

AOPP-g-AN

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A Study of Adsorption Characteristics of Uranium Ion Using Amidoximated PP-g-AN Fibrous Ion-exchanger in Brine Water

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: Acrylonitrile polypropylene (AOPP-g-AN) bed 100%, 8.54, 8.87 g/g 가 가, 100% 3.99 meq/g 10, 9.50 mg/min 3.95 meq/g, pH L/D=1 3.92 meq/g, L/D<2 2 가, 3.63 meq/g, 26 min

ABSTRACT : We investigated uranium adsorption and adsorption process characteristics in brine water, changing column bed height packed with amidoximated polypropylene-g-acrylonitrile(AOPP-g-AN) fibrous ion-exchanger. Swelling ratios of AOPP-g-AN in fibrous ion-exchanger were 8.54 g/g H₂O and 8.87 g/g for H₂O₂ solvent respectively. Ion exchange capacity increased with degree of graft and showed the maximum, 3.99 meq/g at 100% degree of graft. In batch process, uranium adsorption had reached an initial equilibrium in 10 min with the adsorption rate of 9.5 mg/min. Final adsorption capacity was 3.95 meq/g, and pH effect could not be observed. In continuous process, adsorption capacity depended on various packing ratios and showed the maximum, 3.92 meq/g at L/D=1. In L/D<2, breakthrough curve was shown two step by channeling flow and ununiform adsorption. Breakthrough time and adsorption capacity were 26 min and 3.63 meq/g, respectively, in brine water adsorption. When compared with actual brine water and model solution, there was no significant difference of adsorption characteristics.

Keywords : uranium adsorption, fibrous ion exchanger, L/D, brine water.

가 가

가 가 가

가

가

가
가
가

(L/D)

, ICP

가

1-4

3 ppb

46

PP - g - AN(AOPP - g - AN)

¹⁶ Uranyl nitrate - 6 - hydrate (UO₂(NO₃)₂ · 6H₂O) Merck Chemical

, pH

Junsei Chemical

HCl, NaOH, H₂SO₄

Wako Pure Chemical

가

5-7

8

가

AOPP - g - AN

9

가

24 가

(1)

¹⁷

Egawa ¹⁰⁻¹²

acrylonitrile - divinylbenzene(AN - DVB)

$$\text{Swelling Ratio(\%)} = \frac{\text{swelling volume of copolymer}}{\text{apparent volume of dry copolymer}} \quad (1)$$

, Sugasaka ¹³

PVC

. AOPP - g - AN

Soldatov ^{14,15} PP - g - AN

0.1 g 250 mL

0.1 N HCl 가 100

mL

24

AOPP - g - AN

(2) 10 mL
0.1 N NaOH 18

$$\text{Capacity (meq/g)} = \frac{(V_{\text{NaOH}} \times N_{\text{NaOH}}) - 5 \times (V_{\text{HCl}} \times N_{\text{HCl}})}{\text{weight of fibrous ion-exchanger}} \quad (2)$$

N_{HCl} , N_{NaOH}
 V_{NaOH} mL
AOPP - g - AN

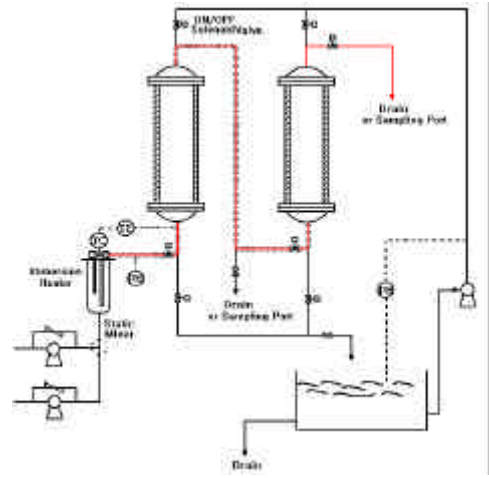


Figure 1. Scheme of continuous adsorption apparatus.

500 ppm 500 mL 1 L
AOPP - g - AN 1
0.1 N HCl 0.1 N NaOH
pH=2 10

10 mL
Arsenazo() 19

1 N H₂SO₄
AOPP - g - AN
(L/D) AOPP -
g - AN

Figure 1

100%
L/D 0.5, 1, 2, 3
1000 ppm
200 ppm
1 mL/sec
UV - Visible
1 N H₂SO₄

$$\text{Ion Exchange Capacity (meq/g)} = \frac{T \times V \times C_0}{W \times W_u} \times 2 \quad (3)$$

where, T = break - through time,
V = inlet flow velocity,
C₀ = concentration of modeling solution,
W = weight of packed ion exchanger,
W_u = weight of uranyl ion

AOPP - g - AN

ICP - AES
Perkin Elmer
1 mL 0.05%
Arsenazo() 1 mL 가 , KCl 25 mL 0.2
M HCl 25 mL,
8 mL 가 가 10 mL가 1

AOPP - g - AN

CE

Instrument (model : EA 1110)

180 mL/min

15 mL/min

가

ICP-AES . AOPP - g - AN

(Φ 1 cm × 10 cm) 1 g

200 ppm

ICP - AES

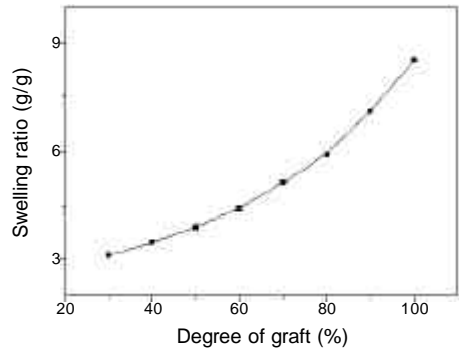


Figure 2. Plot of swelling ratio of amidoximated fibrous ion-exchanger(AOPP-g-AN) vs degree of graft.

Table 1. Measured Swelling Ratio of AOPP-g-AN Fibrous Ion-exchanger in Various of Solvents

solvent	CH ₃ OH	C ₂ H ₅ OH	C ₃ H ₇ OH	C ₄ H ₁₁ OH	H ₂ O	H ₂ O ₂
swelling ratio (g/g)	7.12	7.28	7.52	7.88	8.54	8.87

AOPP - g - AN

가 Figure

2 Table 1 . Figure 2 AOPP - g - AN

Figure 2

가

가

가 , 가

AN 가

가

Table 1 100%

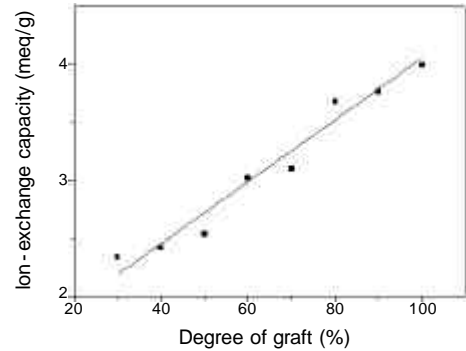


Figure 3. Relationship between ion-exchange capacity and degree of graft of AOPP-g-AN ion-exchanger.

Table 1 AOPP -

g - AN H₂O H₂O₂ 8.54, 8.87

g/g 가 H₂O가

AOPP - g - AN

가

AOPP - g - AN

가

100% 3.99 meq/g

가

가

AOPP-g-AN . AOPP - g - AN

가 Figure 3 . Figure 3

AOPP - g - AN

가

100% 3.99 meq/g

가

가

AOPP - g - AN

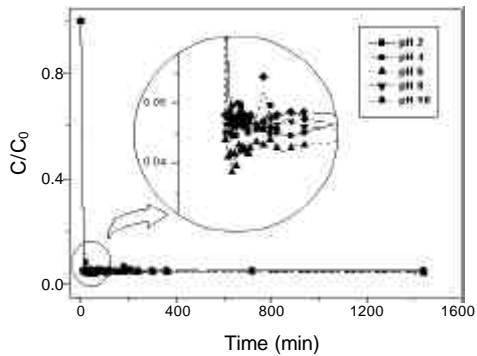


Figure 4. Adsorption capacity of AOPP - g - AN fibrous ion - exchanger for uranium ion as function of time for several different pH (C_0 ; inlet concentration, C ; outlet concentration).

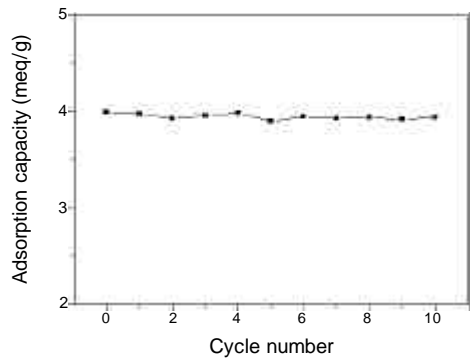


Figure 5. Plot of adsorption capacity of AOPP - g - AN fibrous ion - exchanger vs. regeneration frequency for uranium ion.

가 ,
 . AOPP - g - AN
 bed
 가 Figure 4, 5
 Figure 4 pH AOPP - g - AN
 . Figure
 4 AOPP - g - AN
 pH
 pH

가
 10
 90%
 가
 가
 가
 pH 8 9.50 mL/min
 3.95 meq/g

pH가 7.8 8.2

Figure 5

5
 10
 가
 bed
 bed
 (L/D)
 가 Figure 6, 7
 Figure 6
 L/D=0.5 3

. Figure 6
 0.5, 1, 2, 3
 9, 30, 65, 98
 3.81, 3.92, 3.64, 3.00 meq/g

가 가 가
 L/D=1 3.92 meq/g
 L/D=1
 , L/D가 가
 가
 L/D가 0.5

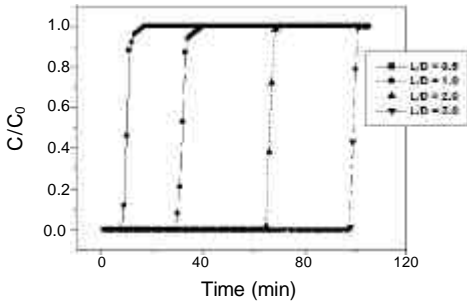


Figure 6. Plot of adsorption ratio(C/C_0) uranium ion vs. time in various column bed ratios(L/D), packed with AOPP - g - AN fibrous ion - exchanger.

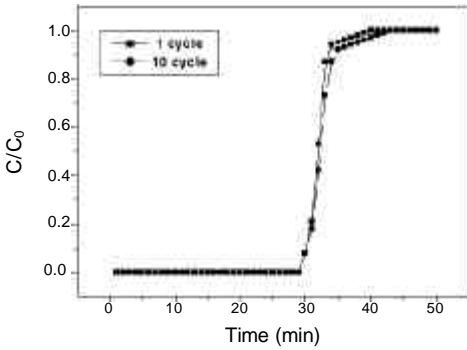


Figure 7. Plot of adsorption ratio(C/C_0) for uranium ion vs. time for two regeneration frequencies.

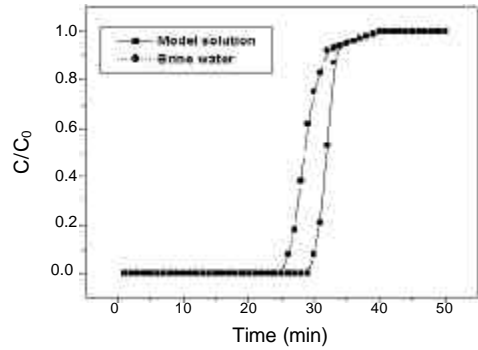


Figure 8. Plot of adsorption ratios(C/C_0) for uranium ion vs. time in brine water and model solution with column (L/D=1) packed with AOPP - g - AN fibrous ion - exchanger.

가 3.81 meq/g
AOPP - g - AN
90%
가
Figure 6 L/D<2

2
L/D<2
, L/D >2
bed
1
Figure 7 Figure 6
L/D

가 L/D=1 bed

Figure 7

10

(L/D=1) Figure 6

가

Figure 8

Figure 8

L/D=1

30

가 180 ppm
3.63 meq/g
AOPP - g - AN
가
Na⁺, Li⁺

가
AOPP - g - AN bed

AOPP - g - AN

1. AOPP - g - AN
가 가 ,
가 가 , 100%

8.54, 8.87 g/g
2. pH
10 ,
9.50 mg/min
3.95 meq/g

3. L/D=1
3.92 meq/g L/D가 가
bed
L/D < 2 가
4.
L/D=1 3.62 meq/g
,
bed L/D=1
:
,

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