S2-09

鉄系粉体と無機系補助材を組み合わせた土壌浄化材料の特性について

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Some properties of soil clean-up with Fe atomized and inorganics as assisting materials system.

Abstract

土壌の吸着浄化工法において、土壌由来アニオン類は、例えば重金属類の浄化性に悪影響を及ぼすことが観察されている。本研究では土壌溶出成分としてケイ酸に着目し、それらを選択的に吸着低濃度化する無機材デバイスを開発し、実験的に鉄粉体を吸着材とする工法への適応性を検討し、鉄粉補助材としての有効性を確認した。

It has been observed that some anions , i.e. Silicate anion, disturbed to adsorb property of the fundamentals on heavy metals removing. We have tried to develop the selective anion catcher by the inorganics compositing and recognized it possibilities experimentally on the Fe atomized adsorbing systems which targets to heavy metals remove.

研究内容/R&D outline

1.補助材の調整/Device preparation

補助材は層状複水酸化物(LDH)*を含む数種の無機材料をスプレードライ法により造粒し、550℃にて熱処理することで調整した。*:Layered Double Hydroxides

Device prepares with some inorganics compounds which includes LDH and has been granulated its by Spray-drying and composited in Furness heating up to 550deg.

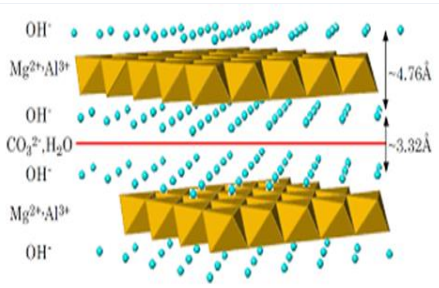


Fig.1 LDH structural model

2.補助材の特性/Device properties

- 補助材の粉体物性として平均粒子径200μm、嵩密度0.5g/cc、BET比表面積21m²/gであった。
  Device has mean particle size 200μm, bulk density 0.5 g/cc and BET specific surface area 21m²/g as powder properties.
- 補助材の材料科学物性/Material properties
  結晶質を有する球形粒子状多孔質粉体で空隙率は約70%と観測される。
  It has been observed that device has some crystalline and round shape , appox.70% porosity

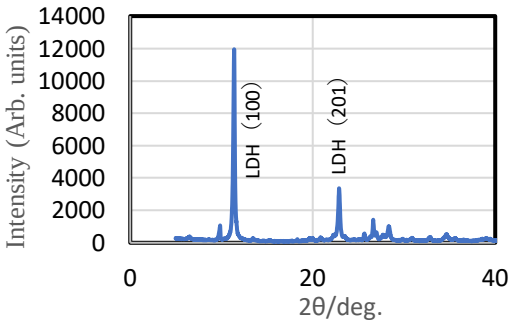


Fig.2 XRD profile of Device

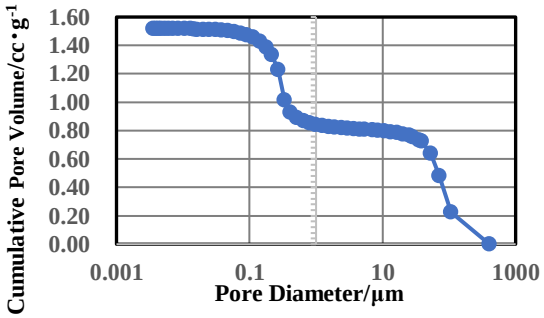


Fig.3 Hg intrusion porosimeter of Device

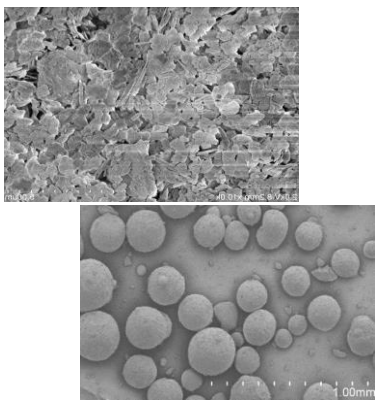


Fig.4 SEM's images of Device

- 補助材のアニオン吸着特性/Device adsorption properties for some anions

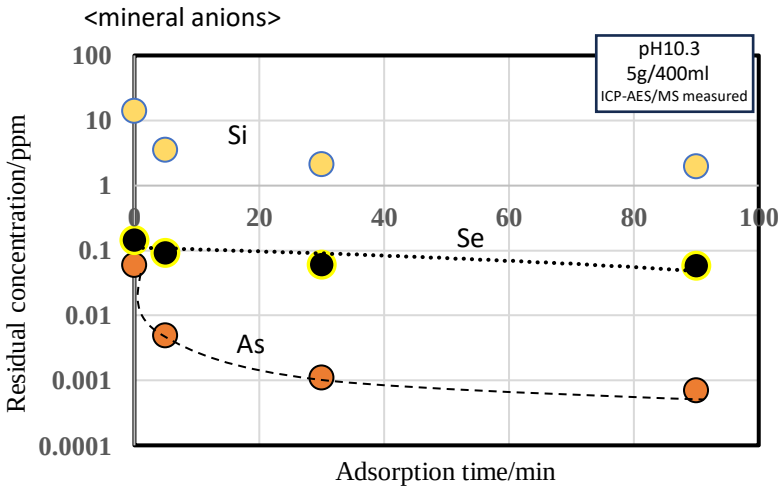


Fig.5 Adsorption properties for mineral anions

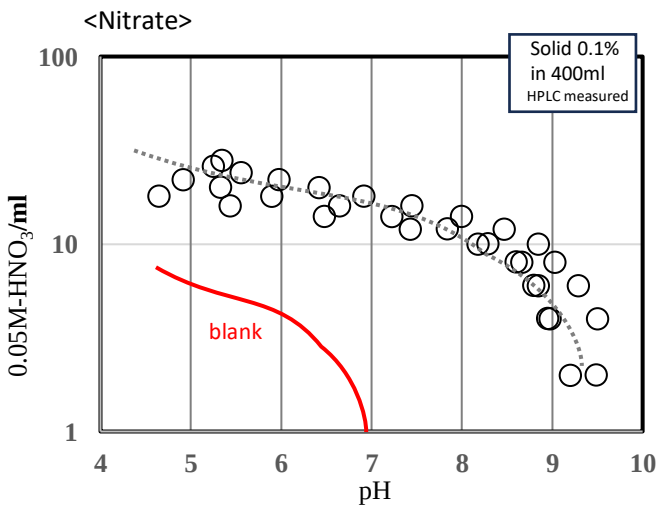


Fig.6 Titration curves for nitrate

アルカリ下でのケイ酸とヒ素イオンに対する短時間吸着特性が観測される。Seについも除去性は認められるが顕著ではない。また、硝酸に対してのイオン除去性が滴定曲線から推察されることから硝酸態窒素への適応可能性も示唆される

It seems that device may adsorb Silicate and Arsenic anion in short period but for Se anions not distinct. From the titration data, it may to understand device has possibilities to remove for nitrate ion and would be estimated to nitrate nitrogen fixedness.

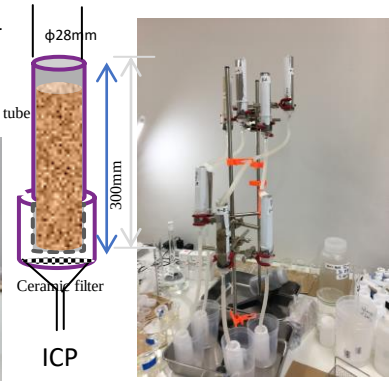
3.鉄粉と複合(混合)させた模擬土壌試験性能/Simulant-Soil Testing

Table1に示す配合を珪砂マトリックスと複合させた土壌層にフィールド水を通水させSi,As,Se濃度の変化を観察した。/Various EC/EA combinations in Table1 were tested for silicasand matrix and the field water was permeated into them for Si,As,Se removing.

Table 1 EC/EA combinations for Silicasand simulant soils

Exp.No.	①	②	③	④	⑤	⑥	⑦	⑧	⑨
Vol%	5			10			20		
Ec	75	50	25	75	50	25	75	50	25
EA	25	50	75	25	50	75	25	50	75
Ec:鉄系粉体/Fe atomized EA:補助材/inorganics									
powder density: Ec=3.84 EA=0.54 cc/g									

Field water



apparatus

Fig.7 Schematic view of experiment

＜実験結果/Experimental results＞

EC/EAが10vol%の系で良好な除去効果を確認(Fig.８)した。特にEA75%の配合では高い効果が認められた。
/In Fig.8 , it has been recognized 10vol% system showed well removal properties, especially EA75% case distinct results.

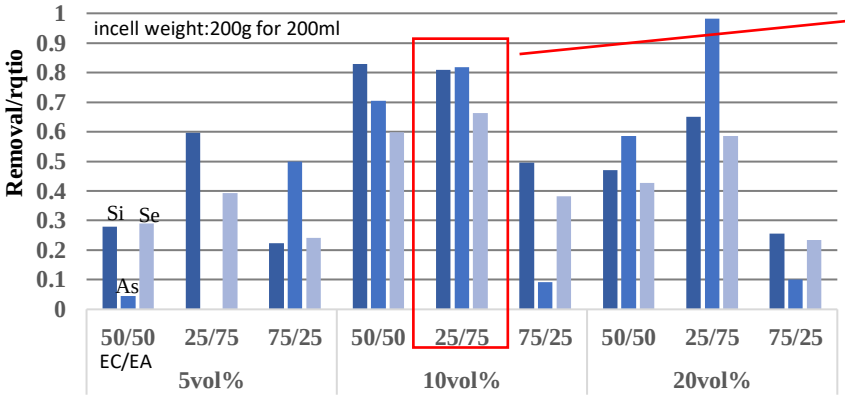


Fig.8 Results of simulant soil tests

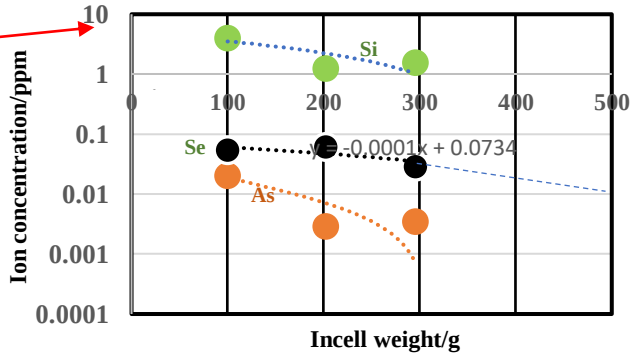


Fig.9 Soil weight effects on EA 75% case

＜考察/Discussion＞

Feと重金属類イオンとの相互作用は主に表面化学反応であると捉えると下記式で表現できるであろう。

$Fe(OH)_2+2H^++2e^-=Fe+2H_2O$ ①

$Fe(OH)_2+HAsO_4^{2-}+H^+=Fe(OH)(HAsO_4)+H_2O$ ②

$n\ Fe(OH)_2+SeO_4^{2-}+8H^++2e^-=[Fe(OH)_2]n\cdot Se+4H_2O$ ③

溶液中に多量に存在するケイ酸アニオンは鉄表面とより強い相互作用を呈し上記反応の進行を阻害することが予想されるが、補助材の併用によりケイ酸アニオンによる表面阻害は軽減される可能性を見出した。

Silicates anion may disturb between Fe atomized surfaces and heavy metals ions interaction which are indicated ①②③. In this study, it has been recognized the inorganics EA has reduced the Silicates affects on Fe surface reactions.(Fig.10) and(Fig.11)

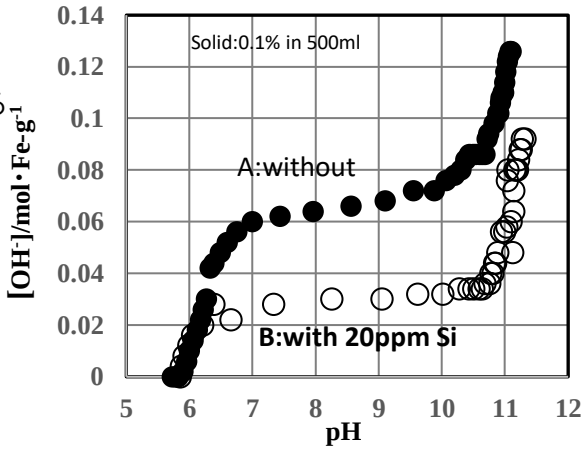


Fig.10 Titration curves of METAL with silicate

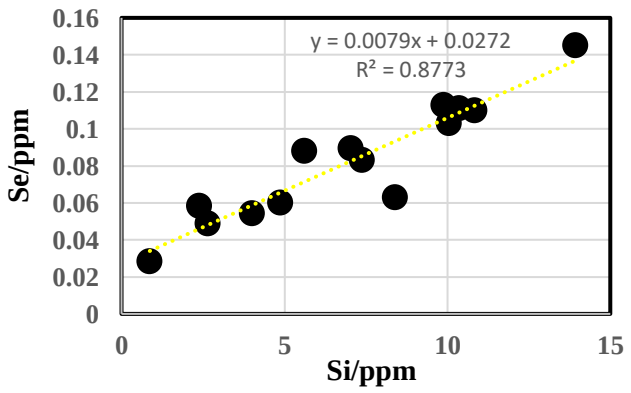


Fig.11 Relationships between Se and Silicate remain concentration

Fig.12よりEA のケイ酸イオン収蔵能は安定したものであると推察/The observed life on Silicates adsorption of EA may stable in statically

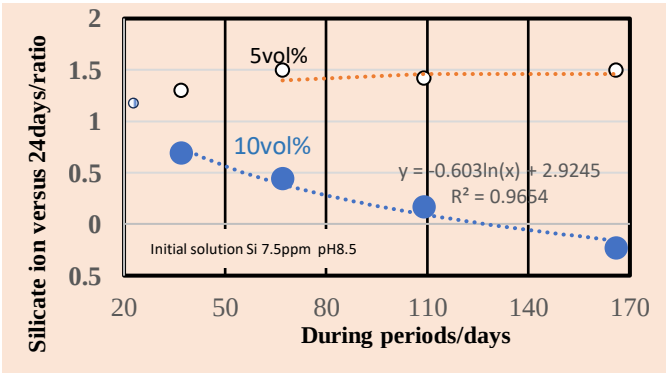


Fig.12 Service life of EA(50ml each period)

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