Does granular sludge structure influence heavy metal adsorption compared to conventional activated sludge?

C. T. Vu*, J. Henriques*, M. Casellas*, C. Dagot**

* Université de Limoges, Groupement de Recherche Eau, Sol, Environnement (GRESE), Limoges, France, (e-mail : justine.henriques@unilim.fr)
** Université de Limoges, UMR INSERM 1092, Limoges, France (christophe.dagot@unilim.fr)

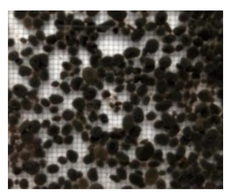
Introduction

Wastewater → Mineral contaminants → Heavy metals → Concentrated in sludge → Landspreading

Wastewater → Organic matters

Conventionnal activated sludge

Granular sludge



Different structures

Contamination of natural environment → Issue for human health protection

Effect on abilities to **adsorb** heavy metals from wastewater or to **desorb** it into natural environment ?

Methods

Sludge samples

CAS : Conventional activated sludge (WWTP of Limoges)

- Addition of lime → **BCh**
- Digestion → **BD**
- Centrifugation → **BC**

BAN : Anaerobic granular sludge (Industrial treatment plant)

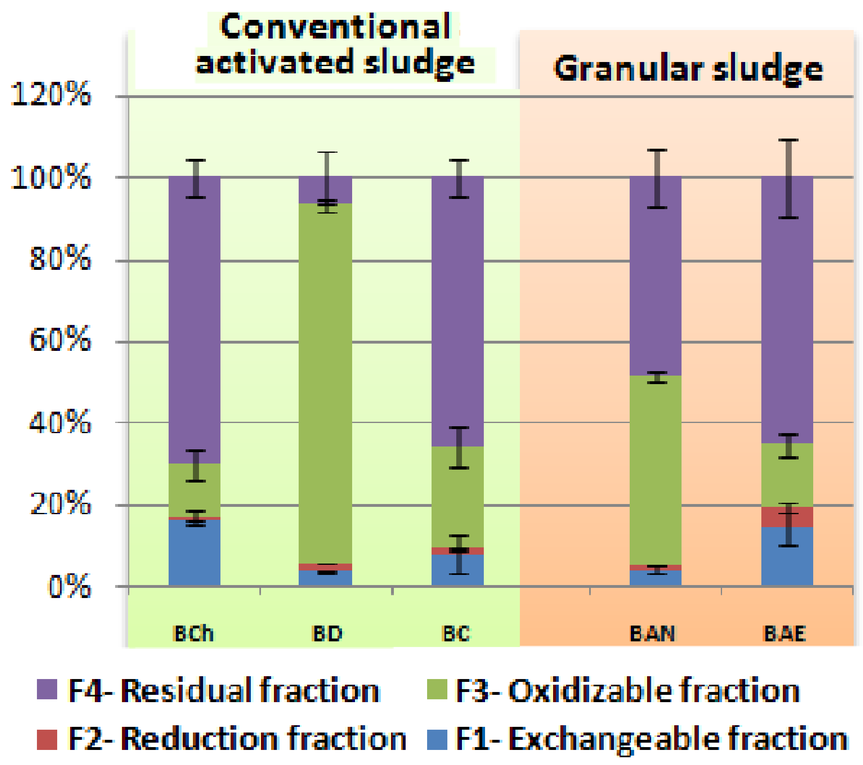
BAE : Aerobic granular sludge (Industrial treatment plant)

Analysis

- Proportion and nature of surface functional groups by pKa measurements (Laurent et al., 2011),
- Copper distribution in the native matrix with a modified BCR protocol (Kazi et al., 2006) and Copper concentrations by Flame Atomic Absorption Spectroscopy,
- Copper adsorption isotherms by adding copper (concentrations from 0 mg/L to 400 mg/L),
- Desorption ability of sludge by re-suspending sludge in NaCl solution (L/S ratio of 50 L/kg).

Results

Sludge		Conventionnal Sludge			Granular Sludge	
		BCh	BD	BC	BAN	BAE
pH		13,1	7,5	5,9	6,8	8,7
Cu Adsorption K_d (L/g)		0,098 ± 0,022	0,324 ± 0,077	0,277 ± 0,059	0,134 ± 0,026	0,731 ± 0,093
% Cu desorption ability		4,8	1,4	1,7	0,4	3,4
Particulate fractions	Carboxyl	52%	81%	61%	58%	65%
	Phosphoric	33%	9%	20%	26%	17%
	Amine Hydroxyde	15%	10%	19%	16%	18%



Copper adsorption capacity : BAE > BD > BC > BAN > BCh
Copper desorption percentage : BCh > BC > BD > BAE > BAN
Proportion of carboxyl fonction : BD > BAE ≈ BC ≈ BAN > BCh

Exchangeable fraction :
BCh ≈ BAE > BC > BAN ≈ BD

Conclusion

High exchangeable fraction → High copper desorption

High exchangeable fraction + High carboxyl groups → High copper adsorption

Reference

Laurent, J., Casellas, M., Carrère, H., Dagot, C. (2011). Effects of thermal hydrolysis on activated sludge solubilization, surface properties and heavy metals biosorption. *Chem. Eng. J.* **166** (3), 841–849.

Kazi, T.G., Jamali, M.K., Siddiqui, A., Kazi, G.H., Arain, M.B., Afridi, H.I. (2006). An ultrasonic assisted extraction method to release heavy metals from untreated sewage sludge samples. *Chemosphere* **63** (3), 411–420