



**Indian Institute of Technology Delhi**  
**DEPARTMENT OF BIOCHEMICAL ENGINEERING & BIOTECHNOLOGY**

**2017-18 Seminar Series**

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***Metal-microbe interactions - relevance in the environmental context***

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Metals are dual edged sword – on one hand their importance in the growth of human civilization cannot be exaggerated while on the other hand their excess presence, sometimes even in  $\mu\text{g/L}$  concentrations in the water, is toxic to the environment. Thus, understanding their behavior in the relevant systems and devising their recovery methods is important.

Microorganisms can affect the mobility and toxicity of the metals and can determine their fate in the engineered and environmental systems. With this knowledge, microorganisms were exploited to carry out leaching of metals, for instance, microbial oxidation of sulfur to produce sulfuric acid lead to release of heavy metals from the waste sludge and this is helpful in the stabilization of the sludge. Similarly, microorganisms also produces ligands that are highly selective towards metals ions which can be used for the recovery of metals from the wastewaters. Further, microorganisms can reduce metal/metalloid ions and can change their solubility. For e.g. microorganisms reduces selenium oxyanions to produce biogenic elemental selenium nanoparticles. This phenomenon reduces the dissolved toxic selenium concentration from the wastewaters but increases the colloidal selenium concentration in the wastewaters. Normally, colloidal particles would settle down in the absence of coating agents, however, extracellular substances produced by the micro- organisms provide them the colloidal stability, thus affecting their fate in the environment and engineered systems. However, all is not known about the metal-microbe interaction and there are many gaps in our knowledge that needs to be fulfilled for deepening the understanding of fate of metals in engineered and environmental systems. This understanding help to develop effective technologies for removing metal contaminations as well as recovery of metals.

**All are welcome**

**Seminar will be held in DBEB SEMINAR ROOM at Block I, Room 232 at 4 PM**  
**For additional information, contact Seminar coordinator D. Sundar at [sundar@dbeb.iitd.ac.in](mailto:sundar@dbeb.iitd.ac.in)**

**ROHAN JAIN****Address:** Hertelstrasse, 19, Dresden, Germany**Nationality** - Indian**Residence status** - German blue card**Marital status** - Married**Phone:** +49(0) 15215283908 **Email:** [rohanjain.iitd@gmail.com](mailto:rohanjain.iitd@gmail.com)**DOB:** 8<sup>th</sup> Dec, 1983**Language skills:** English, Hindi, French (A1)**RESEARCH and TEACHING EXPERIENCE****Marie-Curie Post-doctoral fellow**, Dr. Katrin Pollmann, HZDR, Dresden, **Germany (Oct, 2016 – till now)**

- **Production** of highly selective siderophores based biosorptive biocomposites for the **recovery** of Ga from industrial wastewater
- **Cost-benefit analysis** of the developed technology
- Extension of the developed technology for the other **critical elements such as lanthanides**
- Successful submission of project grant to **Indo-German Science and Technology Centre** for funding of a project based on developed biosorptive biocomposites
- **Co-supervision** of a PhD student on fate of selenium nanoparticle

**Post-doctoral**, Prof. Piet Lens, TUT, Tampere, **Finland (Aug, 2015 – Sep, 2016)**

- Understanding the **transformation** of biogenic amorphous trigonal selenium nanospheres (composed of Se<sub>8</sub> rings) to trigonal selenium nanowires (composed of helical Se chains)
- Identification the **different properties** of biogenic Se nanospheres and nanowires which would impact their **bioremediation effectiveness** and **fate in the environment**
- **Removal** and **recovery** of uranium by adsorption onto **waste activated sludge** and its subsequent desorption
- **Co-supervision** of a PhD student for removal of **furfural** from condensate oil by **torrefied biomass**
- **Invited lecture presentation on the Nanotechnology course** at IHE-Delft, 2016

**Visiting-researcher**, Dr. Harald Foerstendorf and Prof. Satoru Tsushima, HZDR, Dresden, **Germany (May, 2015 - Jul, 2015, 3 months)**

- **Quantum and molecular modeling** to understand the interaction of single amino acids, peptides and full length protein with elemental selenium nanoparticles composed of Se<sub>8</sub> rings and helical-Se chains

**PhD research**, Prof. Piet N. L. Lens, UNESCO-IHE, Delft; Prof. Eric D van Hullebusch, UPEM, Paris; Prof. François Farges, MNHN, Paris (**Nov, 2011 - Dec, 2014**)

- Understanding the **fate of selenium** in the environment and bioreactors by evaluating the **colloidal stability** of biogenic elemental selenium nanoparticles (BioSeNPs)
- Understanding the reduction of selenium oxyanions and production of BioSeNPs in anaerobic reactors at **different temperatures**
- Understanding the reduction of selenium oxyanions and production of BioSeNPs in **aerobic reactors** and observing the effect of BioSeNPs on **activated sludge properties**
- Demonstrated that the BioSeNPs could preferentially adsorb Cu from **metal mixture of Cu+Cd+Zn**

**Internship student** - Prof. Alfonso Jaramillo, ISSB, Evry-Genopole, **France (Sep, 2010 - Jul, 2011)**

- **Linked** the red fluorescent protein (RFP) with the zinc finger protein (ZFP) using latest **cloning methods**
- **Characterized** the promoters with sequence of ZFP linked with RFP using **fluorimeter and flow cytometer**.

**Master Thesis** - Prof. T R Sreekrishnan, IIT Delhi, New Delhi, **India (Jul, 2007 - Jul, 2008)**

- **Developed two-stage reactor** system for **lowering total solid contents** and enhancing metal **bioleaching** from waste activated sludge using autoheated thermophilic aerobic conditions (first-stage) and the CSTR reactor under mesophilic conditions & pH 1.6 (second-stage)

## EDUCATION

- **PhD**, Erasmus Mundus Joint Doctorate programme, UNESCO-IHE, Delft, **The Netherlands**, UPEM, Marne-La-Vallée, **France**; MNHN, Paris, **France (Nov, 2011 - Dec, 2014)**
- **Dual degree (Bachelor and Master of Technology)**, Indian Institute of Technology, Delhi, India (**Jul, 2003 - Aug, 2008**), **CGPA: 7.3/10**

## PROFESSIONAL/ACADEMIC ACHIEVEMENTS

- **First prize** on the technology submitted for the HZDR innovation challenge
- Successful project proposal as a Co-Principal Investigator to **Indo-German Science and Technology Centre** for funding of 450,000 Euros and 230 Lac to German and Indian partners respectively.
- Awarded **Marie-Curie Individual Fellowship Grant (score 95.8)** for pursuing post-doctoral research at HZDR, Dresden
- **Awarded twice** the short term scientific mobility scholarship from **Cost Action ES1302** for 1 and 2.5 months research stay in HZDR, Dresden, **Germany**
- Awarded twice the scholarship to carry out XAS measurements at **Dubble beam line** at ESRF, Grenoble, **France** by **NWO**
- Awarded **Erasmus Mundus** fellowship by **European Commission** to pursue PhD in **ETeCoS<sup>3</sup> program**
- All India Rank of 1078 in **JEE, 2003**

## MENTORING

- Successfully supervised **four master students** during the course of my PhD from 2011 - 2014 with whom we have published **five research articles**
- Co-supervising **one PhD students**

## SELECTED ORAL PRESENTATION

- **Title:** Adsorption of zinc by biogenic elemental selenium nanoparticles; Presented at the **biobased economy conference** organized by Sense school in Den Haag, The Netherlands, Oct, 2012.
- **Title:** Microbial production of selenium nanoparticles; Presented at at proceeding of the **3<sup>rd</sup> International Conference on Research Frontiers in Chalcogen Cycle Science & Technology** in Delft, The Netherlands, Jul, 2013.
- **Title:** Extracellular polymeric substances govern the surface charge of biogenic elemental selenium nanoparticles; Presented at Selen, 2014 conference in Karlsruhe, Germany, Oct, 2014.

## WORK EXPERIENCE (Non-scientific)

**Consultant, Kinapse India Pvt. Limited, Gurgaon (Aug, 2008 - Jul, 2010, 24 months)**

- **Job description:** Providing **management consulting support** to the R&D divisions of Merck Serono, GSK, Pfizer and GE Healthcare
- Worked mainly in domains of **Operational Excellence, Market Access, Resource Management and Change Management**

## RECOMMENDATIONS

- **Prof. Eric D van Hullebusch**, IHE-Delft, Delft, The Netherlands
- **Dr. Katrin Pollmann**, HZDR, Dresden, Germany
- **Dr. Norbert Jordan**, HZDR, Dresden, Germany
- **Prof. Piet Lens**, IHE-Delft, Delft, The Netherlands and TUT, Tampere, Finland
- **Prof. T R Srekrishnan**, IIT Delhi, New Delhi, India

## EXTRACURRICULAR

- 1) Enjoy traveling to different countries and exploring the culture
- 2) Playing and watching sports particularly cricket and tennis
- 3) Enjoy cooking and trying out different cuisines

## Publications

### Peer-reviewed published articles

1. T.R.K.C. Doddapaneni\*, **R. Jain**, P. K. Ramasamy, J. Rintala, H. Romar, J. Konttinen, Adsorption of furfural from torrefaction condensate using torrefied biomass, *Chem. Eng. J.* 334 (2017) 558–568, (Impact factor 6.216).
2. **R. Jain\***, F. Cirina, P. Kaden, K. Pollmann, Investigation of the Ga Complexation Behaviour of the Siderophore Desferrioxamine B, *Solid State Phenomena* (2017) 262, 643-646 (Impact Factor 0.38)
3. **R. Jain\***, N. Jordan, S. Tsushima, R. Hübner, S. Weiss, P. Lens, Shape change of biogenic elemental selenium nanoparticles from nanospheres to nanorods decreases their colloidal stability, *Environ. Sci. Nano.* (2017). 4, 1054-1063, (Impact factor 6.09).
4. P. Dessi, **R. Jain\***, S. Singh, M. Seder-Colomina, E.D. van Hullebusch, E.R. Rene, S.Z. Ahammad, A. Carucci, P.N.L. Lens, Effect of temperature on selenium removal from wastewater by UASB reactors, *Water Res.* 94 (2016) 146–154, (Impact factor 6.942).
5. **R. Jain\***, D. Dominic, N. Jordan, E.R. Rene, S. Weiss, D. van Hullebusch, Eric, R. Hubner, P.N.L. Lens, Preferential adsorption of Cu in a multi-metal mixture onto biogenic elemental selenium nanoparticles, *Chem. Eng. J.* 284 (2016) 917–925, (Impact factor 6.216).
6. A. Spataru, **R. Jain\***, J.W. Chung, G. Gerner, R. Krebs, P.N.L. Lens, Enhanced adsorption of orthophosphate and copper onto hydrochar derived from sewage sludge by KOH activation, *RSC Adv.* 6 (2016) 101827–101834, (Impact factor 3.108).
7. **R. Jain\***, D. Dominic, N. Jordan, E.R. Rene, S. Weiss, E.D. van Hullebusch, R. Hübner, P.N.L. Lens, Higher Cd adsorption on biogenic elemental selenium nanoparticles, *Environ. Chem. Lett.* 14 (2016) 381–386, (Impact factor 3.594).
8. **R. Jain\***, S. Matassa, S. Singh, E.D. van Hullebusch, G. Esposito, P.N.L. Lens, Reduction of selenite to elemental selenium nanoparticles by activated sludge, *Environ. Sci. Pollut. Res.* 23 (2016) 1193–1202, (Impact factor 2.741).
9. E.J. Espinosa-Ortiz\*, M. Shakya, **R. Jain**, E.R. Rene, E.D. van Hullebusch, P.N.L. Lens, Sorption of zinc onto elemental selenium nanoparticles immobilized in *Phanerochaete chrysosporium* pellets, *Environ. Sci. Pollut. Res.* 23 (2016) 21619–21630, (Impact factor 2.741).
10. E.D. van Hullebusch\*, G. Guibaud, S. Simon, M. Lenz, S.S. Yekta, F.G. Feroso, **R. Jain**, L. Duyster, J. Roussel, E. Guillon, U. Skjellberg, C.M.R. Almeida, Y. Pechaud, M. Garuti, L. Frunzo, G. Esposito, C. Carliell-Marquet, M. Ortner, G. Collins, Methodological approaches for fractionation and speciation to estimate trace element bioavailability in engineered anaerobic digestion ecosystems: An overview., *Crit. Rev. Environ. Sci. Technol.* 46 (2016) 1324–1366, (Impact factor 5.790).
11. **R. Jain\***, N. Jordan, S. Weiss, H. Foerstendorf, K. Heim, R. Kacker, R. Hübner, H. Kramer, E.D. van Hullebusch, F. Farges, P.N.L. Lens, Extracellular Polymeric Substances Govern the Surface Charge of Biogenic Elemental Selenium Nanoparticles, *Environ. Sci. Technol.* 49 (2015) 1713–1720, (Impact factor 6.198).
12. **R. Jain\***, N. Jordan, D. Schild, E.D. van Hullebusch, S. Weiss, C. Franzen, F. Farges, R. Hübner, P.N.L. Lens, Adsorption of zinc by biogenic elemental selenium nanoparticles, *Chem. Eng. J.* 260 (2015) 855–863 (Impact factor 6.216).
13. **R. Jain\***, M. Seder-Colomina, N. Jordan, P. Dessi, J. Cosmidis, E.D. van Hullebusch, S. Weiss, F. Farges, P.N.L. Lens, Entrapped elemental selenium nanoparticles affect physicochemical properties of selenium fed activated sludge, *J. Hazard. Mater.* 295 (2015) 193–200, (Impact factor 6.065).
14. Dutta\*, Y. Diao, **R. Jain**, E.R. Rene, S. Dutta, Adsorption of cadmium from aqueous solution onto coffee grounds and wheat straw: Equilibrium and kinetic study, *J. Environ. Eng.* (2015), (Impact factor 1.541).

15. M. Sethurajan\*, D. Huguenot, **R. Jain**, P.N.L. Lens, H.A. Horn, L.H.A. Figueiredo, E.D. van Hullebusch, Leaching and selective zinc recovery from acidic leachates of zinc metallurgical leach residues, *J. Hazard. Mater.* 324 (2015) 71–82, (Impact factor 6.065).
16. V. Singh\*, D.K. Chaudhary, I. Mani, **R. Jain**, B.N. Mishra, Development of diagnostic and vaccine markers through cloning, expression, and regulation of putative virulence-protein-encoding genes of *Aeromonas hydrophila*., *J. Microbiol.* 51 (2013) 275–82, (Impact factor 2.268).
17. **R. Jain\***, A. Pathak, T.R. Sreekrishnan, M.G. Dastidar, Autoheated thermophilic aerobic sludge digestion and metal bioleaching in a two-stage reactor system, *J. Environ. Sci.* 22 (2010) 230–236, (Impact factor 2.937).

#### **Book chapters**

1. **R. Jain**, G. Gonzalez-Gil, V. Singh, D. van Hullebusch, Eric, F. Farges, P.N.L. Lens\*, Biogenic selenium nanoparticles : production , characterization and challenges, in: A. Kumar, N. Govil, J (Eds.), *Nanobiotechnology*, Studium Press LLC, USA, 2014: pp. 361–390.
2. **R. Jain**, E.D. van Hullebusch\*, M. Lenz, F. Farges, Understanding selenium biogeochemistry in engineered ecosystems: Transformation and analytical methods, in: E.D. van Hullebusch (Eds), *Bioremediation of Selenium Contaminated Wastewater*. Springer, Cham, 2017, pp. 35-56