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Abatement of Heavy Metals and Softening of Hard Water by the CoAlPO₄-5 Membrane

CJ v ØNSC 88-2214-E-041-005

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Abstract (Keywords): Improved membrane, Removal rate, Hydrated radius, Optimum amount of addition)

For improved membrane, if CoAlPO₄-5 was appropriately added, could increase rate of metal removed as compared with the PC membrane. Besides, penetration rate would increase and the pressure applied could be lowered largely. The optimum amount of CoAlPO₄-5 added for Co:Al:P = 0.1:0.92:1.0 is about 5 wt.% while that for Co:Al:P = 0.08:0.93:1.0 may shift toward higher content since it has less active sites per unit weight.

Hydrated radius of metal ion had great influence on the removal rate. The larger the radius, the higher the removal rate would exhibit.

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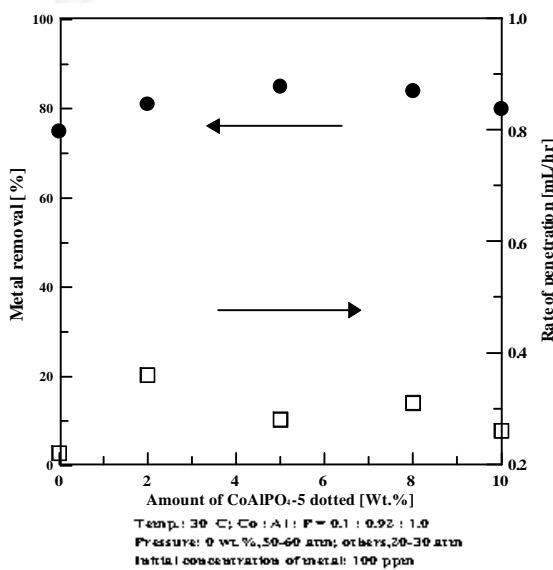
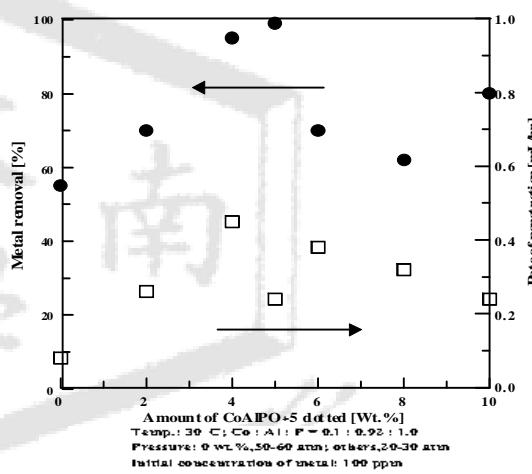
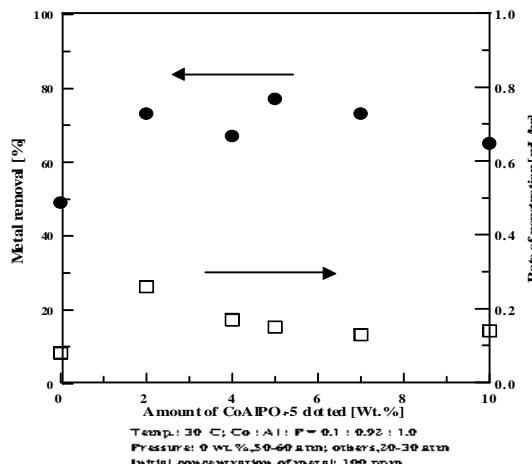
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- Fig.1 Effect of CoAlPO₅ content on Mg²⁺ removal and on rate of penetration**
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- | Amount of CoAlPO ₅ doted [wt. %] | Metal removal [%] | Rate of penetration [ml/hr] |
|---|-------------------|-----------------------------|
| 0.0 | ~55 | ~0.45 |
| 2.0 | ~50 | ~0.35 |
| 4.0 | ~55 | ~0.35 |
| 5.0 | ~85 | ~0.75 |
| 6.0 | ~90 | ~0.75 |
| 8.0 | ~82 | ~0.25 |
| 10.0 | ~35 | ~0.15 |
- Temp.: 30 °C; Co : Al : P = 0.1 : 0.92 : 1.0
Pressure: 0 wt.%, 50-60 atm; others, 20-30 atm
Initial concentration of metal: 100 ppm
- Fig.2 Effect of CoAlPO₅ content on Ca²⁺ removal and on rate of penetration**
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- | Amount of CoAlPO ₅ doted [wt. %] | Metal removal [%] | Rate of penetration [ml/hr] |
|---|-------------------|-----------------------------|
| 0.0 | ~45 | ~0.45 |
| 2.0 | ~50 | ~0.25 |
| 4.0 | ~50 | ~0.15 |
| 5.0 | ~85 | ~0.25 |
| 6.0 | ~90 | ~0.25 |
| 8.0 | ~82 | ~0.15 |
| 10.0 | ~35 | ~0.15 |
- Temp.: 30 °C; Co : Al : P = 0.1 : 0.92 : 1.0
Pressure: 0 wt.%, 50-60 atm; others, 20-30 atm
Initial concentration of metal: 100 ppm



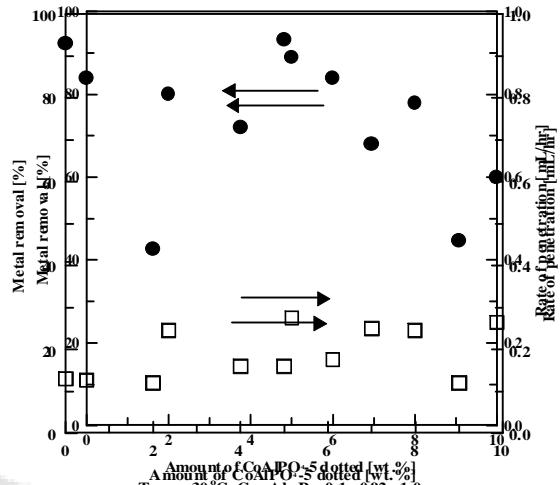


Fig. 7 Effect of CoAlPO₄-5 content on Fe³⁺ removal and on rate of penetration

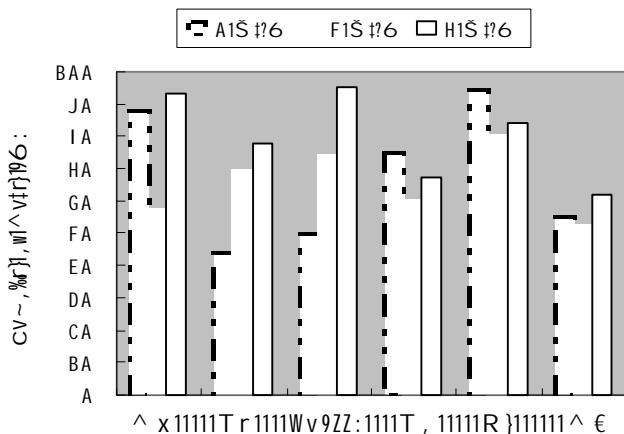


Fig. 8 Removal of metal by the CoAlPO₄-5 dotted membrane with the Co:Al:P = 0.08:0.93:1.00

Table 1 Relationship between removal rate and hydrated radius of metal ions

Metallic ion	Mg(II)	Ca(II)	Fe(II)	Fe(III)	Cd(II)	Mn(II)	Co(II)	Al(III)
Removal rate [%]*	JH	IJ	HH	JB	GJ	JI	IF	JE
Hydrated radius [nm]**	A?I	A?G	A?G	A?J	A?F	A?G	A?G	A?J

* : Data of 5 wt.% CoAlPO₄-5 added

** : Data from reference 5.

