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The multistage vertical bioreactor in water engineering: Ammonia and phosphorous compounds removal from contaminated water

The availability of water quality and quantity is facing an unprecedented crisis created by explosive demographic growth and overuse hence urban and industrial scarcity, limited construction surface and increasing chemical complexity of contaminants, like nutrients, microplastics, endocrine disruptors, etc. Contaminated water is defined here as water not suited for direct human consumption or industrial utilization whose composition has deleterious effects on either human health or the environment. The recovery of water for human utilization presents an unprecedented challenge. That recovery demands effective reactors, of reduced power consumption, demanding little construction surface for retrofitting and refurbishing. Historical records show that contaminated water has been treated to achieve potability for thousands of years. The treatment was only physical (sand filtration) but in more recent times contaminated water has been treated chemically and biologically, or the physical treatment has become more complex. Planar bioreactors (often called aeration tanks) of circular or rectangular cross section have been the first choice for water engineers. Furthermore, in the last few decades, the kinetics of the processes, the control and instrumentation, and the reactor design of the biochemical reactors involved have become more precise and sophisticated. The purpose of this presentation is to describe the STAR process including the application of the Multistage Vertical Bioreactor (USA Patent 8,585,900 B2) to the elimination of nutrients in contaminated water. This bioreactor developed in the Department of Chemical Engineering of Ryerson University (Canada), offers powerful features associated to its performance removal, construction materials, reduced planar construction space, geometry and modular configuration. The simultaneous removal of both ammonia and total phosphorous exceeds 93% for each contaminant. Two abundant microbial groups (unidentified species) and *Zoogloea* are responsible for the simultaneous removal of ammonia and total phosphorous in the process.

Biography

Alvarez Cuenca is a Professor of Chemical Engineering and Director of the Water Technologies Laboratory at Ryerson University (Toronto, Canada). He holds a BEng (Chemical Engineering) from the Universidad Politecnica de Madrid, and an MSc and a PhD in Physics and Chemical Engineering respectively from the University of Western Ontario (Canada). He adds to his curriculum over 15 years of industrial experience with multinational corporations in the areas of fluidized bed reactors, bioreactor design, water treatment and clean power generation. In 2002, he founded Ecotechnos Inc., a company devoted to the design and construction of advanced bioreactors for the treatment of industrial wastewater including nitrogen and phosphorous removal. He is an active consultant for both, government and the private sectors in Canada, Spain and Ibero-America in the areas of water treatment, and energy. His academic record spans over three decades with universities in Europe, Canada, and South America, including Ryerson University, U. of Western Ontario, U. of Waterloo, U. of Guelph, U. of Windsor, U. Politécnica de Madrid (Spain), Universidad Nacional de Colombia (Colombia), U. de Cartagena de Indias (Colombia), Corporacion Universitaria de la Costa (Colombia).

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