TSUKUBA GLOBAL SCIENCE WEEK 2020

筑波大学
University of Tsukuba

Book of Abstract

Frontiers and Sustainability of Bioresources and Environmental Engineering

This is the short version of the abstract for print use.

Full abstracts with all authors, references, and figures can be found at:

http://www.eng.bres.tsukuba.ac.jp/colloid/research-unit/tgsw2020engbres/index.html

Book of Abstract is designed by Saha Santanu, University of Tsukuba

Contents

Message From Chair

Dear Colleagues and Friends,

Welcome to the online session of Environmental Interface Engineering based on the Dynamic Analysis of Colloidal Flocculation.

This session was firstly organized in line with the activity of the JSPS research project of the same name which has been carried out for the last five years. The first proposal was submitted as the main session of Tsukuba Global Science Week (TGSW2020).

However, immediately after receiving news of acceptance from the TGSW main office, the problem of COVID-19 has come out. TGSW2020 made a decision to carry out as an online conference. Accordingly, this session has modified the original plan. In addition to the original idea, the plan was extended to confirm the formation of an excellent network through current and past ten year activities of the Research Unit of Colloid Engineering in Bioresources. The online conference including digital poster sessions reflecting the previous experience was successfully planed by many participants of this network. In addition to the original idea, this activity becomes a new challenge to cope with the pandemic.

I really express my sincere thanks for the collaboration and dedicated effort of my friends, colleagues, advisors, students, and staff.

Let us wish that all attendees and participants of TGSW2020 will have a fruitful and meaningful time.

Sincerely,

Yasuhisa Adachi

Frontiers and Sustainability of Biosources and Environmental Engineering(FSBEE)

The purpose of this conference is to gather young researchers to exchange and share their experiences and research results in engineering and bio resources fields. At the same time, to discuss the practical challenges encountered and solutions adopted.

Due to COVID-19, the number of poster participants was restricted to ease the management. Even so, FSBEE has received a total of 20 poster participants from 7 countries including Japan, China, Russia, Malaysia, Bangladesh, Vietnam, and India.

To make things easier, FSBEE is divided into five groups; (A) Biotechnology, (B) Colloid and Interface, (C) Environmental Sciences, (D) Nanoparticles, and (E) Waste Treatment. Each group consists of 4 participants and will present similar research under the same group topic. Such an arrangement is necessary to achieve more effective networking and to ensure all participants can have a rewarding experience.

Organizing committee

Advisory board

Hiroyuki Ohshima (Tokyo University of Science)

Cordelia Selomulya (University of New South Wales)

Shingo Matsukawa (Tokyo University of Marine Science and Technology)

Hideki Sakai (Tokyo University of Science)

Hongtao Wang (Tongji University)

Kamila Kydralieva (Moscow Aviation Institute)

Partha P. Gopmandal (National Institute of Technology Durgapur, India)

Herve Cottet (University of Montpellier)

Jerome Duval (University Lorraine)

Executive committee (University of Tsukuba)

Yasuhisa Adachi (Chair)

Motoyoshi Kobayashi (Co Chair)

Member (University of Tsukuba)

Sosaku Ichikawa

Toshiharu Enomae

Yuji Yamashita

Marcos Antonio das Neves

Kazuyoshi Ogawa

Zhenya Zhang

Zhongfang Lei

Student Committee (University of Tsukuba)

Muhamad Ezral Bin Ghazali (Chair)

Lim Voon Huey

Wan Khairunnisa Binti Wan Abdul Khodir

Saha Santanu

Zul Hilmi Bin Saidin

Kiyono Omija

Yang Xin

Secretary

Susumu Sakurai

TSUKUBA GLOBAL SCIENCE WEEK 2020

筑波大学
University of Tsukuba

Engineering and Bioresources Sessions

Session Organizers

Sept 28

Main Session 10:00 ~ 12:00

Deeping Researches on Agro-biological Resources with DDP between UT and NTU

Sept 29

Main Session 9:20 ~11:20, 13:30 ~15:10, 15:30~17:10

Engineering Science of Life and Environment Based on Colloidal Flocculation

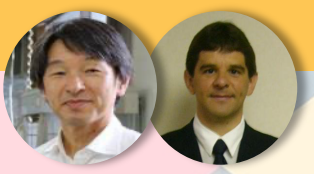
Poster Session 11:30 ~ 13:30

Frontiers and Sustainability of Bioresources and Environmental Engineering

Sept 30

Poster Session 9:00 ~ 12:00

Bioresource Engineering-Colloid and Nano Technology toward Solution of Environmental Problems



Main Session 12:25 ~17:00

Agriculture X AI: Self Sufficiency in Food Production to Achieve Society 5.0 and SDG's Globally

TSUKUBA GLOBAL SCIENCE WEEK 2020

筑波大学 University of Tsukuba

Frontiers and Sustainability of Bioresources and Environmental Engineering

Conducted online on Microsoft Teams

Sept 29

	Parallel Sessions				
Teams	*Room A*	*Room B*	*Room C*	*Room D*	*Room E*
Chairperson	**Kuroiwa Takashi** *University of Tsukuba*	**Sugimoto Takuya** *The University of Tokyo*	**Lili Feng North China** *University of Water Resource and Electric Power*	**Takumi Saito** *The University of Tokyo*	**Hongtao Wang** *Tongji University, China*
11:30	*Opening Remarks*				
20 mins	**A1**	**B1**	**C1**	**D1**	**E1**
20 mins	**A2**	**B2**	**C2**	**D2**	**E2**
20 mins	**A3**	**B3**	**C3**	**D3**	**E3**
20 mins	**A4**	**B4**	**C4**	**D4**	**E4**
1:00	*Closing Remarks & Adjourned*				

Session Organizers

Audience Registration

List of Abstracts – Posters

Here is the whole list of abstracts. For your convenience, any full abstract can be found directly by clicking on the title of respective author, also you can join the Teams room by just clicking on '**Room -**'.

Room -A

Biotechnology Chair Person : **Kuroiwa Takashi** Tokyo City University		
Poster ID	Name, Affiliation	Title
A1	**H. Zhang**, J. Wang, Y. Yu, S. Kaul, Z. Zhang, E. Miyako, R. Wadhwa University of Tsukuba, Japan	Ashwagandha leaf extract -folic acid nanoparticles enhanced the selective targeting of cancer cells
A2	**X. Li**, Z. Lei, X. Li, Z. Zhang, R. Wadhwa, K. Shimizu, Z. Zhang University of Tsukuba, Japan	Evaluation of Anticancer Activities of Cordyceps militaris Grown on Fluorinated Medium on A549 cells
A3	T. H. Dao, T. Q. M. Vu, N. T. Nguyen, **T. D. Pham** Vietnam National University, Hanoi	Adsorption characteristics of polyelectrolytes onto differently charged nanoalumina surfaces and applications in antibiotics removal
A4	**W. Shibahara**, Y. Ito, S. Ichikawa University of Tsukuba, Japan	Edible Polymer Multi Multi-Coating Effect on in Vitro Gastrointestinal Digestion Behavior of Emulsion Oil Droplets

Room -B

Colloid and Interface

Chair Person : **Sugimoto Takuya**

The University of Tokyo

Poster ID	Name, Affiliation	Title
B1	**A. Razali**, F. Turci, C. P. Royall International Islamic University of Malaysia, Malaysia	Local Structural Changes in Colloid-Polymer Mixture: Colloids as Atomic Model
B2	**M. Kobayshi** University of Tsukuba, Japan	How I have been playing with Hiroyuki Ohshima theories
B3	**S. Wada** University of Tsukuba, Japan	Experimental assessment of breakup of marine aggregates
B4	**S. Maurya**, S. Saha, P.P. Gopmandal, H. Ohshima Sikkim Manipal Institute of Technology Sikkim, India,	Effect of ion partitioning on the electroosmotic flow and associated heat transfer though soft nanochannel

Room -C

Environmental Sciences

Chair Person : **Lili Feng**

North China University of Water Resource and Electric Power

Poster ID	Name, Affiliation	Title
C1	**L. Bondarenko**, K. Kydralieva National Research University ,Russia	Humic acids' and silica coated magnetite nanoparticles as effective adsor bents for diclofenac
C2	**Y. Yamashita**, T. Nomiya, Y. Adachi University of Tsukuba, Japan	Coagulation and Sedimentation of Imogolite Clay Nanotubes
C3	**X. Feng**, X. Ping, W. Dongsheng North China Electric Power University, China	Influence of allochthonous organic matters on algae removal: Organic removal and floc characteristics
C4	**Y. Xu**, Y. Bai, T. Hiemstra, W. Tan, L. Weng Wageningen University & Research, the Netherlands	Resolving Humic and Fulvic Acids in Binary Systems Influenced by Adsorptive Fractionation to Fe-(hydr)oxide with Focus on UV-Vis Analysis

Room -D

Nanoparticles Chair Person: **Takumi Saito** The University of Tokyo		
Poster ID	Name, Affiliation	Title
D1	**L. Xiao**, S. Sun, X. Li, Z. Zhang, Z. Lei, K. Shimizu University of Tsukuba, Japan	Effects of Nanobubble Water on the biomass accumulation and Antioxidative Activities of Polysaccharides from Mycelium of Cordyceps militaris
D2	**I. Magomedov**, K. Kydralieva National Research University, Russia	Synthesis, Sorption Properties and Bioavailability of Magnetite–Activated Carbon Nanoparticles
D3	**A. Hakim**, M. Kobayashi Department of Soil Science, University of Chittagong, Bangladesh	Aggregation and aggregate strength of natural organic matter: effects of hydrophobicity and solution pH
D4	**C. Ni**, J. Hou, W. Tan Huazhong Agricultural University, China	Enhanced catalytic activity of OMS-2 nanomaterial for benzene degradation by tuning Sr^2 contents in the tunnels

Room -E

Environmental Sciences

Chair Person : **Hongtao Wang**

Tongji University, China

Poster ID	Name, Affiliation	Title
E1	**C. Liu**, J. Zhao, Z. Lei, K. Shimizu, Z. Zhang University of Tsukuba, Japan	Hydrothermal Carbonization of Sewage Sludge: Effect of Distillers Grains as Additive on Properties and Combustion Behavior of Produced Hydrochar
E2	V. Punnyaswaran, **Md. A. Alsamet**, M. Goto University Technology Malaysia, Malaysia	Biochemical Methane Potential (BMP) From The Anaerobic Digestion of Food Waste
E3	**G. Zhang**, Q. Shi, Q. Lia, H. Wang Tongji University, China	Agents for sludge dewatering in fundamental research and applied research: A bibliometric analysis
E4	**J. Wang**, T. Wang, Q. Zhu, S. Zhang, Q. Shi, H. Wang Tongji University, China	Preparation of A Novel Sludge-derived Biochar by K2FeO4 Conditioning to Enhance the Removal of Pb^2

Ashwagandha leaf extract -folic acid nanoparticles enhanced the selective targeting of cancer cells

Huayue Zhang[1,2], Jia Wang[1,2], Yue Yu[3], Sunil Kaul[2], Zhenya Zhang[1], Eijiro Miyako[4] and Renu Wadhwa[2,*]

[1]Graduate School of Life & Environmental Sciences, University of Tsukuba, Ibaraki 305-8575, Japan
[2]AIST-INDIA DAILAB, DBT-AIST International Centeer for Translational and Environmental Research (DAICENTER), Cellular and Molecular Biotechnology Research Institute, National Institute of Advanced Industrial Science & Technology (AIST), Tsukuba, Ibaraki 305-8565, Japan
[3]Biomedical Research Institute (BMRI), AIST, Ikeda 563-8577, Japan,
[4]School of Materials Science, Japan Advanced Institute of Science and Technology, 1-1 Asahidai, Nomi, Ishikawa 923-1292, Japan

Folate receptor alpha (FRA) is a glycosylphosphatidylinositol cell surface anchored glycoprotein that is overexpressed on the surface of a variety of cancer cells. It binds to folic acid (FA) and mediates its intracellular transport, which is essential for proliferation of these cancer cells. On the other hand, normal cells have limited FRA expression restricted largely to the apical surfaces of the epithelial tissue where it is inaccessible to the circulating drugs. Due to such reasons FRA has been considered as a target for cancer therapy.

Alcoholic extract of *Ashwagandha* leaf (i-Extract) was reported to have selective cancer cell killing activity. This study aimed to increase potency of this activity by recruiting FRA. FRA-ligand, FA, was used as the carrier for i-Extract. FA-PEG-i-Extract (FAP-iEX) nanoparticles were generated by using 1,2-distearoyl-*sn*-glycero-3-phosphoethanolamine-N-[folate(polyethylene glycol)-2000] FA-DSPE-PEG. It was found that FAP-iEX nanoparticles caused dose-dependent growth arrest that was much stronger for HeLa cells (FRA^+) as compared with MCF7 cells (FRA^-). Molecular analysis revealed stronger decrease in Cdk4 and Bcl2, and increase in $p21^{WAF1}$ and pro-PARP-1 in the FAP-iEX treated HeLa cells. These data suggest that Ashwagandha FAP-iEX nanoparticles could be an efficient and safe natural drug for cancer treatment.

References

Yue Yu and Jia Wang: Front Oncol., 9:602, (2019)

---

† Renu Wadhwa.
E-mail: renu-wadhwa@aist.go.jp

Evaluation of Anticancer Activities of *Cordyceps militaris* Grown on Fluorinated Medium on A549 cells

○Xiaoshuai Li[1], Zhongfang Lei[1], Renu Wadhwa[2], Kazuya Shimizu[1], Zhenya Zhang[1,] †

([1] Graduate School of Life and Environmental Sciences, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8572, Japan; [2] AISTINDIA DAILAB, DBT-AIST International Center for Translational & Environmental Research (DAICENTER), National Institute of Advanced Industrial Science & Technology (AIST), Tsukuba, Japan)

Cordyceps militaris (CM), a traditional Chinese insect-born fungus, has been long used as an alternative medicine which can function as antimicrobial, antioxidant, and hyperglycaemic inhibitory substitutes [1]. Fluorine is widely applied in medicinal chemistry to improve a molecular potency and permeability due to its small size and strong electron-withdrawing property [2]. It is innovative to add fluorine to CM culture medium, so as to use biosynthetic machinery in living organisms for fluorine utilization, which can enable the probable incorporation of natural products with structural complexity and fluorine that can tune molecular properties.

This study examined the effects of NH_4F- and KF-added medium on CM cultivation and its properties by harvesting CM fruit body. The water extracts from CM fruit body were used to evaluate their anticancer effects on A549 cells. Compared with the normal medium CM extracts, the ratio of total death cells was respectively increased from 14% to 20% and 19% in NH_4F- and KF-added CM extracts. Correspondingly, the activity of PARP-1 pro was increased by 15%, 35%, and 63%. These results demonstrated that the extracts obtained from fluorine-supplemented medium induced stronger cell cycle growth arrest and apoptosis. Furthermore, they also possessed enhanced anti-migration activity on A549 cells.

References

1. Wu, L., Sun, H., Hao, Y., et al. (2020). Chemical structure and inhibition on α-glucosidase of the polysaccharides from *Cordyceps militaris* with different developmental stages. *International Journal of Biological Macromolecules*, 148, 722-736.
2. Pan, Y. (2019). The dark side of fluorine. *ACS Medicinal Chemistry Letters*, 10 (7), 1016-1019.

---

†Zhenya Zhang, Tel: +81-29-853-4712,
E-mail: zhang.zhenya.fu@u.tsukuba.ac.jp

Adsorption characteristics of polyelectrolytes onto differently charged nanoalumina surfaces and applications in antibiotics removal

Thi Huong Dao[1], Thi Quynh Mai Vu[1], Ngoc Trung Nguyen[1], Tien Duc Pham[1]†
[1]Faculty of Chemistry, University of Science, Vietnam National University, Hanoi

Adsorption of strong polyanions, poly(styrenesulfonate) (PSS) and poly(2-acrylamide-2-methylpropane sulfonic acid) (PAMPS) and strong polycation poly 3-(Methacrylamido)propyltrimethylammonium chloride (PMAPTAC) onto differently charged nanoalumina surfaces was investigated in the present study. The synthesized alpha alumina was characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), Transmission electron microscopy (TEM), Brunauer–Emmett–Teller (BET) method and zeta potential measurements [1]. Adsorption of PSS and PAMPs as well as adsorption of PMAPTAC onto positively charged and negatively alumina surfaces, respectively were controlled by both electrostatic and non-electrostatic interactions [1,2]. Adsorption isotherms of electrolytes onto alumina surface were fitted well by two-step adsorption model. Surface modification of nanoalumina with polyelectrolytes enhanced a significant increase in antibiotics removal [2,3]. The effective parameters which influenced to the antibiotic removal including pH, contact time and adsorbent dosage, were systematically optimized. Adsorption isotherms and kinetics of antibiotics onto polyelectrolytes modified alumina were also studied. Based on the change in surface charge monitored by zeta potential, surface modification by FT-IR and adsorption isotherms, we suggest that antibiotics adsorption onto polyelectrolytes modified alumina was induced by both electrostatic and non-electrostatic interactions but electrostatic attraction was dominant. Our results indicate that polyelectrolytes modified alumina are the new and excellent adsorbents for antibiotics removal from aqueous solution [1,2,3].

References

1. Nguyen, NT., Dao, TH., Truong, TT., Nguyen, TMT., Pham, TD. (2020). Adsorption characteristic of ciprofloxacin antibiotic onto synthesized alpha alumina nanoparticles with surface modification by polyanion. *Journal of Molecular Liquids 309*:113150
2. Dao, TH., Vu, TQM., Nguyen, NT., Pham, TT., Nguyen, TL., Pham, TD, Yusa, Shin-ichi (2020). Adsorption characteristics of synthesized polyelectrolyte onto alumina nanoparticles and application in antibiotic. *Langmuir, Under review*
3. Dao TH, Nguyen NT, Nguyen MN, Ngo CL, Luong NH, Le DB, Pham TD (2020) Adsorption Behavior of Polyelectrolyte onto Alumina and Application in Ciprofloxacin Removal. *Polymers 12 (7)*:1554.

† Full Name (Corresponding author), Tel: +84-98-3056784,
E-mail: tienduchphn@gmail.com/tienducpham@hus.edu.vn

Edible Polymer Multi-Coating Effect on *in Vitro* Gastrointestinal Digestion Behavior of Emulsion Oil Droplets

○ Wakana SHIBAHARA, Yuki ITO, Sosaku ICHIKAWA†
(Faculty of Life and Environmental Sciences, University of Tsukuba)

Oil-in-water (O/W) emulsion is dispersion system in which oil droplets are dispersed in an aqueous medium. It is widely used in the food and pharmaceutical industries, therefore controlling the digestibility of emulsion oil droplets in the digestive tract is one of the important issues for developing functional foods and pharmaceuticals. Layer-by-layer multi-coating of oil droplets by edible polymers is one of the ways to control the stability of oil droplets [1, 2]. In this study, we investigated the effect of layer-by-layer multi-coating using edible polymers on *in vitro* gastrointestinal digestion behavior of O/W emulsion oil droplets. The microchannel emulsification was used for the preparation of the base oil droplets [3]. Chitosan as a cationic polymer, and carboxymethyl cellulose or whey protein isolate as an anionic polymer were alternately coated on the surface of oil droplets. The stability of oil droplets after *in vitro* gastric digestion experiments was different depending on the coating-polymer type of the outermost layer of oil droplets. The hydrolysis rate of lipid triacylglyceride during the *in vitro* small intestinal digestion experiments was affected by the coating-polymer type and number of coating layer. These findings show that layer-by-layer multi-coating with edible polymers can control the gastrointestinal digestibility of emulsion oil droplets.

References

1. Iwata, N., Neves, M. A., Watanabe, J., Sato, S., Ichikawa, S. (2014). Stability control of large oil droplets by layer-by-layer deposition using polyelectrolyte dietary fibers, *Colloid. Surface A.*, **440**, 2-9.
2. Kuroiw, T., Kobayashi, I., Chuah, A. M., Nakajima, M., Ichikawa, S. (2015). Formulation and stabilization of nano-/microdispersion systems using naturally occurring edible polyelectrolytes by electrostatic deposition and complexation, *Adv. Colloid Interface Sci.*, **226**, 86-100.
3. Kobayashi, I., Mukutaka, S., Nakajima, M. (2005). Novel asymmetric through-hole array microfabricated on a silicon plate formulating monodisperse emulsion, *Langmuir,* **21**, 7629-7632.

---

† Sosaku ICHIKAWA (Corresponding author), Tel: +81-29-853-4627,
E-mail: ichikawa.sosaku.fn@u.tsukuba.ac.jp

Local Structural Changes in Colloid-Polymer Mixture

Colloids as Atomic Model

o †Azaima Razali, Francesco Turci* and C. Patrick Royall**

o Department of Chemistry, Kulliyyah of Science, International Islamic University of Malaysia, Jalan Sultan Ahmad Shah, 25200, Kuantan, Malaysia.

*, ** HH Wills Physics Laboratory, Tyndall Avenue, Bristol BS8 1TL.

Colloidal suspension undergoes phase transition: gas, liquid and crystal states, as was observed in the phase diagram of argon atoms. Linked by these similarities, colloids have often been used as atomic models and have been given the term "designer atoms"[1]. The addition of polymer induces aggregation in colloidal dispersion by creating attractive interaction potential between the colloids. The addition of polymer to colloidal suspensions will cause the colloidal particles to aggregate at low volume fraction, φ[2-5] forming a gel. The arrested behaviour in gels due to the polymer addition is analogous to colloidal suspensions quenching. The colloid-polymer mixture can be considered as one component system where the effective interaction is mediated by the polymer according to Asakura and Oosawa[6,7] and Vrij[8]. In our work, we employed a well understood colloid-polymer system in order to investigate the local structural changes in reaching equilibrium ordered state. We studied the ageing of gels with different interaction strengths in experiment and simulation. Then, we also examined the effects of confinement to the sedimentation of colloids and gels. We have investigated the local structures evolution within the far from equilibrium state of gel using a confocal microscope.

References

1. Frenkel, D. (2002). Playing tricks with "designer atoms". *Science*, *296* (5565), 65 – 66.
2. Dinsmore, A. & Weitz, D. (2002). Direct imaging of three-dimensional structure and topology of colloidal gels. *J. Phys.: Condens. Matter*, *14* (33), 7581– 7597.
3. Poon, W. C. K., Pirie, A. D. & Pusey, P. N. (1995). Gelation in colloid-polymer mixtures. *Faraday Discuss*, *101*, 65 – 76.
4. Verhaegh, N. A. M., Asnaghi, D., Lekkerkerker, H. N. W., Giglio, M. & Cipelletti, L. (1997). Transient gelation by spinodal decomposition in colloid-polymer mixtures. *Physica A*, *242*, 104–118.
5. Prasad, V., Trappe, V., Dinsmore, A. D., Segre, P. N., Cipelletti, L. & Weitz, D. A. (2003). Universal features of the fluid to solid transition for attractive colloidal particles," *Faraday Discuss.*, *123*, 1–12.
6. Asakura, S. & Oosawa, F. (1954). On interaction between 2 bodies immersed in a solution of macromolecules. *J. Chem. Phys.*, *22* (7), 1255–1256.
7. Asakura, S. & Oosawa, F. (1958). Interaction between particles suspended in solutions of macromolecules. *J. Poly. Sci.*, *33*, 183–192.
8. Vrij, A. (1976). Polymers at interfaces and interactions in colloidal dispersions. *Pure Appl. Chem.*, *48* (4), 471–483.

† Azaima Razali (Corresponding author), Tel: +60-9-570-5181,
E-mail: azaimarazali@iium.edu.my

How I have been playing with Hiroyuki Ohshima theories

Motoyoshi Kobayashi
(Faculty of Life and Environmental Sciences, University of Tsukuba)

Prof. Hiroyuki Ohshima has been deriving many useful theoretical equations for the development of colloid science. Most of his theories are explicit and thus are easily accessible for researchers doing experiments like me. On this occasion, I would like to share some of our outcomes [e.g. 1-4] based on the analysis of experimental data using Ohshima's theories.

References

1. Kobayashi, M. (2020). An analysis on electrophoretic mobility of hydrophobic polystyrene particles with low surface charge density: Effect of hydrodynamic slip. *Colloid Polym. Sci.*. DOI: 10.1007/s00396-020-04716-2
2. Sato, Y., Kusaka, Y., & Kobayashi, M. (2017). Charging and aggregation behavior of cellulose nanofibers in aqueous solution. *Langmuir*, 33(44), 12660-12669.
3. Nishiya, M., Sugimoto, T., & Kobayashi, M. (2016). Electrophoretic mobility of carboxyl latex particles in the mixed solution of 1: 1 and 2: 1 electrolytes or 1: 1 and 3: 1 electrolytes: Experiments and modeling. *Colloids Surfaces A*, 100(504), 219-227.
4. Yamaguchi, A., & Kobayashi, M. (2016). Quantitative evaluation of shift of slipping plane and counterion binding to lysozyme by electrophoresis method. *Colloid Polym. Sci.*, 294(6), 1019-1026. *27*(21), 12910 - 12915.

Tel: +81-29-853-5721
E-mail: kobayashi.moto.fp@u.tsukuba.ac.jp

Experimental assessment of breakup of marine aggregates

○Shigeki Wada†, Yasuhito Hayashi, Yasuhisa Adachi*,
(Shimoda Marine Research Center, University of Tsukuba, *Life and Environmental Sciences, University of Tsukuba)

Biogenic particles in the oceans are mainly originated from photosynthetic products of phytoplankton. A part of the particles settles into deep sea, and organic carbon involved in the particles are sequestrated. This process is termed as “Biological pump”, by which the amount of carbon annually exported below surface mixed layer in global ocean would be comparable with CO_2 emission by human activity. Large part of sinking particles consists of amorphous aggregates. Transport efficiency of the particles to deep sea strongly depends on their size, and the size of the aggregates is determined by aggregation and disaggregation. While most of the past studies in marine aggregates had focused on aggregation process, recent advances in observatory apparatus to monitor turbulent shear have suggested the importance of disaggregation as well[1,2]. Although strength of aggregates is essential parameter to understand the disaggregation process, experimental assessment has been rarely carried out. Here, we estimated the strength of marine aggregates to be 104-178 nN using Couette devices, being higher than that of mineral particles estimated in the past study[3] probably due to sticky property of components of the marine aggregates such as extracellular polymeric substances.

References

1. Briggs, N., Dall’Olmo, G., & Claustre, H. (2020). Major role of particle fragmentation in regulating biological sequestration of CO2 by the oceans. *Science*, *367*(6479), 791 - 793.
2. Takeuchi, M., Doubell, M. J., Jackson, G. A., Yukawa, M., Sagara, Y., & Yamazaki, H. (2011). Turbulence mediate marine aggregate formation and destruction in the upper ocean. *Scientific Reports*, 9, 16280.
3. Adachi, Y., Di, C., Xiao, F., & Kobayashi, M. (2019). Size, orientation, and strength of Na-montmorillonite flocs flowing in a laminar shear flow. *Colloid and Polymer Science, 297*, 979-987.

---

† Shigeki Wada (Corresponding author), Tel: +81-558-22-6740,
Fax: +81-558-22-0346, E-mail: swadasbm@shimoda.tsukuba.ac.jp

Effect of ion partitioning on the electroosmotic flow and associated heat transfer though soft nanochannel

○Saurabh K. Maurya [1]†, Santanu Saha [2], Partha P. Gopmandal [3], Hiroyuki Ohshima[4]
([1] Faculty of Mathematics, Sikkim Manipal Institute of Technology Sikkim, Sikkim-737136, India, [2] Graduate School of Life and Environmental Sciences, University of Tsukuba, [3] Faculty of Mathematics, National Institute of Technology Durgapur, Durgapur-713209, India, [4] Faculty of Pharmaceutical Sciences, Tokyo University of Science, 2641 Yamazaki Noda, Chiba, 278-8510, Japan)

This study presents a theoretical analysis of ionized liquid flowing through a soft nanochannel under an applied DC electric field and associated heat transfer characteristics. The dielectric permittivity of the soft polymeric layers grafted on the channel walls are generally lower than that of the ionized liquid, which leads to a difference in the Born energy of both the phases. As a result, the effect of ion partitioning induces, which leads to a discontinuity in the concentration distribution of mobile electrolyte ions across the interface between the electrolyte and soft polymeric layer. The fluid flow across the polymeric layer is governed by the Darcy-Brinkman equation and the Stokes equation governs the flow within the bulk electrolyte medium. The electrostatic electric double layer potential is governed by the Poisson-Boltzmann equation, where the mobile electrolyte ions follow the Boltzmann equation. We adopt a finite difference based numerical tool to calculate the axial velocity profile and thereby the temperature distribution across the channel. In addition, we have also derived the analytical results for a soft nanochannel under low potential limit. The essential features of the electroosmotic flow and associated heat transfer characteristics through the undertaken nanochannel are highlighted by the variations in the axial velocity, temperature profile and the Nusselt number. We observed that ion partitioning effect significantly modulates the flow profile and thereby the thermal characteristics.

References

1. XiangchunXuan, DongqingLi (2005). Analytical study of Joule heating effects on electrokinetic transportation in capillary electrophoresis. *J. Chromatography A*, *1064(2): 227-237.*
2. Antarip Poddar, Debonil Maity, Aditya Bandopadhyay and Suman Chakraborty (2016). Electrokinetics in polyelectrolyte grafted nanofluidic channels modulated by the ion partitioning effect. *Soft Matter*, *12, 5968-5978*.
3. Meisam Habibi Matin, Hiroyuki Ohshima (2015). Combined electroosmotically and pressure driven flow in soft nanofluidics. *J. Colloid and Interface Science: 460*, 361-369.

---

† Saurabh K. Maurya (Corresponding author), E-mail: sk.bhu66@gmail.com

Humic acids' and silica-coated magnetite nanoparticles as effective adsorbents for diclofenac

○L. Bondarenko†, K. Kydralieva
(Moscow Aviation Institute, National Research University, Moscow, Russia)

In this work, environmentally friendly Fe_3O_4 nanoparticles modified with humic acids (HA) and/or 3-aminopropyltriethoxysilane (APTES) were proposed for the adsorptive removal of non-steroidal anti-inflammatory drug − diclofenac sodium (DCF). Synthesized nanoparticles were employed to characterize with XRD, Mossbauer spectroscopy, dynamic light scattering, N_2 adsorption-desorption measurements and adsorption kinetics was systematically investigated with different pH. For Fe_3O_4 and Fe_3O_4/APTES the average particle size of crystallines equal 6.9 and 9.6 nm, average hydrodynamic size at isoelectric points as 6.4 and 7.1 made 500 and 300 nm, respectively. The sorption experiments demonstrated the high uptake of DCF with 178 and 256 mg g-1 for Fe_3O_4/APTES/HA and Fe_3O_4/APTES. Ultrasonic treatment of Fe_3O_4/APTES in the absence or presence HA were used to increase the removal degree for DCF at different time, pH and frequencies (30 and 100 kHz; 5-30 min and 3-9, respectively). Fe_3O_4/APTES in the presence HA after sonication at 100 kHz, pH 3 demonstrated higher adsorption (58%, respectively) in contrast with 30 kHz, pH 3 (32%, respectively) within 30 min. According to these results, HA and silica-modified nanoparticles represent great potential for DCF-contaminated water treatment.

Acknowledgements. This research has been financed by the Russian Foundation for Basic Research (#19-33-90149/19).

---

† Lyubov Bondarenko, Tel: +7-901-743-34-54,
E-mail: l.s.bondarenko92@gmail.com

Coagulation and Sedimentation of Imogolite Clay Nanotubes

○Yuji Yamashita†, Takanao Nomiya, Yasuhisa Adachi
(School of Life and Environmental Sciences, University of Tsukuba)

Coagulation behavior of synthetic imogolite was investigated in wide ranges of solution pH and salt concentration. Imogolites are naturally-occurring clay nanotubes which characterizes volcanic ash soil alongside allophane[1]. Imogolite is a hollow fibrous substance with an inner diameter of 1 nm, an outer diameter of 2 nm and a length of several hundred nm[2]. The outer surface is positively charged by dissociation of hydroxyl groups of alumina, and the inner surface is negatively charged by dissociation of silanol groups. In recent years, their unique morphology and surface property attracts material scientists[2]. To understand their roles in natural environment and engineered system, characterization of colloidal properties of imogolite is crucial. Although Karube et al.[3] found a natural imogolite disperses on the acidic side and aggregates on the alkaline side at pH 6.5, salt concentration, which is an essential factor of coagulation behavior of colloidal suspension, has not been considered. In this study, the effect of salt concentration as well as solution pH on coagulation of imogolite was unraveled. At 10 mM of NaCl, the critical coagulation pH (CCpH) was confirmed at pH 6.5. The CCpH decreased with an increase of NaCl concentration while it increased with a decrease of NaCl concentration.

References

1. Yoshinaga, N., Aomine, S., 1962. Imogolite in some ando soils. Soil Science and Plant Nutrition 8, 22–29.
2. Guimarães, L., Enyashin, A.N., Frenzel, J., Heine, T., Duarte, H.A., Seifert, G., 2007. Imogolite Nanotubes: Stability, Electronic, and Mechanical Properties. ACS Nano 1, 362–368.
3. Karube, J., Sugimoto, H., Fujihira, M., Nakaishi, K., 1998. Stability and Charge Characteristics of Allophane and Imogolite. Transactions of The Japanese Society of Irrigation, Drainage and Reclamation Engineering 1998(196), 673-680, a2.

† Yuji Yamashita (Corresponding author), Tel: +81-29-853-6638,
E-mail: yamashita.yuji.gm@u.tsukuba.ac.jp

Influence of allochthonous organic matters on algae removal: Organic removal and floc characteristics

Xiao Feng[1,3] †, Xiao Ping[2], Wang Dongsheng[3]
([1]School of Renewable Energy, North China Electric Power University, [2] Green Intelligence and Environmental School, Yangtze Normal University, [3] State Key Laboratory of Environmental Aquatic Chemistry, Research Center for Eco-Environmental Sciences, Chinese Academy Sciences)

Algae are ubiquitous in surface water and affect the quality of surface water resources significantly by producing toxins as well as taste and odor compounds which adversely affect aquatic ecosystems and human health. This study was conducted to evaluate the effectiveness of three aluminum coagulants on algae removal by coagulation. Laboratory tests demonstrated that the maximum algae removal rates was 98.3% and 96.7% respectively by using PACl and Al_{13} as coagulants, while the maximum algae removal rate was 88.3% by using $Al_2(SO_4)_3$ as coagulant at 0.1 mmol/L. According to the results, it also can be noticed that PACl and Al_{13} had a wide working pH range. In addition, the influence of allochthonous organic matters on algae removal during coagulation was also discussed. The removal rate was increased with a low bovine serum albumin (BSA) concentration owing to improving the adsorption-bridging. A poor coagulation performance was observed with the increasing of BSA dosage since the excess BSA molecules may prevent molecules from approaching and seize the active sites, causing coagulation inhibited. The addition of humic acid (HA) and sodium alginate (NaAlg) had adverse effects on the removal of turbidity and algae, attributed to the preferentially reaction between negative functional groups in HA/NaAlg and coagulant. Thick flocs were formed with the increasing of allochthonous organic matters as the calculation results of fractal dimension (Df). According to high pressure size exclusion chromatography (HPSEC) and three-dimensional fluorescence excitation-emission matrix spectrometry (3D-EEMs), allochthonous organic matter with high molecular weight (MW) can be completely removed, while the organics with low MW regardless of its origin were difficult to remove.

References

1. Wu C.D., Xu X.J., Liang J.L., Wang Q., Dong Q., Liang W.L., Enhanced coagulation for treating slightly polluted algae-containing surface water combining polyaluminum chloride (PAC) with diatomite, *Desalination* 279 (2011) 140–145.
2. Safarikova J., Baresova M., Pivokonsky M., Kopecka I., Influence of peptides and proteins produced by cyanobacterium Microcystis aeruginosa on the coagulation of turbid waters, *Sep. Purif. Technol.* 118 (2013) 49–57.
3. Jiang J.Q., Graham N.J.D., Preliminary evaluation of the performance of new prepolymerised inorganic coagulants for lowland surface water treatment, *Water Sci. Technol.* 37 (1998) 121–128.
4. Ma C.X., Hu W.R., Pei H.Y., Xu H.Z., Pei R.T., Enhancing integrated removal of Microcystis aeruginosa andadsorption of microcystins using chitosan-aluminum chloride combined coagulants: effect of chemical dosing orders and coagulation mechanisms, *Colloids Surf. A Physicochem. Eng. Asp.* 490 (2016) 258–267.

† Xiao Feng (Corresponding author), Tel: +86-10-6177-2456, Fax: 86-10-6177-2456, E-mail: xiaofeng@ncepu.edu.cn

Resolving Humic and Fulvic Acids in Binary Systems Influenced by Adsorptive Fractionation to Fe-(hydr)oxide with Focus on UV-Vis Analysis

Yun Xu [1,2], Yilina Bai [1], Tjisse Hiemstra [1], Wenfeng Tan [2]†, Liping Weng [1,3]†
([1] Department of Soil Chemistry and Chemical Soil Quality , Wageningen University & Research, P. O. Box 47, 6700 AA, Wageningen, the Netherlands;
[2] College of Resources and Environment, Huazhong Agricultural University, 430070, Wuhan, P. R. China;
[3] Agro-Environmental Protection Institute, Ministry of Agriculture, 300191, Tianjin, P. R. China)

Humic acid (HA) and fulvic acid (FA), are major reactive fractions of natural organic matter (NOM). Both HA and FA are simultaneously present in natural systems and bind strongly to oxide minerals (e.g., goethite), and therefore affects the distribution and bioavailability of a range of nutrients and pollutants. However, the competitive adsorption between HA and FA to minerals is not well understood, partly because of a lack of analytical methodology to effectively separate HA and FA in their mixtures.

In this study, an UV-Vis method was developed to quantify concentrations of HA and FA without and after adsorptive fractionation by an iron oxide (goethite, α-FeOOH). The UV-Vis method is based on distinct differences in the UV-Vis spectra of HA and FA, including fingerprints in both the spectra shape and intensity. Adsorption to goethite decreased the specific light absorbance of HA and FA, but the changes in spectral shape were not significant enough to cover their differences.

In addition, the performance of the UV-Vis method was compared to that of acid precipitation and size exclusion chromatography (SEC). The latter two methods give less satisfied quantifying results. Within limitations, the classical acid precipitation method can also be applied to measure the concentrations of HA and FA in mixtures when their concentrations are not too low. The SEC method performs very well in resolving unfractionated HA and FA in their mixtures, but cannot be recommended in quantifying the concentrations of fractionated HA and FA.

† Liping Weng,
E-mail: liping.weng@wur.nl
†Wenfeng Tan,
E-mail: tanwf@mail.hzau.edu.cn

Effects of Nanobubble Water on the biomass accumulation and Antioxidative Activities of Polysaccharides from Mycelium of *Cordyceps militaris*

○Long Xiao, Shuang Sun, Xiaoshuai Li, Zhenya Zhang†, Zhongfang Lei, Kazuya Shimizu

(Graduate School of Life and Environmental Sciences, University of Tsukuba)

Cordyceps militaries is a traditional medicine, which is widely distributed in some Asian countries. The polysaccharide of *Cordyceps militaries* has been reported to have beneficial biological activities such as antioxidant, immunomodulatory and antitumor[1]. This research is to cultivate the the polysaccharide of *Cordyceps militaries* by liquid culture. Nanobubble water (NBW) is produced by mixing air in nano-scale with water through the NBW generator[2]. NBW possesses unique physiological properties which has great application potentials in biological fields, especially in animal culture and plant culture[3]. Up to now little information is available on microorganism culture with NBW addition.

This research is the first report to the effects of NBW on C*ordyceps militairs*. The results showed a significant positive effects on biomass accumulation and antioxidant with different ratio of air nanobubble water supplementation. The mycelium from 25% of air NBW group harvest the highest biomass production and highest polysaccharides production. DPPH radical scavenging assay, hydroxy radical inhibition activity assay, reducing power assay and ABTS scavenging activity assay suggest that polysaccharides from 25% and 75% Air-NB groups exhibited higher ability, which were obvious stronger than the control (0%) group. The further activities will be analyzed in the future research.

References

1. Zhang, J., Wen, C., Duan, Y., Zhang, H., Ma, H. (2019). Advance in *Cordyceps militaris* (Linn) Link polysaccharides: Isolation, structure, and bioactivities: A review. *International Journal of Biological Macromolecules*, 132, 906-914.
2. Gurung, A., Dahl, O., Jansson, K. (2016). The fundamental phenomena of nanobubbles and their behavior in wastewater treatment technologies. *Geosystem Engineering*, 19, 133-142.
3. Temesgen, t., Bui, T.T., Han, M., Kim, T.I., Park, H. (2017). Micro and nanobubble technologies as a new horizon for water-treatment techniques: A review. *Advances in Colloid and Interface Science*, 246, 40-51.

---

† Zhenya Zhang, Tel/Fax: +81-29-853-4712,

E-mail: zhang.zhenya.fu@u.tsukuba.ac.jp

Synthesis, Sorption Properties and Bioavailability of Magnetite–Activated Carbon Nanoparticles

○I. Magomedov†, K. Kydralieva
(Moscow Aviation Institute, National Research University, Moscow, Russia)

In this work, hybrid organomineral sorbents based on activated carbon and magnetite nanoparticles for treatment of technogenic media were obtained. Two approaches were considered in searching for an efficient procedure: X-ray diffraction analysis shows that the major phase of the Fe_3O_4–activated carbon nanocomposites is the phase of Fe_3O_4 nanoparticles irrespective of the synthesis procedure. Comparison of the two procedures for preparing the nanocomposites, performed using examination of the textural characteristics, shows that the *ex situ* procedure is more promising from the viewpoint of these criteria.

The activated carbon coated Fe_3O_4 nanoparticles (Fe_3O_4/AC) were synthesized using a set of approach: (*i*) preliminary synthesis of magnetite nanoparticles (MNPs) by chemical coprecipitation of Fe(II, III) salts followed by introduction of MNPs into AC matrix (*ex situ*) and (*ii*) synthesis of MNPs in the AC matrix (*in situ*) by coprecipitation of Fe(II, III) salts or oxidation of Fe(II) ions. These Fe_3O_4/AC sorbents combine the advantages of nanoparticles and carbon material and can be dispersed directly in water samples to extract analytes, then collected and eluted with a magnet, which avoids time-consuming column passing. Microstructure (content of stoichiometric magnetite, crystalline size), specific surface area and adsorption capacity of AC-MNPs towards Pb (II) varied with synthesis route. According to magnetic characteristics, the AC-MNPs revealed their ferromagnetic behavior at room temperature and a regular decrease in H_C with a decrease in the content of the MNPs in the order Fe_3O_4 > Fe_3O_4/AC-*in situ* > Fe_3O_4/AC-*ex situ*. The results of biological testing demonstrate relatively low bioavailability of the nanocomposite to *Scenedesmus quadricauda* microalgae and a more pronounced biocidal effect with respect to *Paramecium caudatum* ciliates.

† Igor Magomedov, Tel: +7-967-247-04-10,
E-mail: eaua2@yandex.ru

Aggregation and aggregate strength of natural organic matter: effects of hydrophobicity and solution pH

Azizul Hakim[1] and Motoyoshi Kobayashi[2]
[1] Department of Soil Science, University of Chittagong, Bangladesh
[2]Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

Humic colloids are natural organic matter (NOM) present in soil and water environments. The aggregation of NOM, their aggregate size and aggregate strength are important parameters to evaluate the pollutants removal, ion bindings, and the fate transport of ions and pollutants in soil and water bodies. We considered humic substances as NOM. The size of NOM aggregates depends on the strength of NOM aggregates in the flow field and affects the transport of common soil ion and pollutants in porous media. We found the dominant effect of hydrophobic interaction and NOM hydrophobicity on the aggregation and aggregate strength of NOM in a wide range of pH.

References

1. Azizul Hakim & Motoyoshi Kobayashi (2018). Colloids and Surfaces A: Physicochemical and Engineering Aspects, Volume 540, 1-10
2. Azizul Hakim, Tomoharu Suzuki, & Motoyoshi Kobayashi (2019), ACS Omega, 4, 5, 8559-8567
3. Azizul Hakim, & Motoyoshi Kobayashi (2019). Colloids and Surfaces A: Physicochemical and Engineering Aspects, Volume 577, 175-185

Tel: +88-01309915356

E-mail: ahakimsoil@cu.ac.bd

Enhanced catalytic activity of OMS-2 nanomaterial for benzene degradation by tuning Sr^{2+} contents in the tunnels

Chunlan Ni[†], Jingtao Hou*[†], Wenfeng Tan[†]
([†]College of Resources and Environment, Huazhong Agricultural University)

Cryptomelane-type manganese oxides (OMS-2) nanorods have been intensively investigated for application in the degradation of organic compounds, and doping metal ions into the OMS-2 nanoparticle are a common way to modifying its performance[1, 2]. In this study, we reported a novel strategy to enhancing catalytic activity of OMS-2 for benzene elimination by tuning Sr^{2+} concentration in the tunnels[3]. An obvious decrease ($\triangle T_{50}$ = 27ºC and $\triangle T_{90}$ = 37ºC) in degradation temperature T_{50} and T_{90} (corresponding to benzene conversions at 50% and 90%, respectively) was observed. The origin of Sr^{2+} doping positive effect on degradation activity was theoretically and experimentally investigated by CO temperature-programmed reduction, $^{18}O_2$ isotope labeling, and density functional theory calculations. The result confirmed that increasing Sr^{2+} concentration in the OMS-2 nanomaterial not only promoted the lattice oxygen activity, but also facilitated the generation of more oxygen vacancy defects, thus considerably promoting the degradation performance of this nanomaterial.

References

1. Chen, Y.; Huang, Z.; Zhou, M.; Ma, Z.; Chen, J.; Tang, X., Single Silver Adatoms on Nanostructured Manganese Oxide Surfaces: Boosting Oxygen Activation for Benzene Abatement. Environmental science & technology 2017, 51, (4), 2304-2311.
2. Liu, J.; Makwana, V.; Cai, J.; Sui, S. L.; Aindow, M., Effects of alkali metal and ammonium cation templates on nanofibrous cryptomelane-type manganese oxide octahedral molecular sieves (OMS-2). Journal of Physical Chemistry B 2003, 107, (35), 9185-9194.
3. Ni, C. L.; Hou, J. T.; Li, L.; Li, Y. Z.; Wang, M. X.; Yin, H.; Tan, W. F., The remarkable effect of alkali earth metal ion on the catalytic activity of OMS-2 for benzene oxidation. *Chemosphere* **2020,** *250*, 10.

---

*Jingtao Hou (Corresponding author), E-mail: jthou@mail.hzau.edu.cn

Hydrothermal Carbonization of Sewage Sludge: Effect of Distillers Grains as Additive on Properties and Combustion Behavior of Produced Hydrochar

○Chang Liu , Jiamin Zhao, Zhongfang Lei, Kazuya Shimizu, Zhenya Zhang†
(Graduate School of Life and Environmental Sciences, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8572, Japan)

This study applied hydrothermal carbonization (HTC) to treat primary sludge with the addition of distillers grains and examined the properties of produced hydrochar as solid fuels. The co-HTC experiments were carried out at 180°C for 30 min with different mixing ratios of distillers grains to primary sludge (17:83, 25:75, 33:67, and 40:60, wet weight). The produced hydrochar was found to have increased higher heating value (HHV) and fixed carbon (FC) with the increase in mixing ratio, about 16% higher HHV and 4% higher FC at the mixing ratio of 40:60 when compared to the control (produced hydrochar without additive addition). The hydochars with lower ash and higher FC contents under distillers grains addition are more promising for being utilized as clean solid fuel. In addition, under the addition of distillers grains to HTC of primary sludge, the dewatered sludge contained 4-6% lower moisture content signaling its better dewaterability compared to the control. The process water rich in organic substances such as proteins and polysaccharides could be used as carbon source supplement for sewage treatment units or for energy recovery. Thus, use of distillers grains as additive for HTC of sewage sludge may realize energy self-sufficiency in wastewater treatment plants.

---

†Zhenya Zhang, Tel: +81-29-853-4712,
E-mail: zhang.zhenya.fu@u.tsukuba.ac.jp

BIOCHEMICAL METHANE POTENTIAL (BMP) FROM THE ANAEROBIC DIGESTION OF FOOD WASTE

○Vahtsshalaa Punnyaswaran*, Mohamed Abdulrahman Al-same*†, Masafumi Goto*,
(*Malaysia-Japan International Institute of Technology, University Technology Malaysia, Kuala Lumpur, Malaysia)

Food Waste (FW) is generated in huge quantities worldwide. Due to its high COD content and unpleasant characteristics such as bad smell, the improper disposal of FW can cause serious environmental problems. Anaerobic Digestion (AD) is one of the key technologies with the potential to treat FW and produce renewable energy. In this study, Biochemical Methane Potential (BMP) tests for FW under mesophilic conditions using serum bottles[1] of 250 L were conducted to study the effects of Food to Microorganisms ratio (F/M) variations on the bio-methane yield and production. The tests were carried out for two types of food wastes at 3 different F/M (0.5, 1.0, and 2.0). The findings showed that AD of FW at F/M = 0.5 was thee most economic and efficient. In addition, increasing the F/M ratio by double increased the methane yield by 13 % only. Moreover, for both types of FW, when increasing the F/M from 0.5 to 2.0, no significant improvement in methane yield was observed. It was concluded that higher organic loadings led to a slightly prolonged lag phase, and this phenomenon was more obvious as the F/M ratio increased. This phenomenon happens because VFA accumulates as a result of the high organic loading and leads to acidification inside reactor.[2,3]

References

1. Hansen, T. L., Schmidt, J. E., Angelidaki, I., Marca, E., la Cour Jansen, J., Mosbæk, H., et al. (2004). Waste Management, 24(4), 393-400.
2. Hospido, Almudena, Teresa Moreira, María Martín, Miquel Rigola, and Gumersindo Feijoo. 2005. 'Environmental evaluation of different treatment processes for sludge from urban wastewater treatments: Anaerobic digestion versus thermal processes (10 pp)', The International Journal of Life Cycle Assessment, 10: 336-45
3. Vavilin, VA, and Irini Angelidaki. 2005. 'Anaerobic degradation of solid material: importance of initiation centers for methanogenesis, mixing intensity, and 2D distributed model', Biotechnology and bioengineering, 89: 113-22.

---

† Mohamed Abdulrahman Al-samet (Corresponding author), Tel: +60-11-28854870,
E-mail: alsamet.mohammed@gmail.com

Agents for sludge dewatering in fundamental research and applied research: A bibliometric analysis

○Gengping Zhang[a], Qi Shi[b], Qiannan Li[a], Hongtao Wang[b]*†

([a] Tongji University Library, Tongji University, 1239 Siping Road, Shanghai, 20092, China, [b] College of Environmental Science and Engineering, UNEP-TONGJI Institute of Environment for Sustainable Development, Tongji University, Siping Rd 1239, Shanghai, 200092, China)

Here we present a quantitative analysis based on a total of 338 (out of 1126) core papers from Web of Science Expanded and 961 (out of 4678) core patents from Derwent Innovation to provide valuable suggestions that may promote further development in the field of sludge dewatering agents. The core point is to explore the relationship between fundamental research and applied research in the field of sludge dewatering agents through citation, characteristics of different countries/regions, collaborations of research area and organizations. Our results underline that highly cited papers support applied research by citating information among them. Japan paid more attention to applied research, whereas the USA performed well both in fundamental research and applied research. China has high quantity in both papers and patents in agents for sludge dewatering. The unique development path revealed that developing countries still have a long way to go in terms of technology innovation. Collaboration network of research areas has shown strong cooperation among applied researches, however they lack connection with fundamental sciences, such as physics or chemistry. Furthermore, collaboration network of organizations disclosed the necessity for upstream enterprises (agent producers) to work closely with downstream enterprises (agent users) in the sludge dewatering.

---

† Hongtao Wang, Tel: +86-21-65978598,
Fax: +86-21-65985059, E-mail: hongtao@tongji.edu.cn

Preparation of A Novel Sludge-derived Biochar by K_2FeO_4 Conditioning to Enhance the Removal of Pb^{2+}

○Junsen Wang, Tianrun Wang, Qinyun Zhu, Shike Zhang, Qi Shi, Hongtao Wang*, †
(College of Environmental Science and Engineering, Tongji University, NO.1239, Siping Road, Shanghai 200092, China)

In this study, three types of sludge-based biochar BC1, BC2 and BC3 was prepared by (1) raw sludge, (2) sludge after K_2FeO_4 conditioning, and (3) sludge after acidification + K_2FeO_4 conditioning. The results show that BC2 and BC3 have more functional groups, and their Pb^{2+} removal effect and acid-resistance are also greatly enhanced. At pH 3, BC3 can effectively remove 100 mg/L Pb^{2+}. The concentration of Pb^{2+} in the effluent was not detected by ICP-MS (<0.06 μg/L). Most of the Pb^{2+} adsorbed by biochar was in the form of Iron Oxide, which had a high adsorption stability. Through ion exchange measurement and functional group blocking experiments, it was found that the removal mechanism of Pb^{2+} by biochar mainly included ion exchange with Ca^{2+} and Mg^{2+} on the surface of biochar, complexation of free -OH or -COOH functional groups[1], and other effects such as surface chemical precipitation or physical adsorption.[2] By comparing the results of BC1, BC2 and BC3, the fundamental reason for the significant improvement of adsorption effect was the increasing in functional groups and surface active sites.[3]

References

1. Costa J, Vilar V J P, Botelho C M S, et al.（2010). Application of the Nernst-Planck approach to lead ion exchange in Ca-loaded Pelvetia canaliculata [J]. *Water Res*, *44*(13): 3946-3958.
2. Lu H L, Zhang W H, Yang Y X, et al. (2012). Relative distribution of Pb^{2+} sorption mechanisms by sludge-derived biochar [J]. *Water Res*, *46*(3): 854 - 862.
3. Swiatkowski A, Pakula M, Biniak S, Walczyk M. (2004). Influence of the surface chemistry of modified activated carbon on its electrochemical behaviour in the presence of lead(II) ions. *Carbon 42*, 3057 - 69

---

† Hongtao Wang, Tel: + 86-21-65978598,
Fax: +86-21-65985059, E-mail: hongtao@tongji.edu.cn