Effect of fluid shear on *Pseudomonas aeruginosa* biofilm morphology grown under different gravity regimes

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Biofilms can obstruct essential pipelines

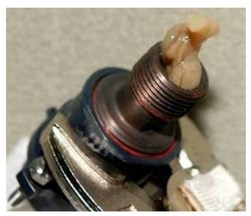
- Biofilms are communities of bacteria in a self-produced extracellular matrix
- Biofilm growth in pipes can lead to contamination and obstruction
- Biofilms are difficult and costly to remove, often requiring replacement of the pipe

Mersus.com

Water cooling system

Biofilms pose a threat to long-duration spaceflight

- Biofilms clog water processing pipelines on the International Space Station
- Water processing systems are required for long-term spaceflight
- Biofilms can contaminate liquids that astronauts use, potentially causing illness



NASA

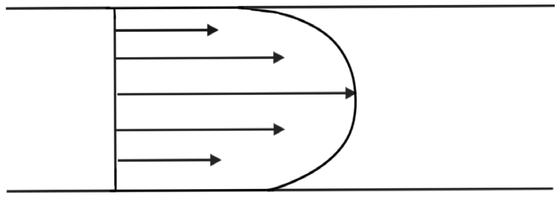
Condensate processor

NASA

Water processor

What is shear stress?

- Shear stress is a horizontal force
- Occurs when liquid moves against a solid



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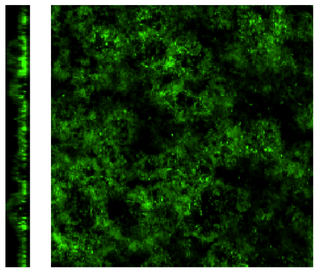
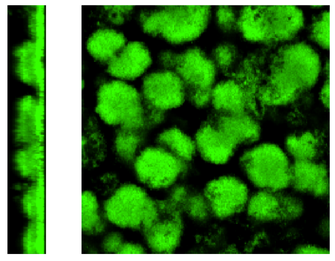
Velocity distribution in a pipe

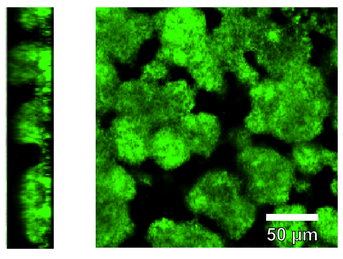
Shear stress affects biofilm morphology under Earth's gravity



0.5 mPa at 1g



2.5 mPa at 1g



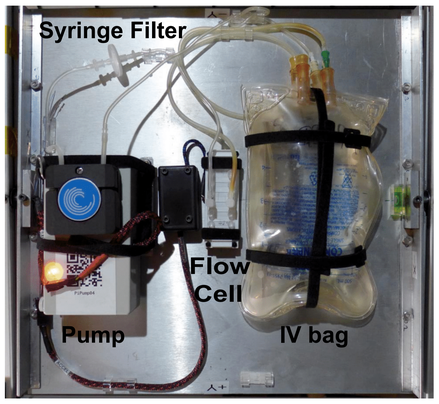
5.0 mPa at 1g

Does microgravity influence the effect of shear stress on biofilm formation?

Hypothesis:
Changes in microgravity will not affect the biofilm morphology, but changes in shear stress will.

System to change shear stress

- *Pseudomonas aeruginosa* grown in novel flow system for 3 days
- Flow altered to produce different shear stress values: 0.5 mPa, 2.5 mPa, and 5.0 mPa

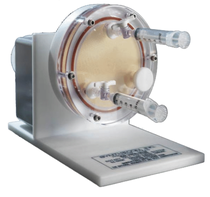


Novel flow system on the 3D clinostat

Cons of microgravity simulating tools

bsgn.esa.int

Random Position Machine



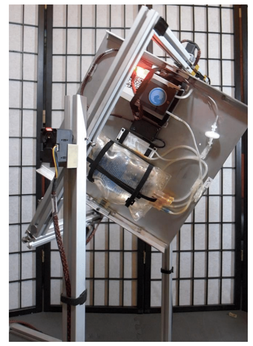
Arizona State University

Rotating Wall Vessel

- These tools are very expensive
- It is difficult to center the sample

Device to simulate different gravity regimes

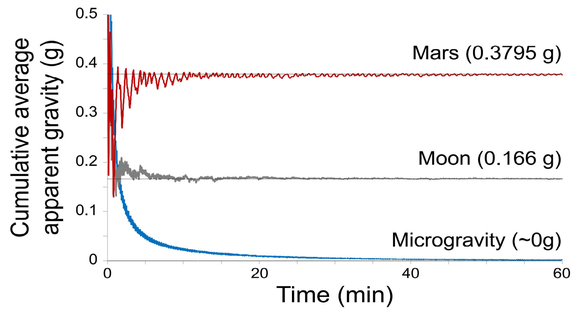
- Rotates on both axes, changing the sample orientation to reduce the apparent gravity
- Accelerometer for closed-loop control
- Sample is located at the center



3D Clinostat

Achieving different gravity regimes

- Gravity regimes: Earth (1g), Mars (0.38 g), Moon (0.17 g), and Microgravity (~ 0 g)



Future Directions

- Optimize the flow system
- Examine the effects of shear stress on biofilms grown under different gravity regimes

Acknowledgements

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