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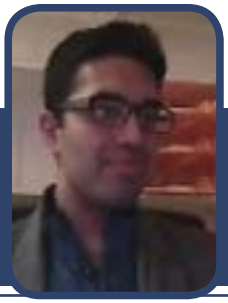

Pratik Desai

Perlemax Ltd., United Kingdom

'Waste Factory' – Microbubble mediated ammonia recovery processes (MMARP)

Ammonia is used ubiquitously and underpins modern human life and population growth, ever growing in volumes of use and within waste produced. With 250MT produced per annum, over 2% of the world's total energy output is used for ammonia production. Less than 2mgL-1 is harmful to flora and fauna but most waste streams contain between 500 mgL-1-4000mgL-1 making this pernicious chemical highly problematic to deal with it. Physico-chemical processes recover ammonia but are not highly effective in terms of efficiencies and either have limited operating ranges or high operating/capital expenditures. They might also require further downstream processing. Desai and Zimmerman, with their team, developed a novel approach – microbubble stripping – via hot microbubble injection in thin liquid layers. The process is able to reduce the ammonia concentration 300 times faster than conventional stripping (industrial benchmark) and has several unique features including the ability to strip ammonia at a pH of less than 8 as well as increasing the optical transparency of the remnant liquor. Desai and Zimmerman using this as a primary processing step were then able to design an entire waste factory basing it on a cascading circular economy approach and demonstrate these on a larger than lab scale. The approach uses a combination of physical chemistry (to remove ammonia), biotechnology (microbial algal communities to selectively target BOD/COD and heavy metal ion removal) and reactive separation of the waste ammonia to upgrade it into tuneable salts of ammonia carbamate and carbonate. The key feature of this entire cycle is that what was once a liability, costing approximately £10-£20 per m3 to treat, is now generating a revenue and waste heat, upto £5-£15 per m3 depending on the selected products. This process is proven on the lab scale and larger than lab scale (10m3 per day) and will be scaled up for an on site process to be implemented, scheduled in 2020, for 80-100m3 per day plant (typical size of leachate lagoon – 50 -100m3 per day) . Figure 1 shows the process cycle.

Biography

Pratik Desai is the R&I Director of Perlemax Ltd., MEng (1st hons) Chemical Engineering w Fuel technology, PhD in Chemical Engineering. He has expertise in microbubble generation, fluidics, is a co-inventor of Desai-Zimmerman Fluidic Oscillator (for generating microbubbles), and has led pioneering work on hot microbubble injection in thin liquid layers including scale up. Pratik has extensive experience in microbubble generation, visualisation, fluid dynamics, non-equilibrium thermodynamics and associated phenomena, fluidics and reaction catalysis. He has worked on/working on lab scale and scale up of 5 different pilot plant processes developing several new technologies. He has designed disruptive solutions to conventional unit operations (microbubble distiller/condenser, microbubble stripper, and microbubble sorption) and translated them from blue-sky research ideas to POC and pilot scale within 2 years. He has also managed several projects and led technical innovations including implementation of microbubbles for ammonia-water- carbon dioxide reaction dynamics and catalysis, bioethanol production and separation, bioreactor design, bagged microbial reactors, fermenters, aquaculture, anaerobic digestion enhancement, foam dynamics, CO2 capture and sequestration–with Ionic liquids, MEA, and mineral carbonation, biodiesel production, micro/nanobubble drug delivery and WWA-self actuated wastewater aeration unit. He has also worked on microbial and algal based engineered communities in order to selectively uptake heavy metal ions from waste streams as well as algal growth and bioreactor development. Following on that, he is working on the 'Waste Factory'- a concept developed by him and Professor Zimmerman which works towards a cascading circular economy approach in order to remediate waste and generate products; converting liabilities and remediating the waste streams into valorised products and energy-'Waste Factory'-DZ MMARP. He has demonstrated each process in this cycle on the lab scale as a PoC and is leading a £3.8Mn application with academic and industrial partners in the UK and India. He is sole inventor of an energy efficient micro/nanodroplet generation method and a novel gas enrichment processing solution. He is lead technologist/lead/co-lead on grants/projects totaling £6.1Mn (overall £13.4Mn). He has successfully run an internship scheme with over 200 members comprising of assistant professors, postdoctoral researchers, doctoral candidates, process engineers, M level, and UG students from across the world. He has consulted/consulting over 45 industrial collaborators/industrial projects. He was a finalist for the IChemE Global Awards 2017 for the Young Researcher Award. His project on Anaerobic Digestion with biogas sweetening is a finalist for the ADBA global awards for best research project and has been highly commended.

pratik@perlemax.com