How can we reduce MPs/NPs in the environment

Dror Angel

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SINTEF

The GoJelly project

This is a EU H2020 innovation project that explores both jellyfish and microplastics as problems that can be turned into resources (potentially), including:

- Food for humans
- Aquaculture feed
- Cosmetics, pharma
- Fertilizer for aquaculture
- A filter for capturing MPs & NPs

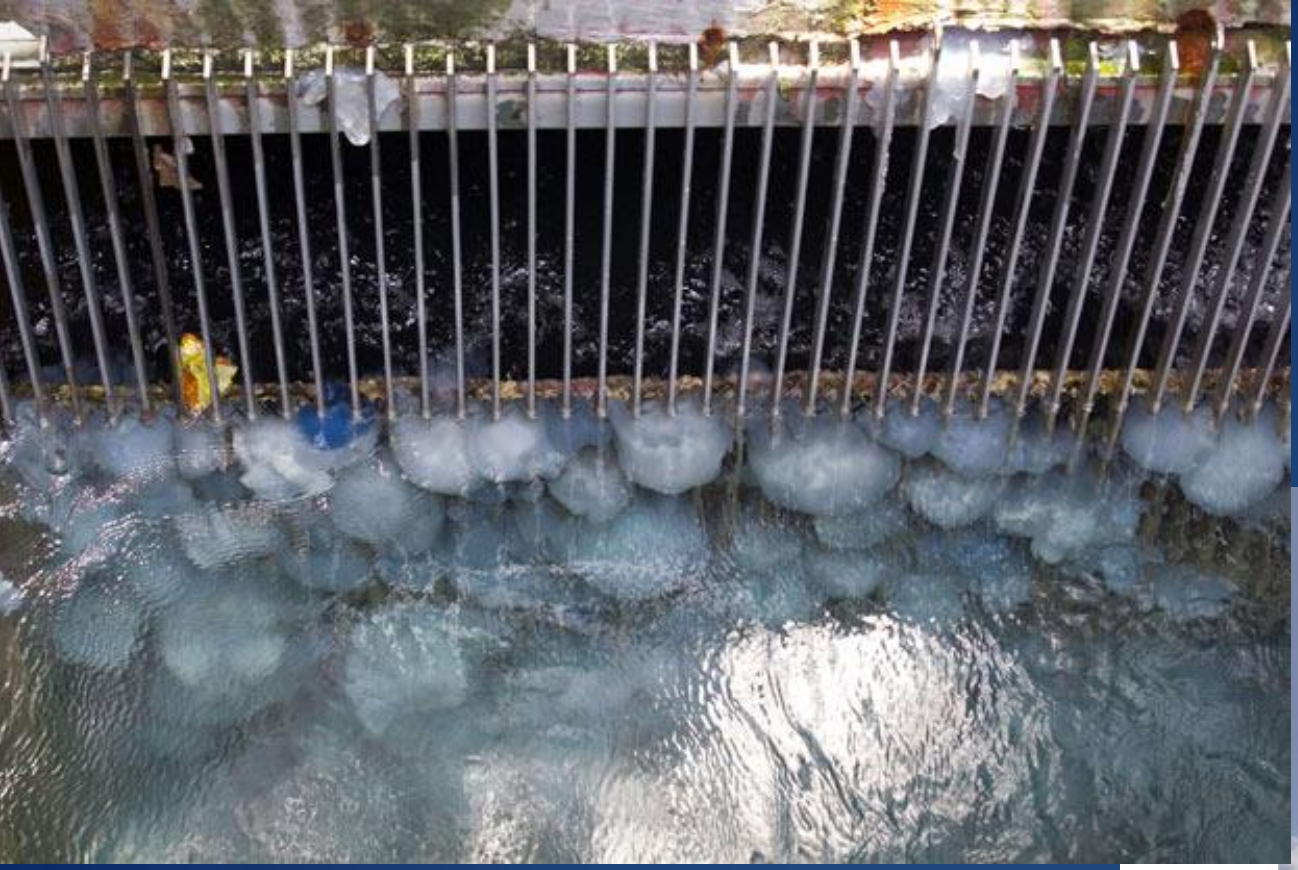
The GoJelly project

- **Turning a nuisance – JellyFish (JF) - into a resource**

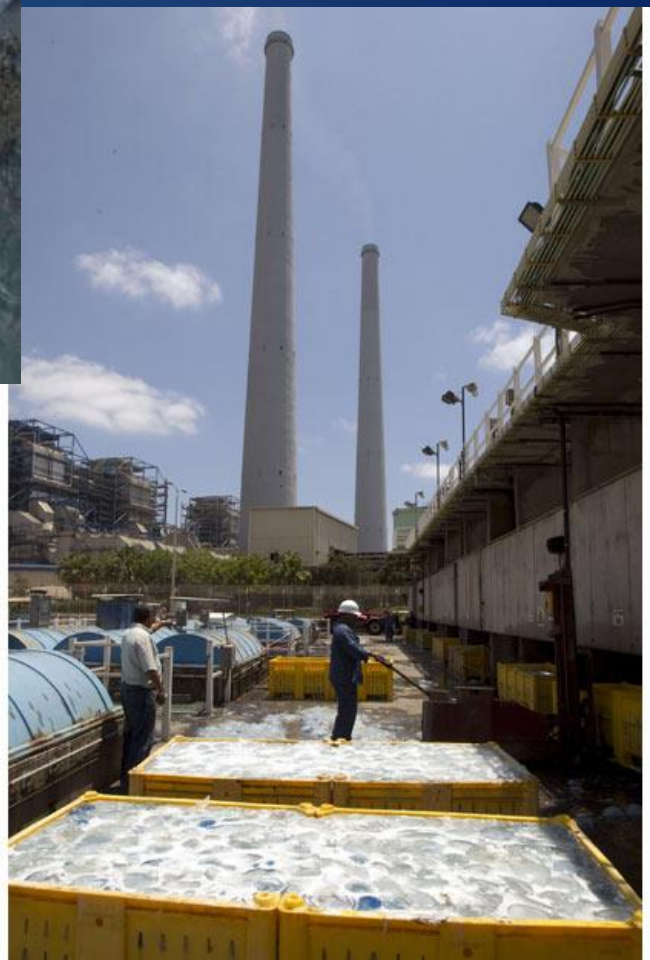
  (similar to plastics – it is not waste; it's a resource)

- JF mucus was shown to capture nano-gold particles (Patwa et al., 2015)
- So… can JF mucus be used to capture **MPs** too?
- To effectively reduce flux of MPs to the environment, want to go to where some of these MPs originate - **WWTPs**
- Goal : create a mucus-based **filter** to capture MPs and NPs

Japan



Israel
summer 2019



Power plant turbines cooling system screens compromised by massive jellyfish numbers

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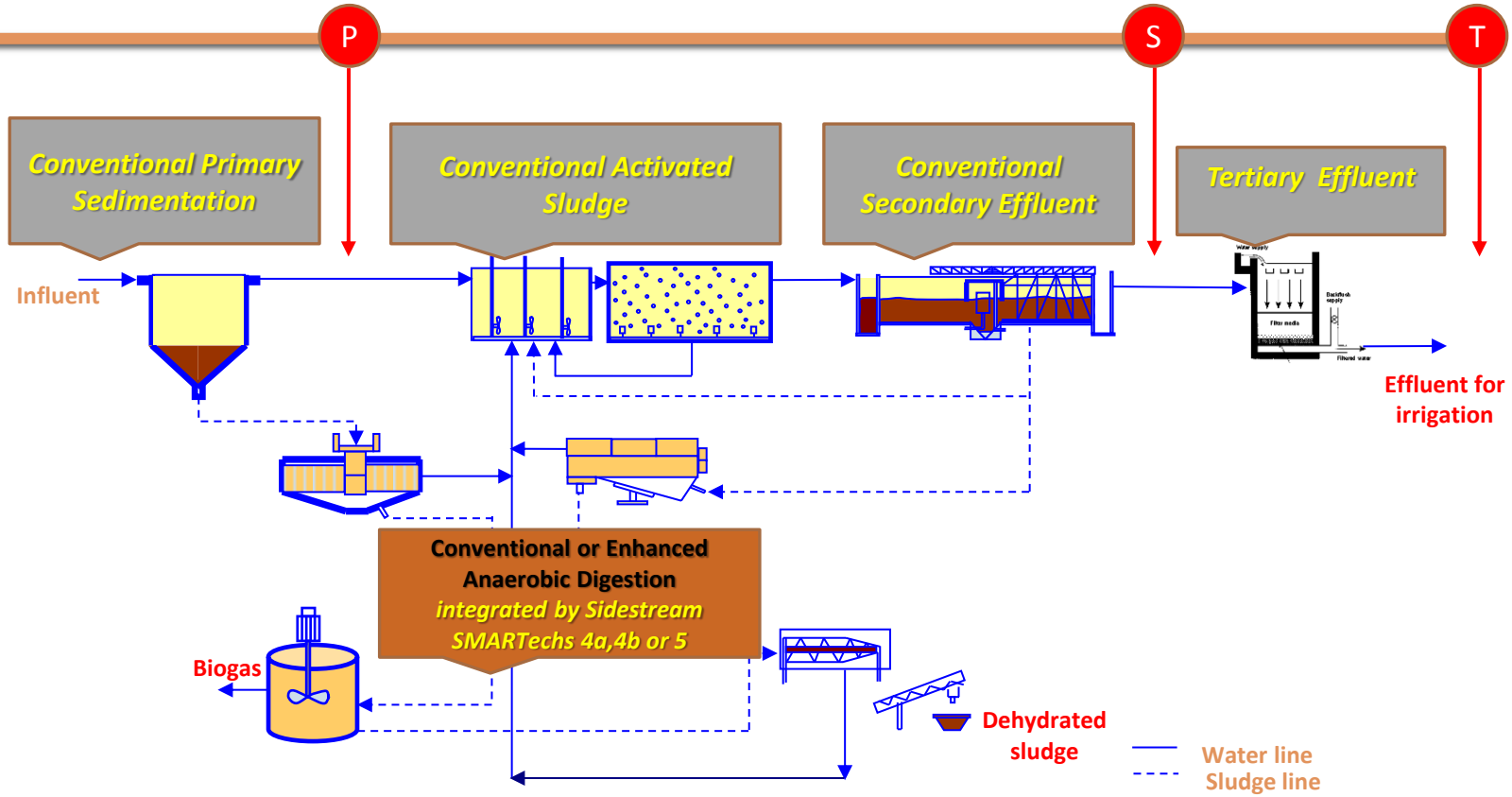
Karmiel WWTP



MPs in Karmiel WWTP - Findings

- WWT removes more **particles** than **fibers**, and removal efficiency decreases with particle size

- A typical WWTP with capacity similar to the Karmiel plant (300K people) releases about **460,000,000 MPs** / day, so there is incentive to address this

challenge

- so there are a lot of particles being released from WWTPs into the environment….

- What can we do about it?

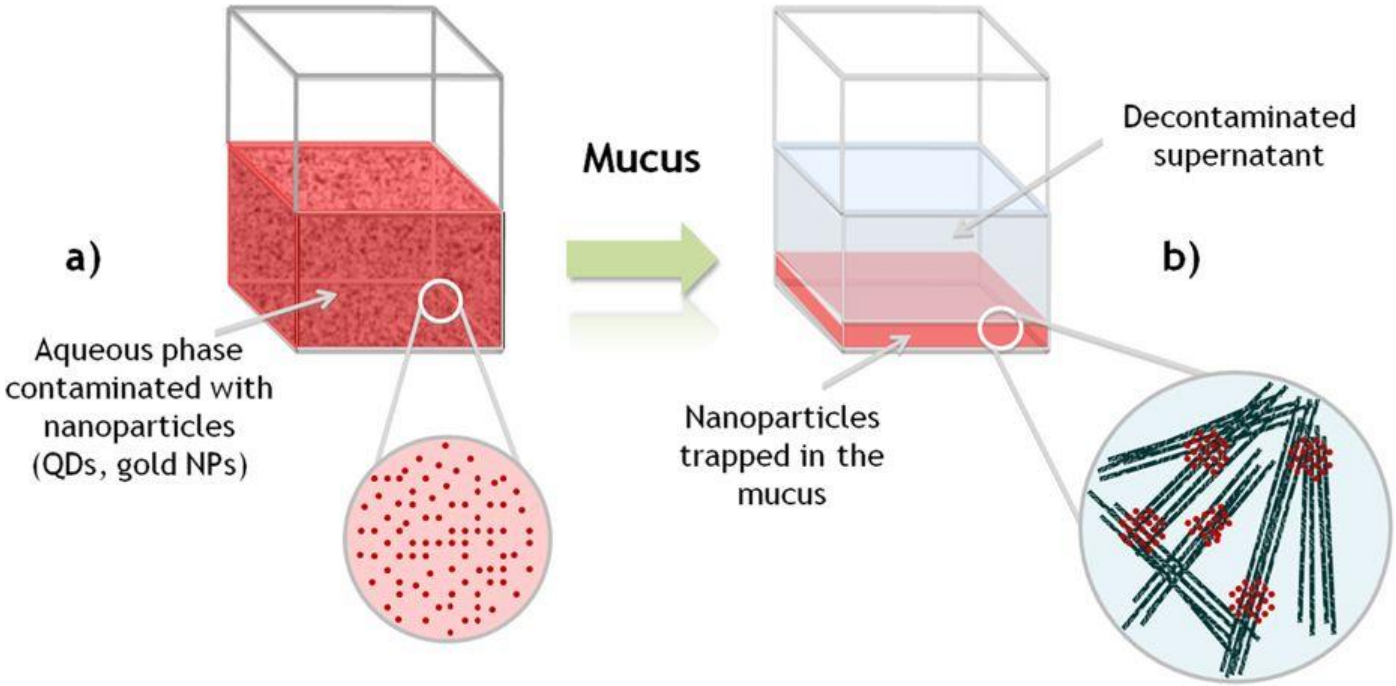
Removing MPs from wastewater

What is being done?

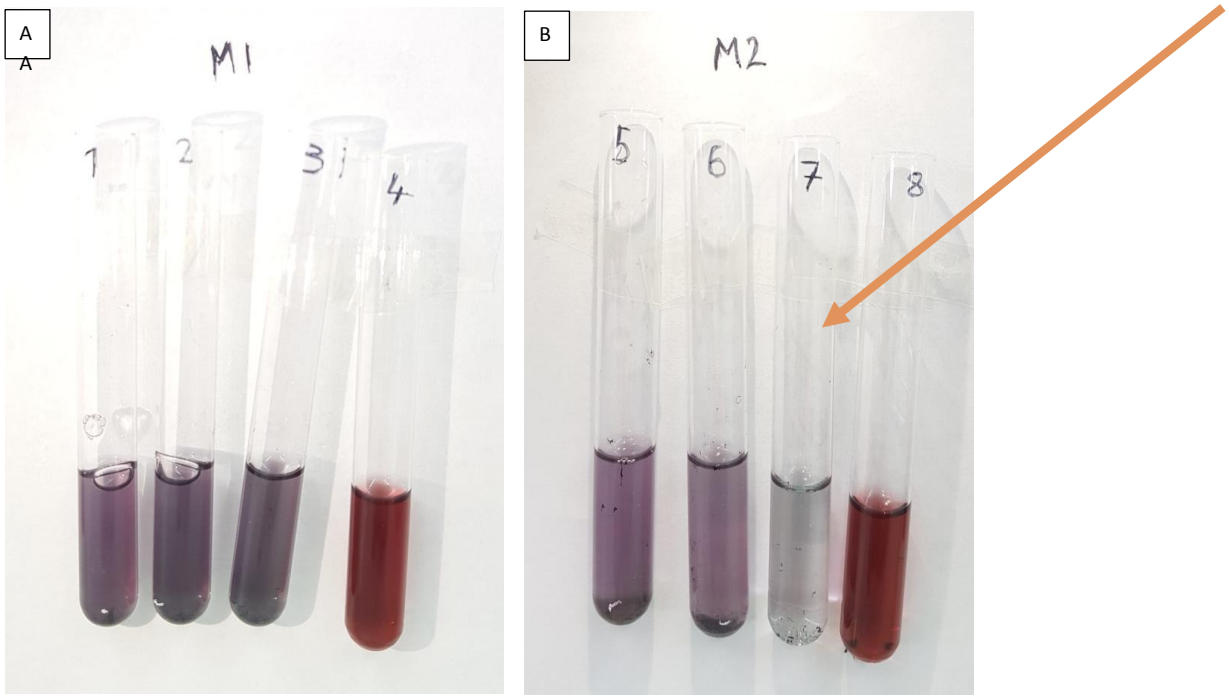
1. Standard **Coagulation/flocculation** – does not remove all MPs
2. *Fionn Ferreira* – **ferrofluids** (oil and magnetite powder) and magnets to extract MPs from water (https://www.thejournal.ie/irish-student-science-award-microplastics-4745270-Jul2019/)
3. **Filtering** wastewater (EU *CLAIM* project) using 1.5mm, 70µm & 30µm filters to capture polymers & then photocatalytic (Tofa et al., 2019) degradation of the polymers. Took 175 h for cracks and spots to appear in LDPE. http://www.claim-h2020project.eu/technologies/
4. **Problem: Because there is no regulation** re WWTP removal of MPs / NPs, there is little **incentive** to develop solutions …

AuNP capture by JF mucus (Patwa et al. 2015)

A. aurita and *P. noctiluca* mucus



Aurelia mucus captures AuNPs



Aurelia sp. mucus added to AuNP.
Different ratios of mucus & AuNP.
Tubes 4 and 8 - AuNP controls.

JF mucus to capture MPs / NPs

Some of the challenges :

- Supply of **mucus** to enable testing – JF availability
- Mucus **shelf-life** : how long can we work with it?
- **Freeze-dried** mucus – not optimal, unfortunately
- **Which** polymers to focus on? PE, PP, PS, nylon, acrylic, others?
- **type of MP** to test – anything not available commercially, needs to be custom-made
- **How** to test MP capture - developing **methods** that work
- Capture is best with **NPs** - not MPs

Summary

- **Mucus from different jellyfish (& probably different biota) has different particle capture abilities (Aurelia mucus is best)**
- Particle capture is instantaneous & highly efficient
- **Nano-size particles are captured better than MPs**
- For commercial application, need to generate a sustainable synthetic matrix for MP/NP capture
- **After capturing the plastics, need to develop procedure to separate mucus in order to re-use/compost mucus and re-use the MPs**
- Regulation (& Policy) re MPs discharge would make this R&D a lot easier

Thanks to:

- Partners from:
  - **Sintef Ocean**
  - **Braude College**
  - **my team at the Univ of Haifa**
  - **the whole GoJelly consortium**
- the European Union

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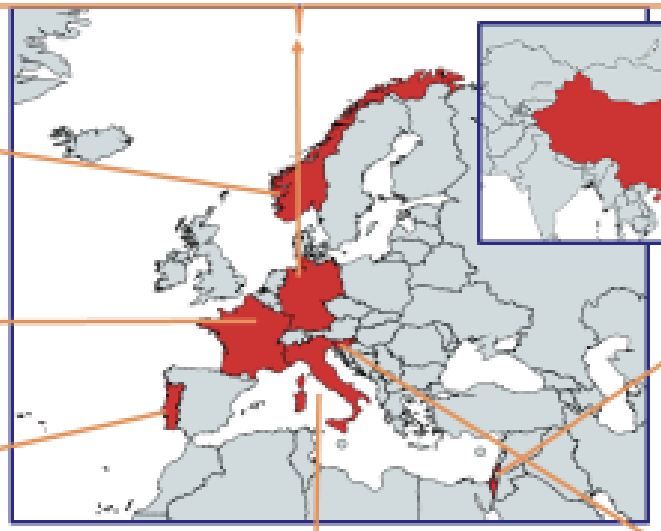

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