<RECWET Special Seminar Series #23>

Paradigm Shift for Biofouling Control & Energy Savings in MBR: *Bacterial Quorum Quenching*

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Faculty of Engineering, University of Tokyo, Hongo Campus

http://www.recwet.t.u-tokyo.ac.jp/e/symposium_e.html

Membrane Bioreactor (MBR) is an enhanced method for municipal and industrial wastewater treatment that provides treated water of better quality with a small footprint. However, MBR is still suffering from membrane fouling. There has been a huge amount of research effort attempting fouling problem through engineering, materials, and chemical approaches. However, each attempt has some limitation because membrane biofouling is a natural biological process.

In 2002, Lee's group at Seoul National University harbored the idea of a revolutionary anti-biofouling strategy that quorum sensing (QS), i.e., cell-to-cell communication between microorganisms using signal molecules to regulate group behaviors such as biofilm formation, might be closely associated with the chronic problem of biofouling in MBRs. In 2005, they successfully detected signal molecules, N-acyl homoserine lactones (AHLs), in a lab-scale MBR for wastewater treatment. Furthermore, they observed that the enzymatic decomposition of extremely minute amounts of signal molecules significantly mitigated biofouling, even in a mixed-culture MBR in which hundreds of different species coexist.

Over last seven years since the first paper on this issue was published in 2009, they went on to demonstrate the effectiveness of QQ-MBR in a series of laboratory and field experiments. As a result, great progress in QQ-MBR has been made toward its practical application in terms of various factors as shown in Figure 1. At present, QQ-MBRs in pilot- & test bed-scales have been installed and being operated to demonstrate its effectiveness at municipal wastewater treatment plants, waiting for its ultimate destination of commercial deployment. In this presentation, each step in the historical development of QQ-MBR will be examined including economical analysis of QQ-MBR in comparison with conventional-MBR.

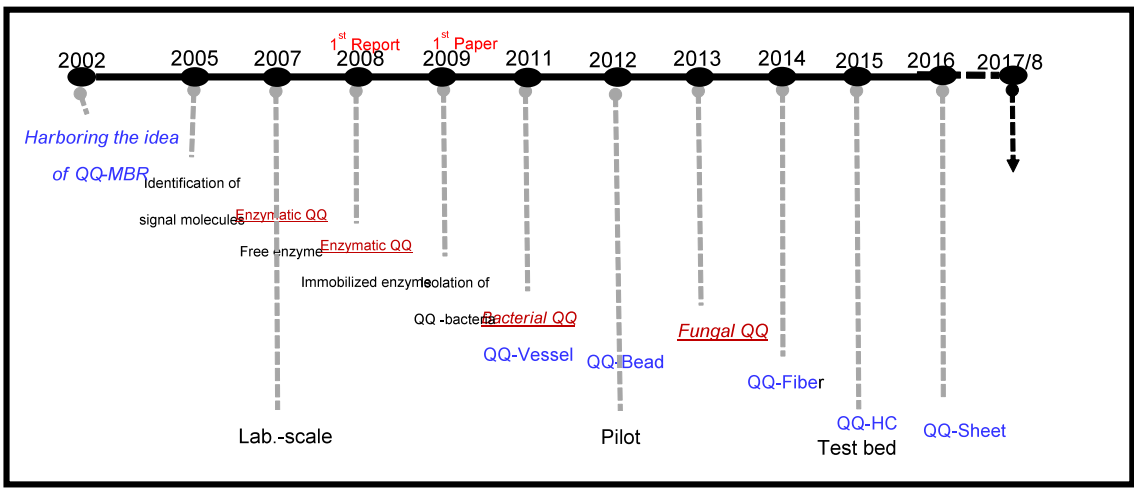

Figure 1. Evolution of Quorum Quenching MBR.

Chung-Hak Lee

Dr. Chung-Hak Lee has been Professor at School of Chemical & Biological Engineering, Seoul National University, South Korea (1989 ~ 2017) and is presently Professor Emeritus, Seoul National University.

He received PhD in Environmental Engineering from INSA de Toulouse, France in 1980. He is a Senior Fellow of the International Water Association. He had been chairman for Membrane Technology Specialist Group from 2010 to 2013. He devoted himself to the development of membrane-based innovative water/wastewater technologies, focusing on the analysis and control of membrane fouling. He published more than 150 peer reviewed papers almost in the area of membrane technology.

Particularly, he opened a new horizon to biofouling control and energy savings in membrane processes through linking molecular biology (Quorum Quenching) and engineering science in the field of water and wastewater treatment. Since 2009, the so-called 'QQ-MBR' has been propagating wider and wider into academic and industrial sectors as well. His work on QQ-MBR has been notified in '*Science* (editor's choice)' and '*Nature* (technology feature)'.