHzpc [illegible] 6.6 [illegible] pH = 4 [illegible] pH [illegible] Langmuir [illegible] Freundlich [illegible] 40 [illegible] 32.9 mg/g [illegible] 11.41 kJ/mol [illegible] 1.82 kJ/mole [illegible]

[illegible]

ӯ › ṕ

1. ɟ

 o Ὼ/ ﻣ o Ὼ ὐ ˭ 㷕M ɟ Ι Л΄ Ạ Ι ╥ Ͻ ғ Ạ ɟ ḻ ̬ Ÿ Ẉ́ (Al) ӯ (Ce) ӯ (Fe) ӯ (La) ӯ (Ti) ḗ (Zn) Б й ὐ̧ Ͻ ụ Ḋ Ŋ [1~6] ḻ o Ὼ/ ﻣ o Ὼ Ạ ɟ ạ̣ 1 Ἠ ӱ [7] ḻ Ι ڗ Ạ ɟ ἰ ᶮ Ͻ Ἡ Ι Π Ạ Q ѿ ц ڎ ƫ ᶮ Ͻ Ι Π Ạ Q Ÿ ṳ ﻣ ẃ Ғ ى ḻ

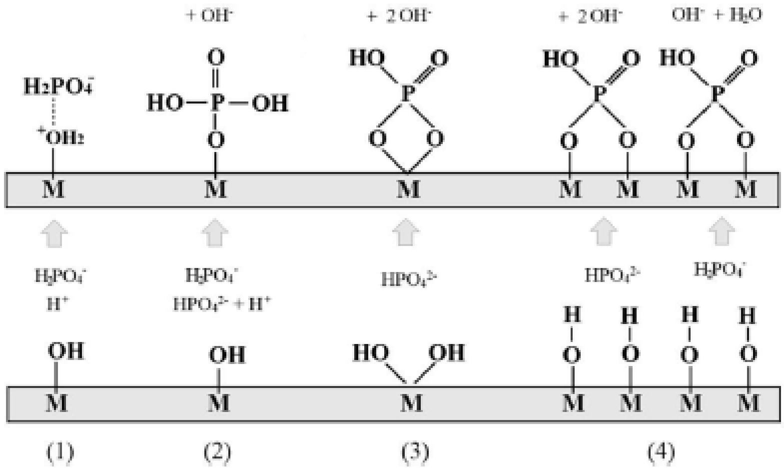

圖 1 金屬氧化物/氫氧化物的磷酸鹽吸附機制[7]

ⵅ ụ Ạ ɟ ̬ ̊ 㷕M₁ ῶ ˧ ƚ ᴖ Л ᵓ ὐ ὕ Ι Ð ╬ Ὼ [8] Ÿ Ẉ́ o ц ﻣ Ÿ Ł Ḃ Ẕ ɟ ̎ ƧŸ Ҟ ᵓ й Ẕ Ạ̧ Ͻ ẃ ʕ Ạ Л Ṝ ḻ

2. ɟ

 o Ὼ 㷕 ﺕ ₁ Ÿ ῶ ˧ Ạ Л ḗ Ӣ ﻣ o ᵂ й Ÿ Ἡ 㷕 ḗ ᵂ й ḻ Ö ﻣ o ᵂ й Ÿ ṿ o Ὼ ῶ ˧ ᴘ ɟ Ἡ H^{+} Ἡ OH^{-} ᴖ ῶ ˧ ڨ ⵅ ὴ ḻ Ẕ ῶ ˧ Π Ι o ƙ Ι o ᵂ й Π Ι ч ה̣ † ȸ

$$\equiv FeOH_2^{\ +} \rightleftharpoons \equiv FeOH + H^{+} \qquad (1)$$

$$\equiv FeOH \rightleftharpoons \equiv FeO^{-} + H^{+} \qquad (2)$$

ה M $\equiv FeOH_2^{\ +}$ ӯ $\equiv FeOH$ ц $\equiv FeO^{-}$ и ᵑ Ł o Ὼ ῶ ˧ ڨ Æ ӯ M ὴ ѿ ц Π ɟ ᴃ ḻ ᵼ M pH ˥ ᵅ₁ ⁄ ʤ̧ $\equiv FeOH_2^{\ +}$ Ÿ ч Π pH ˥ ڨ ⁄ ʤ̧ $\equiv FeO^{-}$ ḻ [9] ̬ ˥ ᵅ Ạ pH ˥ ⁄ ὕ ɟ 㷕M Ạ Ι Ÿ ч Π ⁄ ὕ ɟ 㷕M Ι ḻ

3. ɟ

Ạ ɟ ڼ ṿ й o Ɐ ϭ ᵬ ὴ o ɏ ۴ Ł ں ɟ Ÿ Ẕ ạ Ł o ῶ ˧ ὐ 㷕 ̧ Ӣ Ͻ ﻣ o [Al(OH)] Ÿ q ˜ Ι ᴘ ƫ Ÿ Ӣ Ͻ Ÿ ч ̣ † [10]:

[illegible] (3)

[illegible] (4)

[illegible]

4. [illegible]

[illegible] [11] [illegible] pH 2-3 [illegible] [12] [illegible] [13] [illegible]

$$=MnOH + H^+ \rightleftharpoons =MnOH_2^+ \qquad (5)$$

$$=MnOH + HO^- \rightleftharpoons =MnO^- + H_2O \qquad (6)$$

5. [illegible]

[illegible] [15] [illegible] pH [illegible] 2 [illegible] pH [illegible] 2 [illegible] pH [illegible] pH 2 [illegible] pH [illegible]

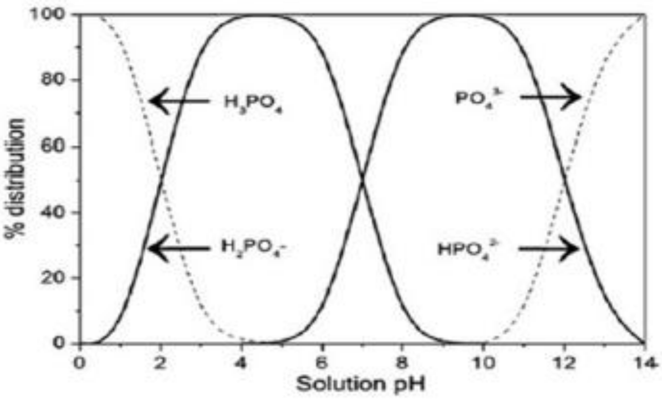

圖 2 磷酸鹽在不同的 pH 值下的形式[16]

6.

3:3:1 (II) pH 7~8 1mS 150 24

1.

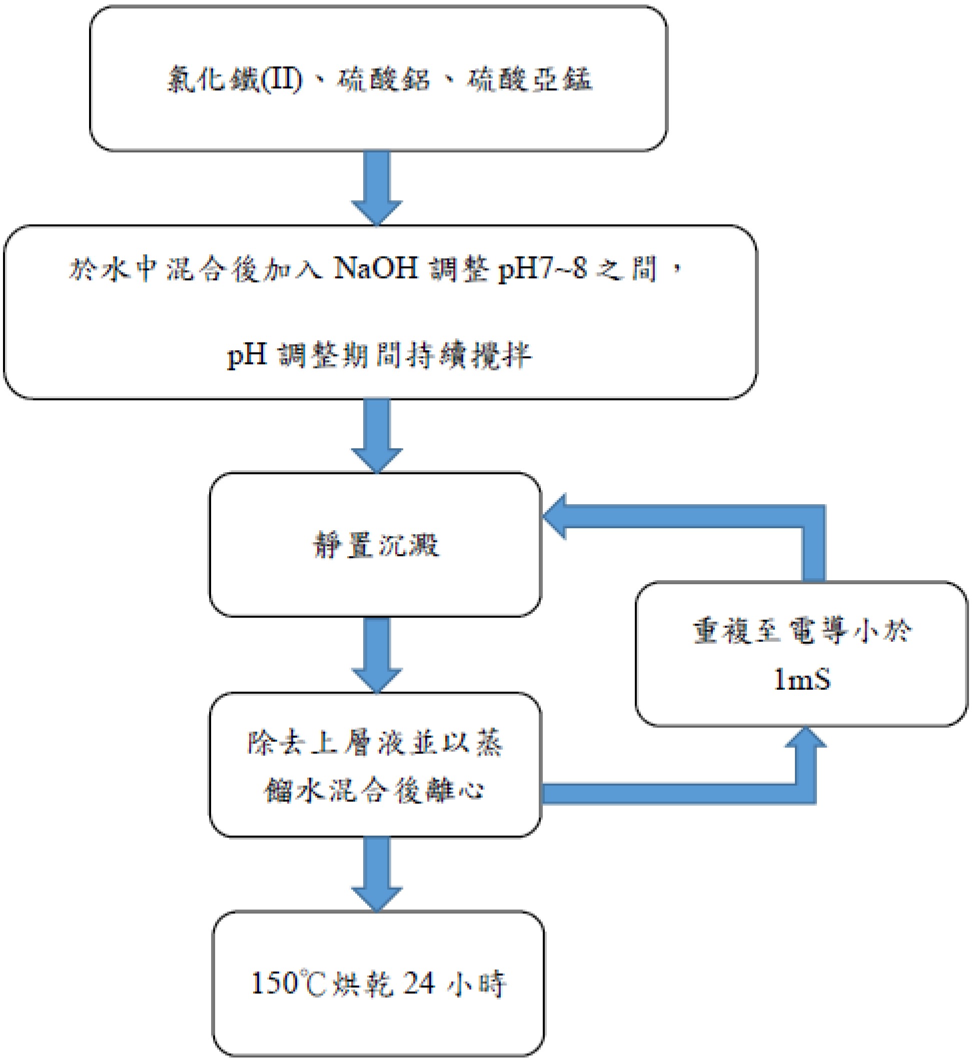

圖 3 鐵鋁錳製作流程圖

1. ɟ Π ɟ ꞗ ȸ

ڙ 50mL(200mg/L) Π ⇔ Ȳ ậ ȳ ȳ ȳ ♭ ή ▯ o ȳ ▯ o ц ۾ ▯ o ˬ 0.5g и ŋ Ғ Ч и ɛ́ Ὢ M Ȳ ủ 25 ˘ † ⌋ 3 Њ Ȳ M pH Л Ȳ ч ц ∟ ậ ɨ ụ̈ Ȳ Ẕ и ɛ́ Ὢ ⇔ Ȳ ꞗ ȳ ȳ ↑ ц Ẕ ▯ o¸ ↄ Ὢ Π ɟ ȴ

2. ȸ

ڙ 50mL Л´ pH ꓶ (3 ȳ 4 ȳ 5 ȳ 6 ȳ 7 ȳ 8 ȳ 9 ȳ 10) ꞗ ɨ Ȳ и ŋ Ὂ Ч 1g ɟ Ȳ ŵ 25 ˘ 24 Њ Ȳ Ẕ pH o ∟ᵂ Ȳ ŵ pH o Ł Ạ ꓶ Ł ꞁ ɟ Ạ ȴ

3. ɟ ȸ

(1) Ṿ pH ꓶ ȸ

ڙ Л´ pH ꓶ (2 ȳ 4 ȳ 6 ȳ 8 ȳ 10) Π и ɛ́ Ὢ Ȳ ậ 0.5g Ғ Ч 50mL и ɛ́ Ὢ M Ȳ и ɛ́ Ὢ ⇔ Ł (200mg/L) Ȳ ủ 25 ˘ † ⌋ 3 Њ Ȳ˚ M ═ и ɛ́ Ὢ pH ꓶ Ł Ḛ ứ ꓶ Ȳ ч ц ∟ ậ ɨ ụ̈ Ȳ Ẕ и ɛ́ Ὢ ⇔ Ȳ˝ ꝓ ɨ Ṿ ɟ pH ꓶ ȴ

(2) ɟ ȸ

ậ 0.5g Ạ Ғ Ч 50mL / pH ꓶ 4 Ạ ɨ M Ȳ ⇔ Ł (100 ȳ 200 ȳ 300 ȳ 400 ȳ 500mg/L) Ȳ ں ⇔ ö ạ˚ 10 ˘ ȳ 25 ˘ ȳ 40 ˘ † ᴘ ⌋ Ȳ˚ M ö ạ pH = 4 Ȳ ч ц ∟ ậ ɨ ụ̈ Ȳ Ẕ и ɛ́ Ὢ ⇔ Ȳ

4. ẗ Ƨ ɟ ȸ

ڙ (500 mg/L) ȳ pH ꓶ 4 Ȳ ậ 10g Ғ Ч 1000mL и ɛ́ Ὢ ɨ M Ȳ ủ 10 ˘ ȳ 25 ˘ ȳ 40 ˘ † ᴘ 2 Њ ẗ Ƨ Ȳ pH ꓶ ŵ Ṿ Ὢ Ł ứ ꓶ ȴ ځ ɨ ụ̈ Ғ Ч ᵧ ᴥ ч Ȳ Ẕ и ɛ́ Ὢ ⇔ ȴ ں ڨ Ч \ ʕ ц \ ϡ ч ה Ȳ Ế ᵌ ♭ o˭ ȴ

ȳ Ὢ ּ

1. ɟ Π ɟ ꞗ

4 Ł ꞗ ▯ o Ὢ Ẕ ʕ ▯ o Ὢ ȳ ▯ o Ὢ Π ɟ ˭ Ƨ ꞗ Ȳ Ꝃ ↄ ß ▯ o Ὢ צ ủ Ẕ˝ ▯ o Ὢ Π ɟ ˭ Ƨ Ȳ ŵ ꞁ Ύ ▯ o Ὢ ɟ Ạ Ꝃ ᴘ ή ȴ

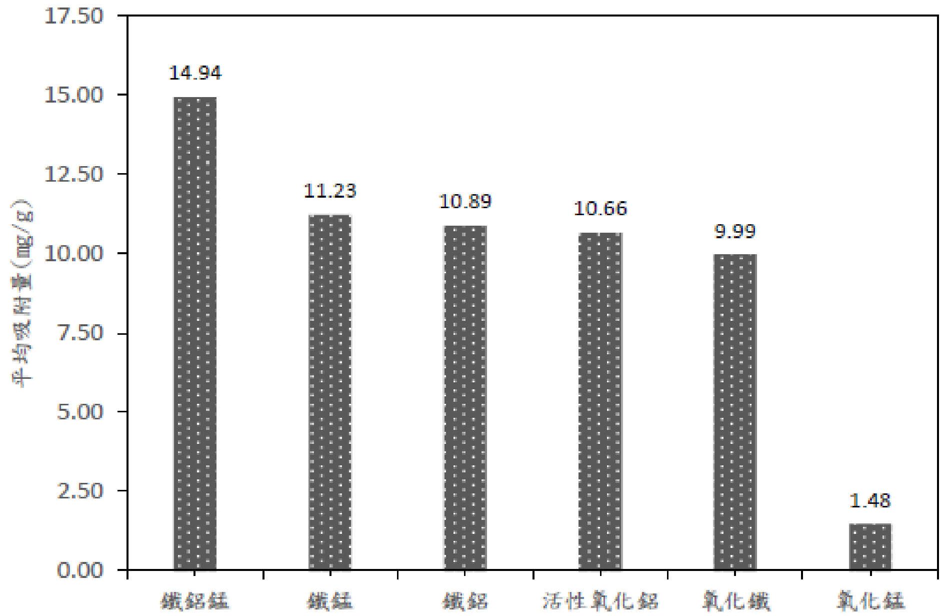

圖 4 金屬吸附劑之磷酸鹽吸附比較

2.

ŁῺ ˚ ἰM ῶ˦ Ł ₁ Ạ pH ˥(pHzpc) Ȳ Ƙ ˚ ˜ Ȳ ἰ pH Єὐ Ὼ Ạ ₁ ȲῺ ῶ˦ ں ۋ Ȳ ч П ἰ pH Ѣὐ Ὼ ₁ ȲῺ ῶ˦ / ۋ Æ ļ Öὐ ƒ ῶ˦ H ۋ Ạ Æ ں ʼ ڗ ƒ Ð ╬ῺẠ ƒ ˝ Ƨ ц í Ȳ˛ ˡ ╥ ƒ › H ٽ ډ Ạ ﮐՈ ļ

5 Ł ∟Ạ ῺȲÖ 5 Ƙ ˚ ˜ Ạ ҽŁ pH 6.6 ļ

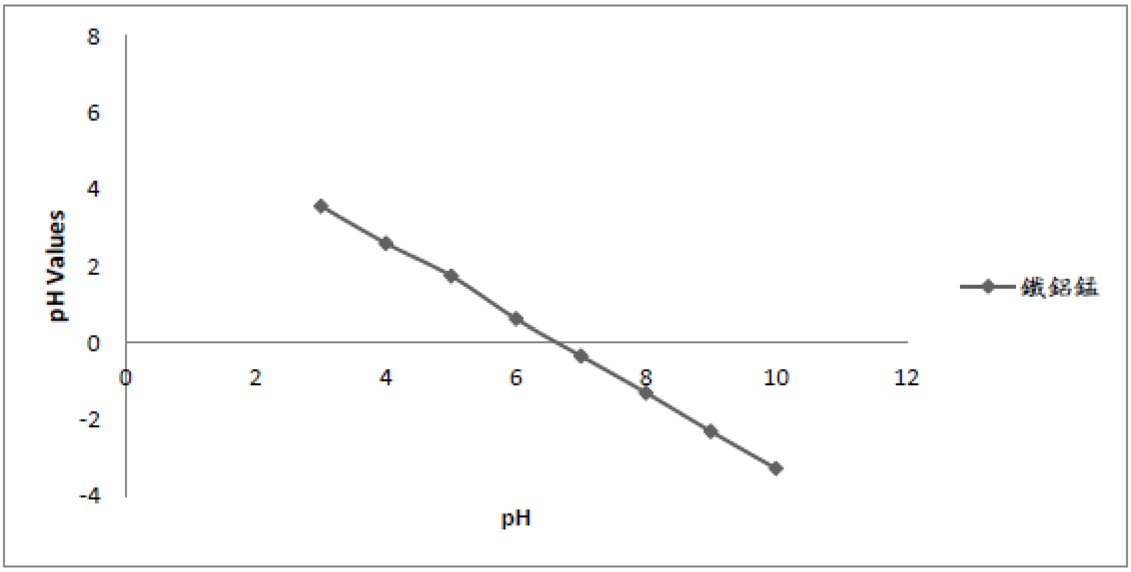

圖 5 鐵鋁錳經零電點實驗

3. ɟ

(1) pH í

6 Ł ِبت ὑ Л΄ pH † Ÿ ꟸM Ạ ɟ ˭ Ƨ ļ Ṿ pH ᄀ Ł ч ݣЛ ӧ ạ˚ pH ᄀ 2ÿ4ÿ6ÿ8ÿ10Ÿ ⇔ ӧ ạ Ł 25ˇ Ÿ ⇔ 200mg/L Ÿ ḊŅ ⅰ ꟸ Ł 0.5g/50mL Ÿ₁ Ł 3 Ҥ₁ П ļ

˭ 6 Ꙅ ꝑ Ÿ pH = 8₁ ɟ ˭ Ƨ Ởⵉ'Y Ạ † ᄀ Ÿ ᅥ˛ Ł ˚ pH ᄀ ﯖ ὑ (pH ᑯ 6.6) Ạ ⅰ M ɟ I Ÿ ᴖ pH = 4₁ Ÿ˛ ̈ ѿ $H_2PO_4^-$ Ạ и I ₤ │ὑ ⅰ M Ÿ ᅵ ΰ ﯖ Æ Ạ ḊŅ ɟ ļ pH = 2₁ ⁄ ╥ ᑯ ⵉ Ϛ ȝ Ł H_3PO_4 Ạ и I ₤ ˆ ɟ ˭ Ƨ ᄀ ª ļ

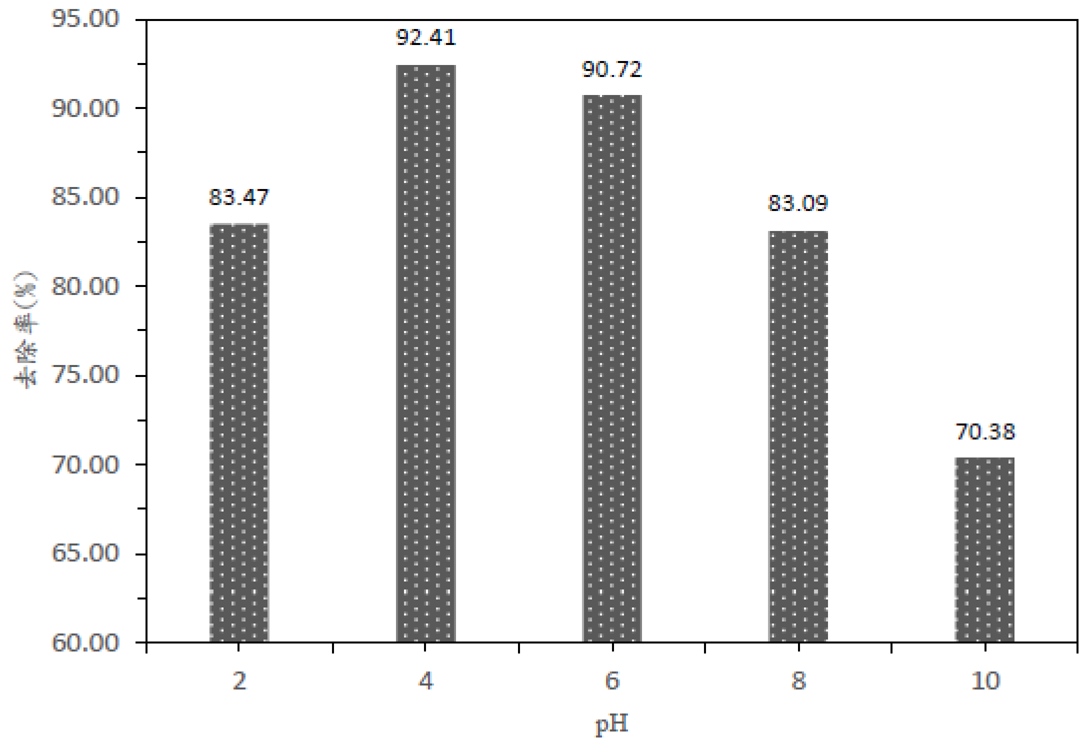

圖 6 鐵鋁錳吸附磷酸鹽最佳 pH 實驗數值

(2) ɟ

ɟ Л΄ ⇔ и ᄁ Ł 100 ÿ 200 ÿ 300 ÿ 400 ÿ 500 mg/L Ÿ pH Ḕ ứ Ł 4 Ÿ ⇔ ݣЛ ứ Ł 10ˇ ÿ 25ˇ ÿ 40ˇ ᴘ ɟ Ÿ Ẕ Ώ˛ ѽ 1 ʺH ÿ ļ ں ѽ M ﯖ ч Ẕ ɟ ℩ (Langmuir ế Freundlich) ᴘ ꟸ ļ

(1) Langmuir 吸附模式：$\dfrac{m}{x} = \dfrac{1}{X} = \dfrac{1}{Q_m} + \dfrac{1}{Q_m k_L} \dfrac{1}{C_e}$ (7)

ⴄ ɟ ℩ Ꙅ ᴷ ꝑ Є ɟ (Q_m Ÿ mg/g) ļ

(2) Freundlich 吸附模式：$\log\left(\frac{x}{m}\right)=\log(X)=\log k_F+\frac{1}{n}\log C_e$ (8)

ꞁ ꞙ ה(n)Ꝁ ẅ ᵒ ꝑ ꞙ Ḋ ꞙ ᴆ ╬"Ω Ạ ᴘ Ł (ﻯ ᵓ ÿ ῇ ʹH Л ᵓ ꞙ) ḻ Ẕ Ώ̩ ῶ 1 "H ẙ Ῡ Ꝁ ẅ ᶱ ˜ Ạ ꞙ Ꝗ ῇ Langmuir ꞙ ה Π ﻯ ۇ ⇔ Ạ ῇ ⅂ Ꝗ ῇ ḻ˚ 4 0 ꞓ C Є ꞙ (Q_m) Ł 32.9(mg/g) ẅ Ꞔ Langmuir ۇ (K_L) Ł 0.08(L/mg) ḻ

表 1 鐵鋁錳吸附磷酸鹽之等溫吸附數據

溫度	Langmuir			Freundlich		
	Q_m(mg g^{-1})	K_L(L mg^{-1})	R^2	n	K_F	R^2
10℃	25.575	0.05	0.9527	2.9904	4.366	0.9195
25℃	31.546	0.10	0.9691	3.6310	10.099	0.8384
40℃	32.895	0.08	0.9693	2.7137	5.785	0.963

Ṽ ῶ 1 Π Ώ Ῡ ﺭ"H Ḗ ᶱ ⇔ † Π ⫐ Ö ᵋ w ủ ῶ 2 Ῡ Ṽ Jaycok and Parfitt[17] Ạ Ῡ "Ω ꞙ Ạ ¸ G ï Ł0 ʲ -20 kJ/mol Ῡ o ꞙ ⁄ Ł -80 ʲ -400 kJ/ mol Ῡ ⁄ Ꝁ ɔ ꝑ ˚ 10 ÿ 25 ÿ 40 ˘ ⇔ † Ῡ Ꝁ ᶱ ˜ ꞙ Π Ꞔ ˈ "Ω ꞙ ḻ

ᵓ ӥ Van ɵ t Hoff Ƨ Ѡ ה Ꝃ ꝑ ¸ G ï (⫐ Ö ᵋ) Ῡ̩ † ה ȸ

$$\Delta G^o=-RT\cdot\ln(K_L) \qquad (9)$$

表 2 鐵鋁錳吸附磷酸鹽在於 10℃、25℃、40℃所求得之自由能

溫度(T)	自由能(kJ/mol)
10℃	-9.2
25℃	-11.4
40℃	-11.4

4. ꞔ Ƨ ꞙ

ꞔ Ƨ ꞙ Ł˚ Ꝗ ứ ʙ ᴎ ᵑ ꞙ Ạ ⇔ o ⅂ Ῡ' ꟼ \ Ϛ (pseudo-first-order model) Ꞔ \ ϡ (pseudo-second-order model) ꞙ ה Ỵ̄ Ẕ ⅂ ῇ Ῡ Ḗ ᶱ ¸ ᏧᏁ † Π Ꞔ ۇ Ῡ ự Ḗ ᶱ ƅ o ᵋ ḻ

Ö ῶ 3 ᶱ ˜ ủ \ ϡ ﻯ ۇ Ạ ⅂ ῇ Ῡ ự ۇ ꟼ Arrhenius Ѡ ה :*lnk=lnA-Ea/RT* Ῡ Ḗ ᶱ Ꞔ ƅ o ᵋ (E_a) Ł 1.817 kJ/mol ḻ˜ Spark[18] Ạ ḻ E_a Ҍ ủ 42 kJ/mole Ł "Ω ꞙ Ῡ Є ủ 42 kJ/mole ῶ ÿ Ł o ꞙ Ῡ ╝ ꞙ Ł "Ω ꞙ ḻ

表 3 鐵鋁錳對磷酸鹽之動力吸附

Treatments		r^2		Rate Constants	Activation energy
		1^{st} order	2^{nd} order	k_2(g mg^{-1} min^{-1})	E_a(kJ/mole)
Temperature	10℃	0.8523	0.9507	0.0037	1.82
	25℃	0.8706	0.9996	0.0585	
	40℃	0.7415	0.9870	0.0040	

ӯ

ѯ ὐ ▯ o Ὦ ɟ Π ש ὴ Ÿ Ὼ Ꮶ ج. † ȸ

1. ̧ ӯ ӯ ʕ/ ̗ ▯ o Ὦ ɟ ί ꟿ Ÿ Ꮶ ѿ ̊ ̃ ▯ o Ὦ ɟ ̋ ɛ ὐ ʕ Ἡ ▯ o Ὦ ʖ
2. ̊ ̃ ̊ pH = 6.6 ѿ †ı ὦ ՛ ۊ Æ Ÿ џ Ö Ṿ pH ί ̊ ̃ Ÿ ▯ o Ὦ̊ pH = 4ı Ÿ ꟿM Ạ ɟ ̋ ɛ Ṿ Ÿ ƙ ں 92.4% ʖ
3. ɟ Ÿ Ꮶ ѿ ̊ ̃ ɟ Ϙ ἥ Langmuir ɟ ה Π ѯ ۊ ⇔ Ạ ἥ ד Ϙ ἥ ʖ̊ 4 0 ҿ C Є ɟ (Q_m) Ł 32.9(mg/g) ѿ ц Langmuir ۇ (K_L) Ł 0.08(L/mg) Ÿ ᵔ 10 ӯ 25 ӯ 40 ̆ ⇔ † ˈ Ł Ὦ ɟ ʖ
4. ɟ Ạ ч Ÿ Ꮶ й ۱ ঽ ̤ ɛ ה Ғ ѿ Ÿ oy Ꮶ Ế ̊ ч ҕ o ̋ (Ea) Ł 1.82 kJ/mol ὦ ӱ Ł Ὦ ɟ ʖ
5. ▯ o Ὦ ɟ Ạ ạ ʘ̃ Ł Æ ɟ ί Ạ Ὦ ɟ ʖ

ȡ ӯ ݜ ȣ ὴ

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TFT-LCD ꟷ ᅩ㶁 ˛ ɔ Ⅿ э Al-MCM-41 ἧ ˝ П ש ṅ

The environmental humidity control performance of TFT-LCD waste glass and sandblasting waste to synthesis mesoporous Al-MCM-41 by hydrothermal process

ῼ [1*] ῼ [2] ҿ [3] Є Ѽ [4]

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Ă ש ṅ ₩ 㶁 ˛ ɔ Ặ ˛ ɔ Ÿ Ö ᲅ ق῞ῼTFT-LCD ꟷ (Thin Film Transistor-Liquid Crystal Display, TFT-LCD) ᵂ Ł ະ Ḋ Ÿ Ö ᅩ (Sandblasting Waste) ᴩ Ÿ ₩ ⇔ Ł 4 5 0ц ᶔ Ғ Ł 1.5 ㎅ Ẃ Ÿ ậ Ẕ ˜ ˜ ᷡ ה ᵂ Ł ϱ ¡ ᴩ 㶁 Ặ ɔ Ÿ ụ ο Л ́ ¡ Ệ ㎅ Ł (5ÿ10) ц 㶁 ⇔ Ł (9 0ÿ 1 0 5ÿ 1 2 0) Ⅿ э Al-MCM-41 Ḋ Ŋ ʆ ụ ᵓ й XRF ÿ FTIR ÿ SEM ÿ ^{27}Al NMR ц BET Ꞩ ᴩ и ἐ ʆ Ὠ ÿ ȸ Ḋ Ŋ П ◖ ἧ Ҁ ἧ ρ (TCLP) ˈ ˛ Ặ Ÿ ╝ ẕ ο q ᵓ й П Ƨ ʆ ש ṅ Ὠ ÿ ȸ ₩ 㶁 ⇔ Ł 1 2 0 Ạ Al-MCM-41 Ⅿ э Ḋ Ŋ Ÿ ẕ ﯙ П ㎅ ῶ ˧ 1260 m^2/g ц э ̋ и ᵉ Ł 3-4 nm ȷ ᵔ Ö ^{27}Al NMR ÿ ₩ Td-Al ᷡ ה ɲ │˚ ὑ Al-MCM-41 Ⅿ э Ḋ Ŋ ᾰ ▌в Ÿ ụ ₩ ҳ ˧ Ꞷ ה │˚ ȷ ں Al-MCM-41 Ⅿ э Ḋ Ŋ ᵂ Ł Ḋ Ŋ Ÿ ́ ₁ ˛ w Ă Ų Ặ JIS A 1475 ∂ Ḋ Ặ П ӝ ɖ ӝ ʑ 㶁 (dʑ5 kg/m^3) П Ÿ ╝ ᵓ й ᲅ П ق῞ῼẃ ˛ ɔ ậ ˈ ˥ ữ П ⁞ й Al-MCM-41Ÿ… Ł П Ꞷ ה Ÿ Ꞷ Ặ ϛ Ề й ß Ẕ h ₤ Ạ ʑ ˜ П ق῞ῼ ц oy Ҟ Є Й ﯙ Ẕ Ғ ˥ П Ⅿ э Ḋ Ŋ Ÿ ₩ й ὑ ʼ ʆ

: TFT-LCD ꟷ ÿ ᅩ ÿ 㶁 ˛ ɔ Ặ ÿ Al-MCM-41 ÿ Ḋ Ŋ

ӯ › ṕ

ъ Ł ӛ › ʑ ʌ ʒ ʌ Π Ϛ Ÿ ᵔ ^ ʑ ̊ Ẕ ε ╥ ̋ ï ╜ † Ÿ ɔ Ł ה ؠ ӱ ˥ ὰ ϕ ̃ Й ʑ ʌ Π Ϛ [1] ʖ ̊ ד ʒ Ȅ ́ ₁ Ÿ ِ ʒ Ặ ≡ ʌ Ÿ ِ ο ц Ÿ ṿ ₇ ο Ł ο ̃ پ Ế Π ӛ Ÿ ᵔ ۊ ٍ ۊ Ꞷ— Ặ 3C ₇ ̬ ᵔ Ӣ [2] Ÿ ̂ ṿ TFT-LCD ؠ ˥ ὰ ὐ ِ I Ế Є c Ÿ ᵔ ậ ̓ Ặ ʌ (Cathod Ray Tube, CRT) ӱ ʖ ̃ NPT ˥ ὰ ש ṅ 2020 ד ں ̃ Й 514 TFT-LCD ⊦ ⎡ ⁄ ȷ ᵔ ̋ Ĥ ̍ ̃ ы ̿ ậ Π Л й Π Л Ÿ ѹ Щ й ̔ Ÿ ʌ ṣ Ÿ ̓ ̏ Ŏ Ÿ ̂ ṿ ʑ w ơ̄ ⅍ í ӯ ̉ ▯ Ʈ ♂ ӯ Й ̋ Ọ ʖ ̃ ש ṅ ӱ Ÿ2025 ד ы ̿ ъ ̿ ᴟ Ł 800 Mn^2 Ÿ Ẕ M ⊥ Π Й ϕ ̃ ẃ ⊐ ὐ ы ̿ ʙ ϱ ◕ ̃ Ḋ ц ̃ ψ M Ÿ Ö ὐ ὐ ̃ Ĥ M ɔ ᵽ Ϛ ̃ Ÿ Ẕ й M Й Π Є ̃ Ŋ Ÿ Ꝁ ᵓ й ⊥ ˧ ᴩ Ÿ ŵ ю ̃ ˧ Ŋ Π ɛ ц h Ÿ ╝ ̃ Й Є ⊥ Ÿ ѹ ̃ ᴩ ╜ ᴊ̌ ̓ 107 ד л ʑ Ụ ق ̋ Ọ Θ ̋ Ọ . ӱ ⊥ Ł 1,230 e [3] ʖ ӛ › ̊ γ Ö ὐ ⊥ ắ ß ̤ Π Ặ ˥ ạ Ÿ ю Ẕ h ق ̋ Ọ q ᵓ й Ꞷ ה ʖ ̬ ˀ Ÿ ́ ̿ ́ ₁ ʌ ϱ Ẕ ъ ق ̋ Ọ Π q ᵓ й Ꞷ ה Ÿ ѹ ̿ л ο q ᵓ й Ÿ ᵛ Ꝁ Ǝ (Cradle to Cradle) ̓ E Ÿ Ⴎ Π ӛ Ÿ ں Ł Ṿ ƙ ο ʖ

ᵔ Ö ὐ 1992 ד ד ϱ ש ṅ e Ꝏ M41S Ṇ w Ặ M э Ḋ Ŋ Ÿ Б ɟ i ̤ ש ṅ ̃ ̋ Ḥ Ÿ ᵂ Ł ɟ ӯ ο ц Π Ȍ ο Ḋ Ŋ Π Ÿ ̬ Ẕ ẓ ⁄ ӯ Є ʬ ῶ ˥ ц ȡ л Ặ э ̋ ʖ ب MCM-41 ẓ ˀ Ϙ ῄ Ÿ ᵀ ̬ h ῄ ӯ Ѭ ứ ῄ ד ⅄ ц Й ɔ Ă ʪ ۊ Ÿ ̬ ˀ ˥ ạ Ẕ ὐ Ⴎ ϱ Ặ й ʖ ᵔ ̃ ŵ Ȁ й ӱ Ÿ Ϥ MCM-41 Ặ ̋ ▌ Ꝁ ̂ Ӝ ̋ Ϙ ʙ ɲ ɔ Ÿ ṿ Ḋ Ŋ ῶ ̖ Ặ ɟ ̗ ῄ [4] ʖ ˀ ʮ Ÿ γ ὐ Ű ۊ Ϥ ⅄ ₤ δ ˧ Ÿ ד Ÿ ῲ Ặ δ ˧ Ặ Ѭ Ḧ Ÿ ʌ ΰ ɔ Ặ Ӣ Ÿ ̃ w Ă ̃ Ѭ Ϸ ʈ ῶ ӱ Ÿ Щ Ặ ד ⇔ Ł 40-70% Ÿ ́ ̿ ᵓ й ق ̋ Ọ ẓ צ ῄ ̿ Π M э Al-MCM-41 Ÿ ϕ ̃ Ꝁ Ặ ⇔ ụ ˥ ᵅ M ̬ ᴆ ╬ Ÿ Л ̃ ɛ ̿ ̓ H ṿ й Ẕ ̃ Ÿ Ţ ̃ ᵓ й Ѫ Ặ ˧ Ÿ Ḋ Ŋ Ă ṝ ẓ צ Ặ ɟ ̋ Ŏ Ϙ ῄ ᴩ ⅍ ʙ ⇔ Ÿ ß ӧ ạ ⇔ Ặ ӛ Ặ [5] ʖ ŵ Ȁ MCM-41 M э Ḋ Ŋ ϕ ̃ ŵ ̃ ц ̃ ˥ ΰ̃ Ặ ο ᴩ ̗ ɔ Ÿ ṿ ц Й ɔ Ă ۊ Ÿ ╝ Ă ש ṅ ᵓ й TFT-LCD ⊦ ᵂ Ł ̃ ӟ Ȁ Ḋ Ŋ ȷ ⊥ ᵂ Ł Ḋ Ŋ ậ ̃ Ÿ ᵂ Ł ậ ̓ ̗ ɔ₁ ̋ H Π ̃ ц ̃ Ÿ ѹ ́ ₁ ̿ ̗ ɔ M э Al-MCM-41 Ÿ ụ ى Ẕ ῄ ц Ѭ ứ ῄ Ÿ ᵓ й ˀ Ꞷ Ặ ẓ צ Ÿ ᵅ ɔ Ă ц x ̖ Ặ ʖ ѹ ӛ › Ł Ѧ ю ṿ й TFT-LCD ⊦ ц ⊥ ъ ق ̋ Ọ ᵂ Ł ̗ ɔ Al-MCM-41 M э Ḋ Ŋ Ÿ ̬ ᵂ ڠ Ÿ Ƃ ╗ ؠ Ể ʬ ο ц Ѭ ⇔ ὐ ̗ ɔ M э Al-MCM-41 Ặ Ÿ ụ ᵂ Ł ᴷ M э Al-MCM-41 Ẕ ɟ ῄ ̿ ╥ ᵡ ̗ w Ă Ⴎ Ặ JIS A 1470 ∂ Ḋ Ặ Π ᴩ ᴷ ʖ

ӯ Ꞷ Ặ

1. Ḋ Ŋ Ꞷ Ặ

Ă ש ṅ ̋ H ṿ й TFT-LCD ⊦ ậ ⊐ M █ ̔ ǀ Ⴎ ʖ ⊥ ẃ ⊐ M █ ы ̿ ד ʒ e Ꝏ ʖ ˀ ʮ Ÿ Ł ̓ Ă ש ṅ ̋ H ݗ Π TFT-LCD ⊦ ц ⊥ ᵂ ο ẓ ̓ ῶ ῄ Ÿ Ă ש ṅ ݗ ậ Є ݗ (ݗ 100 e ụ ŵ ϱ) Ÿ Ϥ M ש 24 Ӈ₁ ∟ Ÿ ŵ 200 mesh Π Ÿ ˀ ж ȡ ̋ Ÿ ᵂ Ł ̗ ɔ Al-MCM-41 и I Π Ḋ Ŋ ʖ TFT-LCD ⊦ ц ⊥ Ṽ ̋ H e œ Π NIEA R208.03C Ꞷ Ặ ̉ Ḋ Ŋ Π pH ˥ Ÿ ụ ŵ ʬ ̄ Ặ Ḋ Ŋ ὐ ῄ M Π ʬ ̄ ȷ ç ṿ й и έ Ặ и έ Ḋ Ŋ Π ̋ и ᵉ ʖ Ă ש ṅ и ᵑ ṿ й NIEA R355.00C ế NIEA R201.14C П Ѡ Ἅ Ÿ ѿ ꟿ ה ݷ I ɟ | ʊ (FLAA) ứ Ḋ Ŋ П ц TCLP p ⇔ ļ ¸ Ↄ Al-MCM-41 и I П Ḋ Ŋ ǫ ˜ Ł ɤ г ɜ Ϯ ö ɜ o (CTAB) ӯ ه o ӯ ӯ Ꝺ ꟿ ц ƙ I ꟿ ļ

Ă ש ṅ Al-MCM-41 и I П Ѡ Ἅ Ÿ … ѿ TFT-LCD ⊦ ⊥ ᴘ Ÿ ѹ ͻ й ⇔ 450 ˘ ȷ ɞ Ƒ / Ł 1.5 Ÿ ں ậ Ẕ ̃ ļ ụ ɞ Ƒ ю CTAB ᵂ Ł ꜜ ݷ ҍ ή ế 30 mL ƙ I ꟿ ц Ꝺ ꟿ Ў ¸ ˜H ˚ П ᵼ ļ ụ ѿ ᵼ Ḝ ꟿ Ł (5 ӯ 10 ӯ 20) ˝H ˚ П ̃ ᵼ Ƒ Ч ∃ CTAB ꟿ ᵼ M ᴘ ˜H Ÿ ṿ й 1M Ẕ pH ٦ Ÿ Ў ¸ ᵼ ˜H ∟ Ч ủ ؤ ؤ ݣ M Ÿ ụ ѿ ꟿ ⇔ (90 ˘ ӯ 105 ˘ ӯ 120 ˘) ᴘ ꟿ ч 48 Њ ļ ∟ Ÿ ˝H ˚ Ê̦ ˝Ọ ƙ I ꟿ ݭ ụ ∟ Ÿ ủ 105 ˘ Ꜷ M ὂ ļ 550 ˘ ∟ ѿ ں ƙ ꜜ ݷ ҍ ή П ά ļ ụ̃ ᴡ Ă Ụ JIS A 1470 П ⇔ Ἅ Ạ Ȅ Ÿ M э Al-MCM-41 ˚ ℸ ⇔ 53-75% Ạ ɟ ˝O ⇔ ȷ ں M э Al-MCM-41 ˝O Ч ℸ ⇔ 53% Ạ ß ế Ÿ q Ч ℸ ⇔ Ł 75% † Ÿ ӧ 24 Њ Ÿ ∟ Ч ℸ ⇔ Ł 53% † Ÿ ᴘ 24 Њ ӧ Ÿ ∟ Ế ˚ ᴃ ݷ ủ Л ´ ₁ † M э Al-MCM-41 Ạ ɟ ╥ ᵡ ¸ ᴡ Ă Ụ Ἅ JIS A 1470 ∂ Ḋ Ἅ П ɟ (ǳ29 g/m^2) П ļ

2. ῶ ݷ Ҁ ή

Al-MCM-41 и I П M э Ö X-ray ꞩ Ä ꟿ и έ (D8AXRD) Ŋ ц ц П JCPDS Ŋ Ÿ ѿ ͻ Ḋ Ŋ П ℸ ˝Ọ ₤ ứ Ÿ ꟿ Ṕ ⇔ ủ 2 ȼ 1-8 ٢ ᴘ ɟ ц ȷ Ӵ ꞃ ʈ ц ʊ ɟ ˝Ạ ᴃ ѿ ˝H ¸ Ↄ Al-MCM-41 и I ʙ П Ÿ Ẕ ˝Ạ Ł 400-4000 cm^{-1} ȷ ụ ѿ XRF ʊ и έ (RIX 2000) ứ ݷ Ḋ Ŋ П o a ى Ↄ ȷ ᶦ ʈ Ÿ Ö ꟿ ϯ ה I Ɏ FE-TEM ɏ Ÿ ǫ ˜ ˝H ¸ Ↄ П Al-MCM-41 П ᶮ ˝Ọ ӯ Є Њ ц э ♂ ȷ ụ ؿ ¸ δ ɟ M э Al-MCM-41 П Ÿ ᴘ M э Ҁ ή П ש ṅ Ÿ ѹ Ö BET Ἅ ứ ꟿ ῶ ݷ Ÿ ´ ₁ BJH Ἅ Ẕ э ̃ и ᵉ ļ

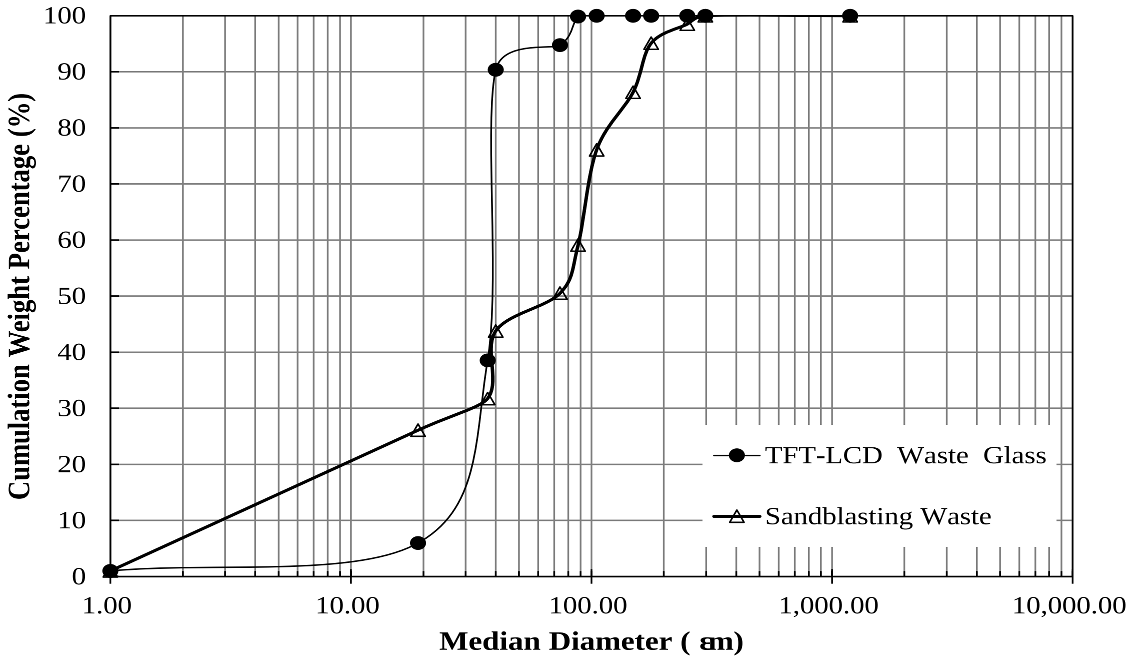
ӯ Ὼ ִ

1. ɜ Ă Ḋ Ŋ Ҁ ή

ῶ 1 Ł ˛ Ḋ Ŋ П ɜ Ă ˝Ọ ή ļ Ö ῶ 1 ˚ ˜ Ÿ TFT-LCD ⊦ ц ⊥ П pH ٦ Ł 9.09 ц 10.10 ļ ᶦ Ÿ Ꝁ ˚ ˜ TFT-LCD ⊦ ц ⊥ ˡ Ł ʮ ή Ạ Ḋ Ŋ ȷ ç ʈ Ÿ TFT-LCD ⊦ ц ⊥ П ꟿ ̃ и ᵑ Ł 2.85 ц 2.89 ļ 1 Ł ˛ Ḋ Ŋ П и έ Ὼ ļ Ὼ ÿ TFT-LCD ⊦ П ˝ ǫ ˜ и ᵉ ủ 19-105 ε m Ÿ פ Ł 99.8% ȷ ⊥ П ˝ ǫ ˜ и Ӝ ủ 19-177 ε m Ÿ פ Ł 95.09% ļ

ῶ 1 TFT-LCD ⊦ ⊥ П ɜ Ă Ҁ ή

Sample	pH (1ȸ10)	Specific Gravity	Density (g/cm^3)	Moisture (%)	Fineness (m^2/kg)
TFT-LCD Waste Glass	9.09	2.85	2.17	0.01	253
Sandblasting Waste	10.10	2.89	2.79	0.01	177



1 TFT-LCD ⊦ ц ┴ П ̃ и Ӂ и ἐ

ῶ 2 Ł˯ ḊŊ П о ɔ и ἐ ˌ TFT-LCD ⊦ ɸ˜ ɔ и Ł SiO_2 ÿ Al_2O_3 ц CaO Ÿ и ŋ ᴾ 69.70% ÿ 15.30% ẘ ц 8.45% ȷ ᵔ ┴ ɸ˜ ɔ и ẘ SiO_2 ц Al_2O_3 Ł ɸ Ÿ и ŋ Ł 70.10% ц 13.90% ˌ Ẕ M TFT-LCD ⊦ ɸ˜ ẃ ⫗ ⊦ ҙ ὰ П й Ŋ Ÿ ᵔ SiO_2 ц Al_2O_3 Ł Q΄ ɔ ⊦ Ạ ɸ Ÿ ╝ Ă ש ṅ Ö TFT-LCD ⊦ ц ┴ ᴘ Ÿ ṿ Ẕ ẓ Ṝ ٽ П ̃ ц Ÿ ẘ ˛ ɔ Al-MCM-41 и Ι Ÿ ṳ΄ ˦ ˧ ẓ ᵅ ɔ Ă ц q ᵓ й П í ˭ ˌ

ῶ 2 ḊŊ П о ɔ

Composition (%)	TFT-LCD Waste Glass	Sandblasting Waste
SiO_2	69.70	70.10
Al_2O_3	15.30	13.90
Fe_2O_3	0.18	7.72
CaO	8.45	1.31
MgO	0.77	-
TiO_2	0.22	5.82

2. ̿ ᵽ ⇔

ῶ 3 Ł˯ ḊŊ П̿ ц ᵽ ⇔ ˌ̿ и ἐ Ὼ ÿ Ÿ TFT-LCD ⊦ П̿ ẘ Zn Ł ɸ Ÿ Ẕ ƶ Ł 160 mg/kg Ÿ Ẕ ẃ ɸ˜ Ł ˥ ὰ ẘ M П ˌ ┴ M̿ ẘ Cr Ł ɸ Ÿ …˯ ы ˭ ὰ ᶔ П Ÿ ┴ ̋H ̂ Ÿ Ẕ ƶ Ł 90 mg/kg Ÿ Ẕ ıı Ł Zn ц Cu ƶ Ÿ и ŋ Ł 65 mg/kg ц 25 mg/kg ˌ Ă ש ṅ ç ẘ NIEA R201.14C П ◖ ἥ Ҁ ἥ ᵽ ˑ (TCLP) Ȁ̃Ÿب˯ ḊŊ ᴘ̿ ᵽ ṳ ẘ FLAA ứ˯ ḊŊ П ̿ ᵽ ⇔ Ÿ Ẕ Ὼ˛ ῶ 3 ̋H ÿ ˌ TCLP̿ ᵽ Ὼ ÿ Ÿ TFT-LCD ⊦ ц ┴ П Zn ᵽ и ŋ Ł 0.1 mg/L ц 0.8 mg/L П̿ ᵽ ˌ TCLP ᵽ Ὼ ÿ Ÿ

˯ Ḋ Ŋ Π ̃ ᶈ ˈ ˏ Ặ̃ Ÿ ╝ TFT-LCD ⊦ ц ⊥ ˈ ẓ ο Π Ƨ ʻ̡

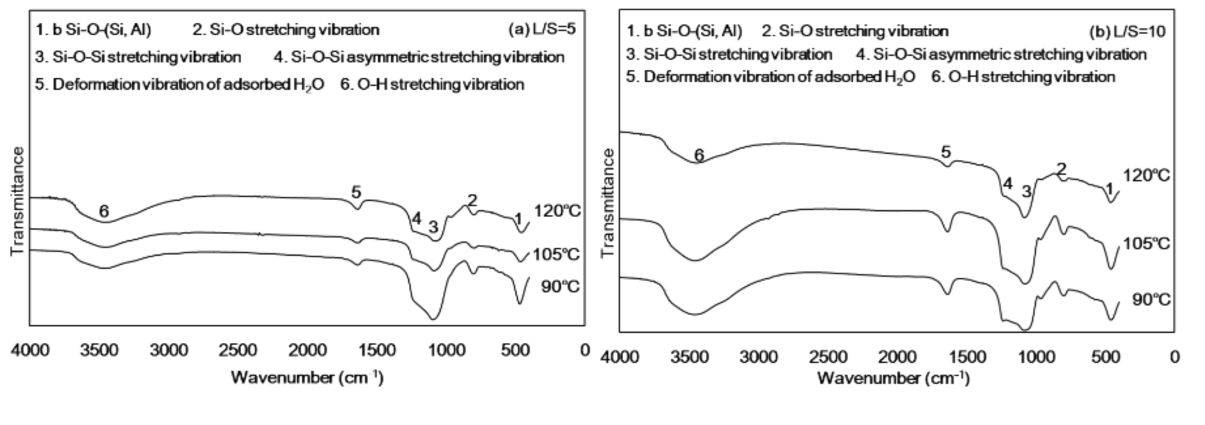
ῶ 3 TFT-LCD ⊦ ⊥ Π ̃ ц TCLP ᶈ ⇔

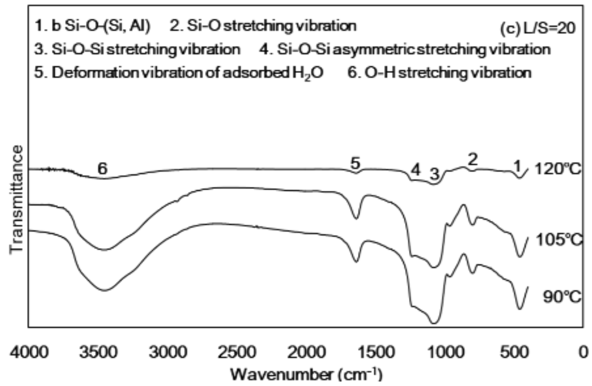
Total Metal (mg/kg)	Pb	Cr	Cu	Zn	Cd	Ni
TFT-LCD Waste Glass	N.D.	N.D.	N.D.	160	N.D.	N.D.
Sandblasting Waste	N.D.	90	25	65	N.D.	10
TCLP (mg/L)	Pb	Cr	Cu	Zn	Cd	Ni
TFT-LCD Waste Glass	N.D.	N.D.	N.D.	0.1	N.D.	N.D.
Sandblasting Waste	N.D.	N.D.	N.D.	0.8	N.D.	N.D.
Regulatory Limits	5.00	5.00	15.00	ʟ	1.00	ʟ

N.D.:Pbʤ0.015 mg/L ȷ ȷ Cdʤ0.021 mg/L ȷ Niʤ0.112 mg/L

3. Al-MCM-41 М э и Ι Π FTIR и έ

˜ Guangjian Щ ש ṅ ╓ ᶈ Ÿ FTIR Ҡ ӣ ẃ ̋Ḥ ͻ Π Al-MCM-41 Ạ ο Ỉ ʃ ц צ Ừ ̄ ̈ʒ ứ [6] ʻ̡ ╝ Ă ש ṅ Ö ͻ ɱ ц ʊ (FTIR) ̋Ḥ ͻ Π Al-MCM-41 и Ι Ẕ Ϙ ứ ο Ü ̤ ο Ỉ ʃ ʻ̡ 4 Ł SGA ͻ Al-MCM-41 Ẕ FTIR Ỉ ʃ ʻ̡ Ö М ̊ ˜ Ÿ ̇ɩ Ḛ ʍ Ł 5 ₁ Ÿ SGA a_1 ÿ SGA a_2 ц SGA a_3 ̋Ḥ ͻ Π Al-MCM-41 Ÿ ˚ Ặ̃ ὐ 3441 cm^{-1} ц 1634 cm^{-1} ᴮ ȹ ˜ Ł ῶ Ꞁ ̃ ʒ ц ɟ Ѭ ή и Ι ÿ Si-OH ʎ │ ˚ ɟ Ѭ и Ι ̋Η ˆ ȷ ᴖ Ö М ̊ ˜ Ÿ ̇ɩ Ḛ ʍ ϲ Ł 10 ц 20 ₁ Ÿ SGA b_3 ц SGA c_3 ̋Ḥ ͻ Π Al-MCM-41 Ẕ ى ⇔ צ † Ꞁ Π Ÿ … Si-OH ɟ ׀ ʎ Ạ ى ⇔ Ꞁ ᵅ Ÿ ˊ ₁ ˆ Si-O-Si ʒ Ạ† ᴼ ̤ ى ⇔ ى Ÿ ╝ Si-OH ʒ ˏ Ч ˥ , ṿ Si-OH ʒ ƶ Ꞁ ᵅ Ÿ ᴖ Si-O-Si ƶ צ ̋Η Ғ ȷ ᴖ Ѭ ⇔ Ł 90 ˘ ₁ Ÿ SGA a_1 ÿ SGA b_1 ц SGA c_1 ̋Ḥ ͻ Π Al-MCM-41 Ÿ ˚ Ặ̃ ὐ 459 cm^{-1} ᴐ Ü ̤ ц ὐ 796 cm^{-1} ᴼ Ÿ ȹ ˜ … Si-O-Si ̃ ▌Ü ̤ ̋Η ˆ Ÿ ᴖ Ѭ ⇔ ϱ ϲ ∃ 105 ˘ ц 120 ˘ ₁ Ÿ ᴮ ὐ Ẕ ̃ Ặ̃ ᴮ צ ʹΥ ى ⇔ † Ꞁ Π Ÿ ᴖ М ̊ ˜ Ÿ ̇ Ꞁ ƅ ή ˥ ɟ ׀ ؤ ᴮ ὐ 2921 ÿ 2851 ц 1485 cm^{-1} Ѽ ο Ч Ÿ ῶ ÿ ̇ Ꞁ ƅ ή ∟ Б │ ˚ ὐ ˏ ͻ Al-MCM-41 ₇ М Ÿ צ Ὼ̃ Б ƙ ں ȷ Ẕ М ̊ 1082 cm^{-1} † ᴼ ÿ 799 cm^{-1} ᴼ ц 459 cm^{-1} ᴐ ̤ Ł Si-O-Si ̃ ▌ ̤ ̋Η ˆ Ÿ │ ˚ Al-MCM-41 Ϙ ɟ ׀ ʎ ῶ ÿ Ḋ Ŋ ṳ ˯ ∟ [7] ʻ̡

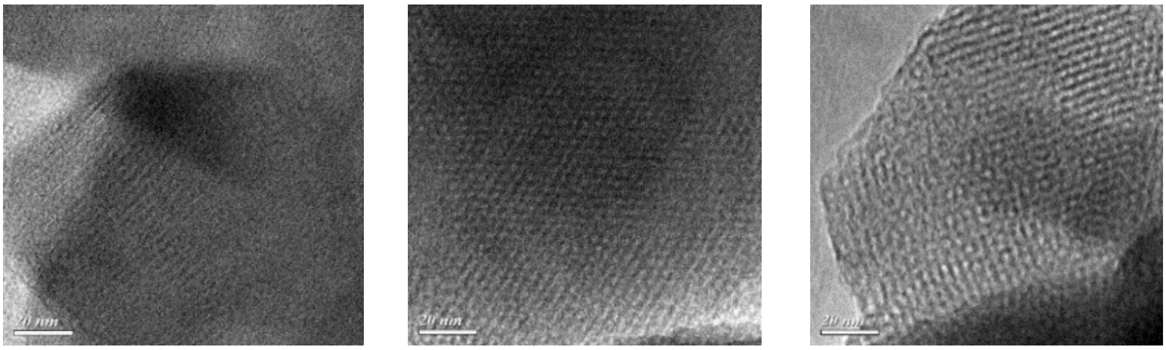




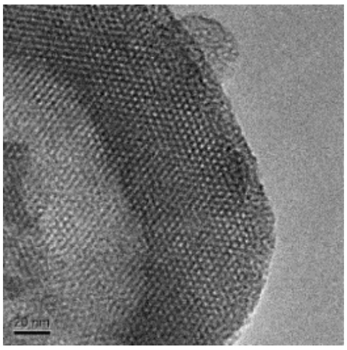
4 ʺḨ ͻ Al-MCM-41 Мэи l Ẕ FTIR ǐ ᔑ (a) L/S= 5 ȷ (b) L/S= 10 ȷ (c) L/S= 20

4. Al-MCM-41 ₤ o Π ϘῄῄῄἫ

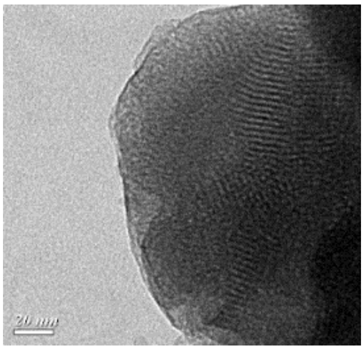
Ă שׁ ṅ ʺḨ ͻ Π Al-MCM-41 Мэи l Ÿ … ᵓ й ﾑ ⫯ ה l (FEI-TEM) Ÿ ὐ э ♂ o ᴩ ێب Ÿ ṳ ₩ TEM Ϛ Ề Ẕ э ᔑ ה и ᵉ ǐ ᔑ ȴ 5 Ł SGAʺḨ ͻ Мэи l Π TEM ȴ Ö 5 (c) Ł ʁ ⇔ Ł 120 ˘ı Ÿ ᵢ Ệ ꞩ и ᵑ Ł 5ı Ÿ SGAa₃ ÿ ᶈ Ö ὐ Al ƶ ؤ Ÿ ╝ ˆ Ẕ ˈ ῄ צ ᶈ ♂ М э Ḋ Ŋ Ÿ э ♂ צ ˀ ῄ ⅃ ȷ ᵔ 5 (f) ȳ (i) Ł ᵢ Ệ ꞩ Ł 10 ц 20ı Ÿ SGAb₃ ц SGAc₃ ᵢ Ệ ꞩ Ғı Ÿ ÿ ᶈ צ ˀ ῄ ؤ Π г ᔑ М э Ạ ᔑ ͻ ȷ ᵔ Ö 5 (a) М ᵒ ˜ Ÿ ᵢ Ệ ꞩ Ł 5 ȳ ʁ ⇔ Ł 90 ˘ı Ÿ SGAa₁ ʺḨ ͻ Π Al-MCM-41 Мэи l Ÿ … ˬ Ö ὐ ʁ ⇔ ᵅ Ÿ ╝ ͻ ʻ Л ű ᔑ ͻ Ÿ э ♂ Л ʹY Ẕ э ˝ ЄЊ Ł 3.92 nm ȷ ᵔ ʁ ⇔ c ∃ 120 ˘ Ÿ SGAa₃ ʺḨ ͻ Π Al-MCM-41 Мэи l Ÿ Ẕ ῄ Ṿ Ÿ ╝ ʁ ⇔ Ғ / ˭ , Ṿ э ♂ Ł ʹY Ẕ э ˝ ЄЊ Ł 3.41 nm ȷ ᑊ ʯ Ÿ ᵢ Ệ ꞩ Ł 10 ȳ ʁ ⇔ Ł 90 ˘ı Ÿ SGAb₁ ʺḨ ͻ Π Al-MCM-41 Мэи l Ÿ Ẕ э ♂ э ˝ ᕭ Ł 3.67 nm Ÿ … Ö ὐ ؏ o ˜ ˛ ế ᔑ ͻ Π ∃ ж Ÿ ╝ ὐ ˛ ؤ Ÿ ᵔ ᶈ ȡ л э ц ؤ ʺΏ г Ṕ ᔑ Ÿ ᑊ Ώ XRD Ώ Ϛ ˆ ȷ 5 (g)-(i) Ł ᵢ Ệ ꞩ Ł 20 ȳ ʁ ⇔ Ł 120 ˘ı Ÿ SGAc₃ ʺḨ ͻ Π Al-MCM-41 Мэи l Ÿ Ẕ э ℸ Π Ạ Ł 3.13 nm ȷ ˛ ϱ ᵒ ˜ Ÿ Ғ ᵢ Ệ ꞩ Ł 20ı ȳ ʁ ⇔ c ∃ 120 ˘ı Ÿ Ẕ г Ṕ Ł ʹY ڿ w צ ˀ Ÿ 0y Al ƶ Al-MCM-41 М э צ ˀ г Ṕ J̇ w ᔑ ͻ ṳ ḥ צ Л ȍ Ÿ ṳ Yang ⱎ שׁ ṅ ᵓ й Ë˛ ͻ צ ˀ М э Ḋ Ŋ Al-MCM-41 Ώ Ϛ ˆ Ÿ Al-MCM-41 ˈ צ ˀ М э ế ؤ Ạ ؏ г ᔑ э [6] ȴ



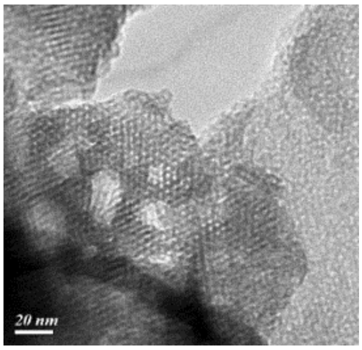
(a) 90 ˘ -L/S=5 (b) 105 ˘ -L/S=5 (c) 120 ˘ -L/S=5



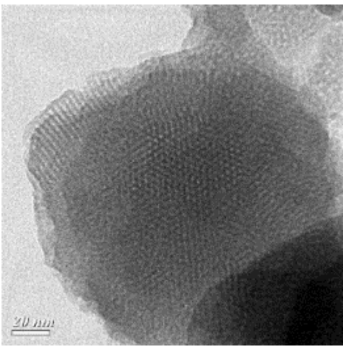
(d) 90 ˘ -L/S=10



(e) 105 ˘ -L/S=10



(f) 120 ˘ -L/S=10



(g) 90 ˘ -L/S=20

(h) 105 ˘ -L/S=20

(i) 120 ˘ -L/S=20

5 ˝Ң ͻ Al-MCM-41 М э и І П TEM

5. Al-MCM-41 П δ ɟ ᵽ

6 Ł SGA П δ ɟ ᵽ ɭ 6 М ÿ Ȳ ¡ Ȇ ꙗ Ł 5 ı ȳ Ѭ ⇔ Ł 120 ˘ ı Ȳ $SGAa_3$ П М э Al-MCM-41 ˥ ὐ ¡ Ȇ ꙗ Ł 10 ц 20 ı Ȳ $SGAb_3$ ц $SGAc_3$ П М э Al-MCM-41 ὐ ᵅ ˥ Ƨ Ł 0.2-0.3 ı Ȳ ˡ ß э ϼ Ạ ц̤ ɟ ˝Н і ڗ ȷ ᵔ ˥ Ƨ ὐ 0.3-0.4 ı Ȳ Ѭ ⇔ Ö 90 ˘ с ᗱ 120 ˘ ı Ȳ Л ́ ¡ Ȇ ꙗ ı ⵣ ≡ ϼ с П Ȳ Ł Ѫ ˝Н ̂ ȷ ѹ ὐ ؤ ˥ Ƨ Ł 0.5-0.9 ı Ȳ ˝Ң ͻ П Al-MCM-41 ˡ ẓ Ӂ ὰ ῼ ̏ ﭗ ص Ȳ … ц ῶ Ⅎ Ạ̤ ɟ ˥ ɭ ᵔ ὐ ῶ 4 Ł SGA ͻ Al-MCM-41 П Ϙ ἥ и ἐ Ȳ ÿ ¡ Ȇ ꙗ Ł 5 ᗱ 20 ı Ȳ SGAa ȳ SGAb ц SGAc П Al-MCM-41 П δ ɟ Ȳ Ẕ ꙗ ῶ Ⅎ и ᵑ Ю ὐ 506-587 m^2/g ȳ 733-795 m^2/g ц 781-1013 m^2/g ˡ IV ₤ Ł ẕ ₤ М э Ḋ Ŋ П Ϙ Ȳ ́ ı ẓ ⵣ Ṿ П ɟ ἥ ⁼ [8] ɭ