https://precym.mio.osupytheas.fr/the-13th-international-symposium-on-microbial-ecology-isme13/

Marieska Verawaty , Zhiguo Yuan, Maite Pijuan, Philip Bond
The 13th International Symposium on Microbial Ecology (ISME13) Seattle, USA on August 22-27, 2010

https://www.researchgate.net/publication/369857133_Poster_he_13th_International_Symposium_on_Microbial_Ecology_ISME13_Seattle_USA_on_August_22-27_2010

Advanced Water Management Centre
www.awmc.uq.edu.au

The University Of Queensland
AUSTRALIA

Use of Fluorescent Microbeads to Understand Aerobic Granule Formation for Activated Sludge Wastewater Treatment

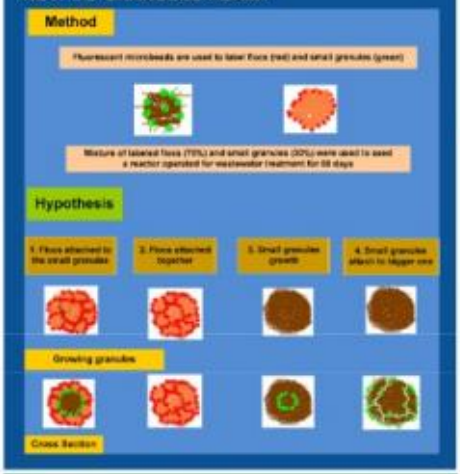
Verawaty. M[1], Pijuan. M[1], Yuan. Z[1] and Bond. P[1]

1. Advanced Water Management Centre, The University of Queensland, Australia.

INTRODUCTION

- Aerobic granular sludge is an emerging technology for wastewater treatment
- Potential advantages
  - Fast settling and high biomass
  - Operational and cost savings
- Potential disadvantages
  - Long start-up periods
  - Loss of biomass
  - Poor understanding of granule formation
- Floccular sludge is generally used as the starting material
- This study uses a novel method to improve the understanding of the granule formation process

HOW DO GRANULES FORM?



RESULTS

- Labelled biofilms were successfully detected in samples from the activated sludge reactor over the 80-day period (Figure 1 and 2).
- In the early stage (first 20 days) there was evidence that flocs were attaching to the surface of the granules, and further analysis indicated this attachment was permanent (Figure 3).

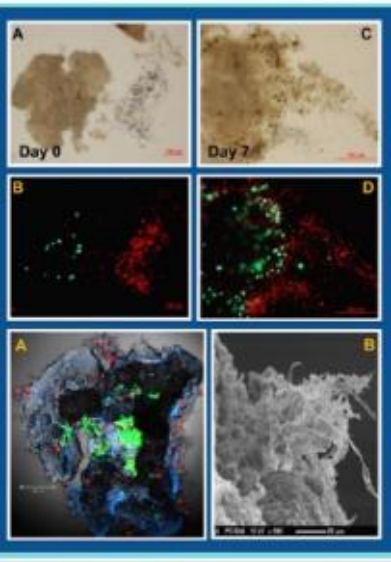


Fig 1. Pairs of light microscopy (A & C) and epifluorescent microscopy (B & D) images of labeled flocs and small granule interactions.

Fig 2. Granules formation detected by Confocal Laser Scanning Microscopy (A) and Scanning Electron Microscopy (B).

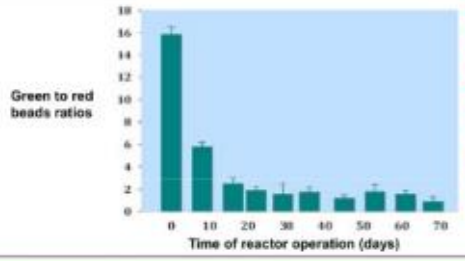


Fig 3. Ratio of green and red beads on granules examined during the reactor operation. In the first 20 days, flocs become attached to the small granules

CONCLUSIONS

- A novel approach using fluorescent microbeads labelling was used to monitor biofilm dynamics within a wastewater treatment reactor.
- The results imply that the granules act as nuclei for floccular particle attachment, which accelerates the granule formation.
- This provides important conceptual understanding for the innovative application of aerobic granules for wastewater treatment.

ACKNOWLEDGEMENTS

Environmental Biotechnology Cooperative Research Centre (EBCRC) Pty Ltd, Sydney, Australia. Smart State Fellowship Program (Queensland Government), Waste Technology Australia (WTA), AusAid Scholarship, and Richard Webb, Centre of Microscopy and Microscopy, The University of Queensland.

For more information please contact Marieska Verawaty (m.verawaty@awmc.uq.edu.au), Phil Bond (p.bond@awmc.uq.edu.au), telephone number +61 7 3346 9042, +61 7 3346 3226.

Development of flocs and granules labelling method with fluorescence microbeads to understand aerobic granule formation for activated sludge wastewater treatment

M. Verawaty[1], Z. Yuan[1], M. Pijuan[1,2], and P.L. Bond[1]

1. **The University of Queensland Advanced Water Management Centre (AWMC), QLD 4072, Australia.**
2. **Catalan Institute for Water Research, Technological Park of the University of Girona, 17003, Spain.**

Aerobic granular sludge is an emerging technology for wastewater treatment. Aerobic granules form larger biofilm aggregates than conventional sludge floccular biofilms, settle much faster than flocs, and can maintain higher biomass levels.

Thus, there are potential operational and cost saving advantages using aerobic granules. However, long start-up periods are required for the development of aerobic granules from a floccular-based system, and loss of biomass and can occur. In a recent study using an innovative seeding strategy, addition of crushed granules to a floccular sludge significantly reduced the start up period (Pijuan, submitted).

However, currently there is poor understanding of how granules form and such conceptual information is important for improving start-up strategies.

This study aims to determine mechanisms of granule formation and understand the accelerated process.

A novel methodology was used to follow the granule formation. Granular and floccular biofilms were labelled with differently coloured fluorescent microbeads (4 μm diam); these were then added to a laboratory scale wastewater treatment reactor. Confocal laser scanning microscopy, incorporating image analysis using the daime program, was used to monitor the granule formation period. Labelled biofilms were successfully detected in samples from the activated sludge reactor over the 80-day period. In the early stage (first 20 days) there was evidence that flocs were attaching to the surface of the granules, and further analysis indicated this attachment was permanent.

The results imply that the granules act as nuclei for floccular particle attachment, which accelerates the granule formation. This provides important supporting evidence for this innovative strategy and for the full-scale application of this technology. Additionally, our novel use of fluorescent microbeads to monitor biofilms for an extended period in a reactor, provides foundation methodology for studies of biofilm dynamics.

Keywords: fluorescence microbeads, flocs, crushed granules, aerobic granulation.

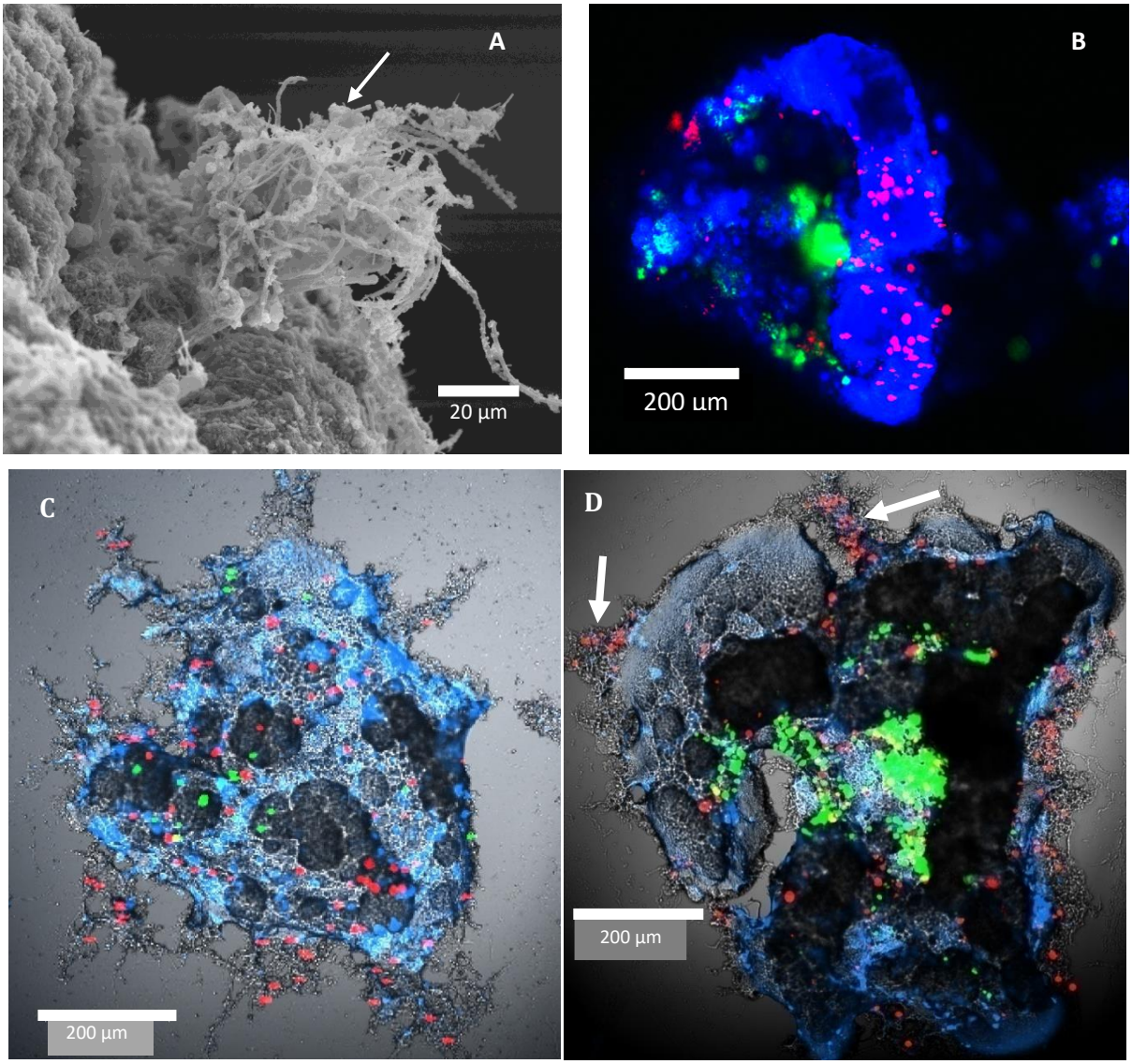


Figure 1. Evidence of attachment of flocs onto granule surfaces on day 26 of reactor operation. An SEM image of the granule surface with what appears to be protruding floc material, arrowed (A). The CLSM images of a section of a granule (B). Brightfield CLSM images showing the attachment of labelled flocs (red) to the surface of the labelled granules (green) (D and E).