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Title: Determining the Mechanisms for Aerobic Granulation from Mixed Seed of Floccular and Crushed Granules in Activated Sludge Wastewater Treatment

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Abstract: Aerobic granulation is a novel and promising technology for wastewater treatment. However, long start-up periods required for the development of granules from floccular sludge, and the loss of biomass in this period leading to poor nutrient removal performance are key challenges. In a recent study the addition of crushed granules to a floccular sludge significantly reduced the start-up period, and also maintained the nutrient removal performance during granulation. In this study, we examined the mechanisms responsible for the fast granulation from a mixture of floccular and granular sludges. Fluorescent microbead particles (4 μm diameter) were successfully applied to differentially label the surfaces of floccular and crushed granular aggregates. Labelled flocs and crushed granules were added to a laboratory scale wastewater treatment reactor, and the granule formation process was monitored using confocal laser scanning microscopy over an 80 day period. Flocs were observed to attach to the surface of the seeding granules, resulting in reduced biomass washout during granulation. This mechanism not only reduces the granulation period, but also maintains the nutrient removal performance of the reactor. The results indicate that the granules acted as nuclei for floccular particle attachment, which accelerated granule formation.

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To the editor of Water Research

Brisbane, August 20th 2011

Dear editor,

Please find herewith our manuscript entitled "Determining the Mechanisms for Aerobic Granulation from Mixed Seed of Floccular and Crushed Granules in Activated Sludge Wastewater Treatment" which we kindly submit for publication in Water Research. The authors are Marieska Verawaty, Maite Pijuan, Zhiguo Yuan and Philip Bond.

Aerobic granulation is a novel and promising technology for wastewater treatment. However, long start-up periods required for the development of granules from floccular sludge, and the loss of biomass in this period leading to poor nutrient removal performance are key challenges. In a recent study the addition of crushed granules to a floccular sludge significantly reduced the start-up period, and also maintained the nutrient removal performance during granulation. Even though the technology has been developed, the true mechanisms of how the seed mixtures can accelerate the granulation process still poorly understood.

In our manuscript, we examined the mechanisms responsible for the fast granulation from a mixture of floccular and granular sludges. Fluorescent microbead particles (4 µm diameter) were successfully applied to differentially label the surfaces of floccular and crushed granular aggregates. Labelled flocs and crushed granules were added to a laboratory scale wastewater treatment reactor, and the granule formation process was monitored using confocal laser scanning microscopy over an 80 day period. Flocs were observed to attach to the surface of the seeding granules, resulting in reduced biomass washout during granulation. This mechanism not only reduces the granulation period, but also maintains the nutrient removal performance of the reactor. The results indicate that the granules acted as nuclei for floccular particle attachment, which accelerated granule formation.

Enhance method in aerobic granules formation is attractive. Developing an understanding on methods to accelerate granules formation is important; the fundamental aspects of how the interaction of the mixture of seeding strategy of floccular and granular sludge is the key information need to be revealed. Therefore, we believe that our findings are of broad interest and of sufficient impact to be considered for publication in Water Research. Overleaf you will find several reviewers we would like to suggest.

Kind regards,

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