

HDR



## Introduction: Teigan Gulliver, PE

- 11 years water/wastewater experience
- Solids stabilization, thickening, dewatering, biosolids management experience
- Water and Sanitation Peace Corps volunteer in Peru
- Engineers Without Borders
- WEF – Residuals and Biosolids Committee





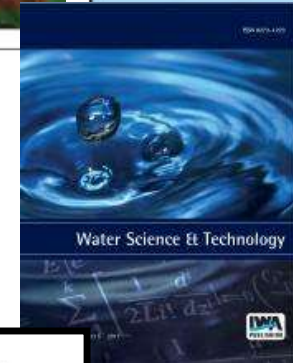
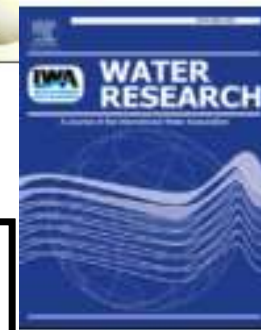
# Microplastics: From Sinks to Oceans, and the Water in Between

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# ENVIRONMENTAL Science & Technology



## Microplastic contamination in the San Francisco Bay, California, USA

Rebecca Sutton <sup>a,\*</sup>, Sherri A. Mason <sup>b</sup>, Shavonne K. Stanek <sup>a,1</sup>, Ellen Willis-Norton <sup>a,2</sup>,  
Ian F. Wren <sup>c</sup>,Carolynn Box <sup>d</sup>

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## Transport and fate of microplastic particles in wastewater treatment plants

## Microplastics in freshwater and terrestrial environments: Evaluating the current understanding to identify the knowledge gaps and future research priorities

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## Influence of wastewater treatment plant discharges on microplastic concentrations in surface water

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<sup>a</sup> Department of Civil and Environmental Engineering, Rutgers, The State University of New Jersey, 96 Frelinghuysen Rd., Piscataway, NJ 08854, United States

## Wastewater Treatment Works (WwTW) as a Source of Microplastics in the Aquatic Environment

Fionn Murphy, <sup>a,†</sup> Ciaran Ewins, <sup>‡</sup> Frederic Carbonnier, <sup>§</sup> and Brian Quinn <sup>§</sup>

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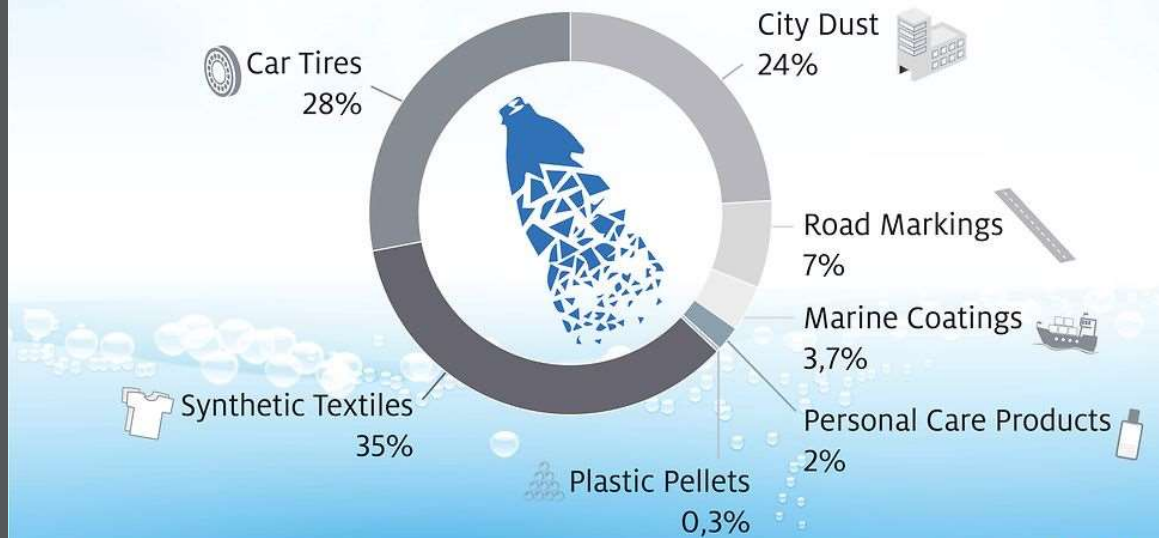
# What is it?

- MICROPLASTICS

- Very Small → 5mm diameter or smaller
- Start that small (Primary)
- Break down to that small (Secondary)

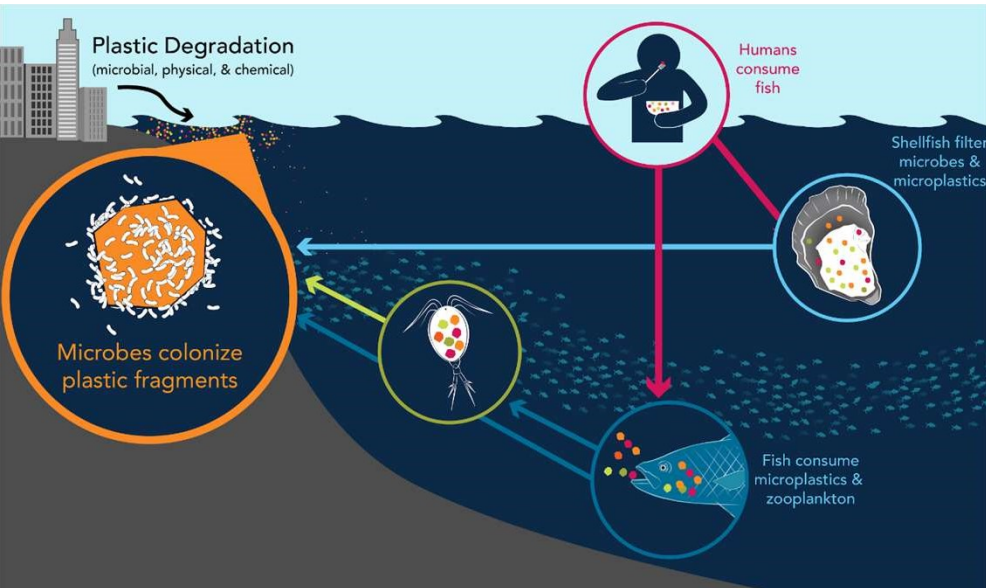


## Where do microplastics in our oceans come from?



Source: IUCN 2017





## So What?

- **MICROPLASTICS** are there!
  - Many enter through WRRFs
  - Some are NOT removed in water/wastewater Treatment
  - Do Not Degrade → PP, PE, PVC Plastics
  - Collect in waterways and shores
  - **Aquatic life impacts**
    - Reproductive issues, Eating issues
  - **Environmental impacts**
    - Transport POPs
      - PCB, DDT



This rainbow runner had consumed 17 plastic fragments. Marine plastic pollution plays an unknown role in human exposures to toxic chemicals.

# Microbeads - Why This is Important?

- MICROBEADS
  - Used in face cleansers, toothpaste, hand scrubbers
    - 5 mm diameter or smaller
  - Not completely removed in wastewater treatment
    - 0.1-7 microbeads/L in WWT effluent
      - 8 trillion microbeads discharged/day
  - **Aquatic life impacts**
  - **Environmental impacts**
  - Negative consequences of synthetic microbeads
- Microbeads banned

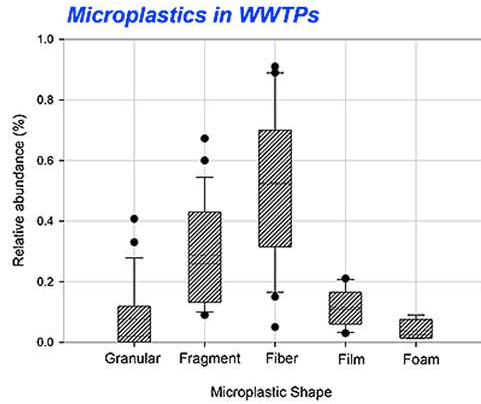
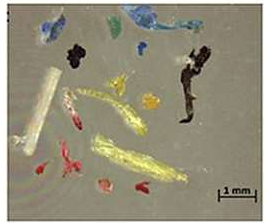


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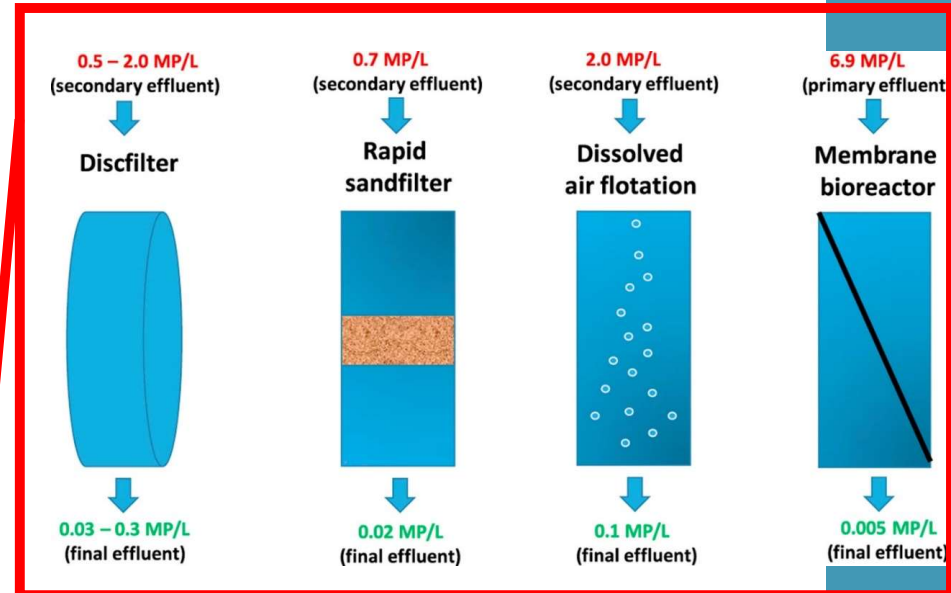
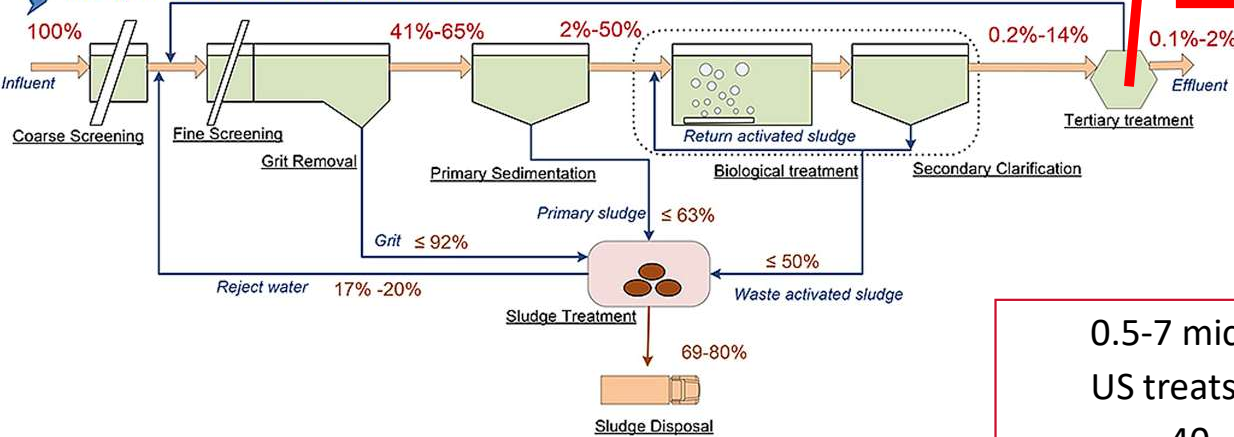


Source (All): Conservation & Science at Monterey Bay Aquarium

# Movement of Microplastics



## Microplastics Particle Flow in WWTPs

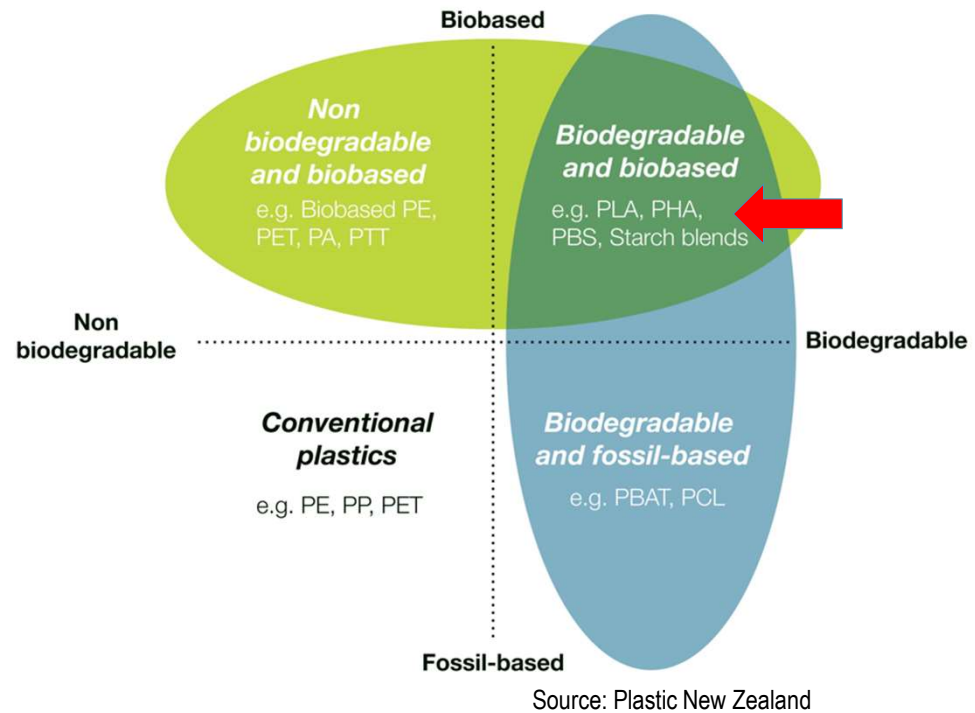


0.5-7 microplastic/L in WWT effluent  
 US treats 80 trillion L/day  
 40 - 560 trillion microplastics discharged/day



# Many Types of Plastic

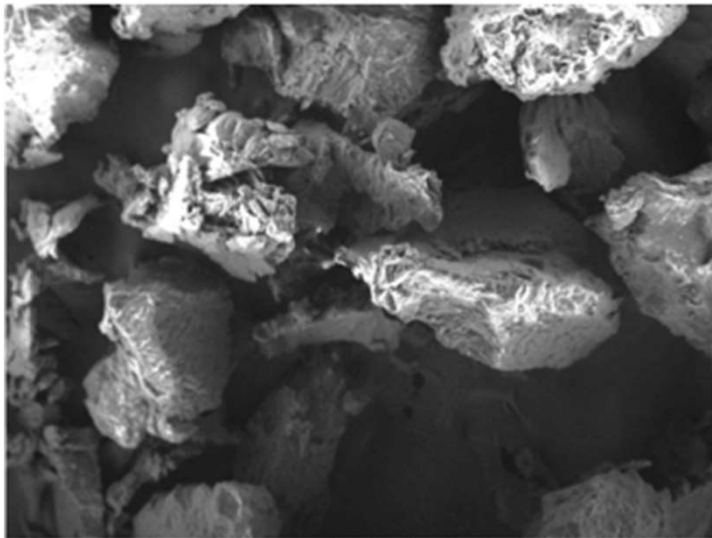
- Synthetic Plastic
  - Made from Petroleum or Petro-chemical Products
- Bio-based Plastic
  - Carbon from renewable sources
- Biodegradable Plastic
  - Decomposes naturally in the environment



# Can Microplastics Degrade in Wastewater?

Add MBs to different wastewater sludges:

- Activated Sludge (MLSS)
- Return Activated Sludge (RAS)
- Aerobic Digester Sludge (AerD)
- Anaerobic Digester Sludge (AnD)



TM-1000\_0986 2016/09/23 15:43 D1.9 x100 1 mm



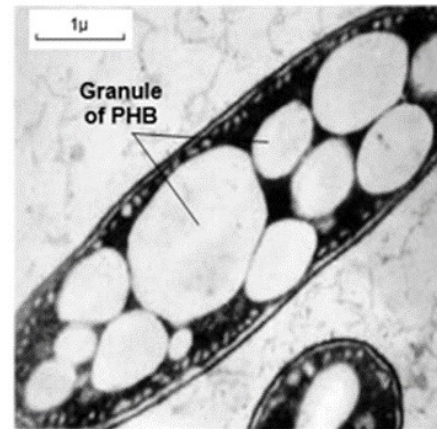
PE Microplastics



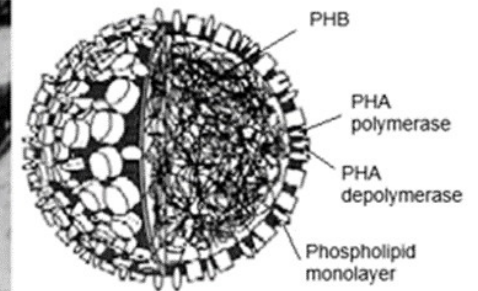
PHB Microplastics

# What's PHB?

- The most common poly-hydroxy-alkanoate (PHA)
- Stiff, brittle polymer (AKA plastic)
- Used in packaging, medical and tableware
- Produced by microorganisms!
  - Produce as carbon storage when stressed → nutrient limited environment
  - *Cupriavidus necator*, *Methylobacterium rhodesianum* or *Bacillus megaterium*



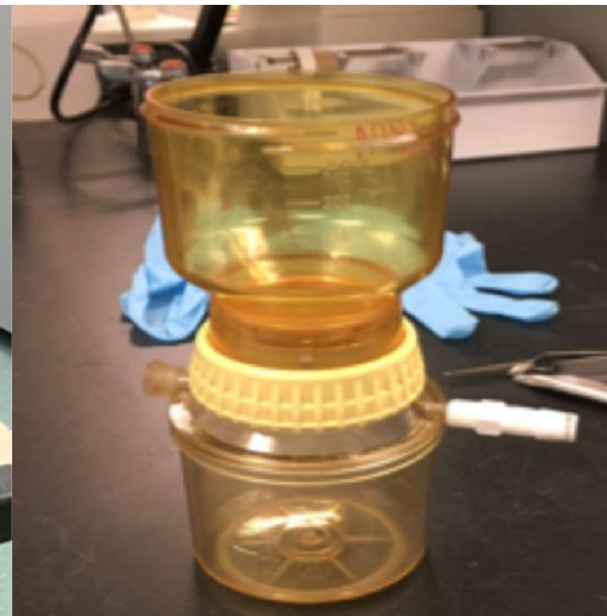
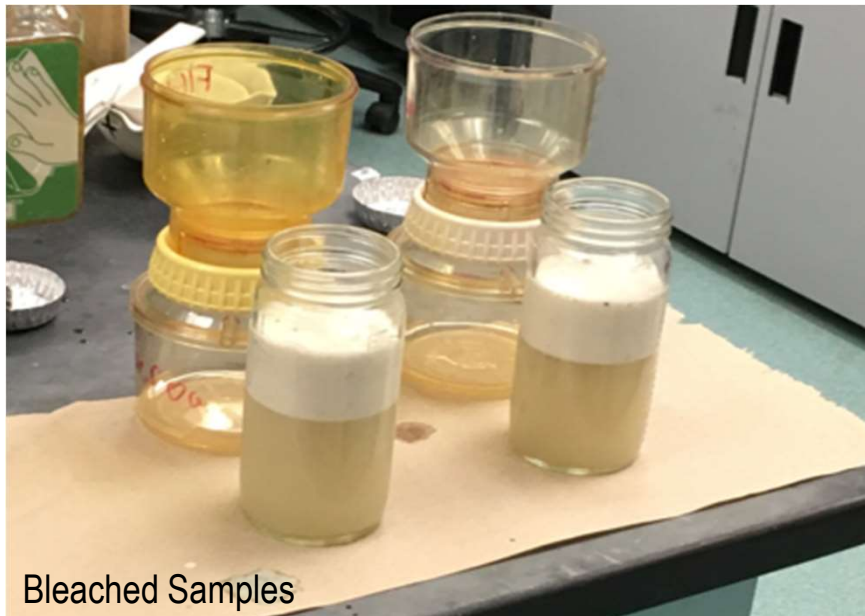
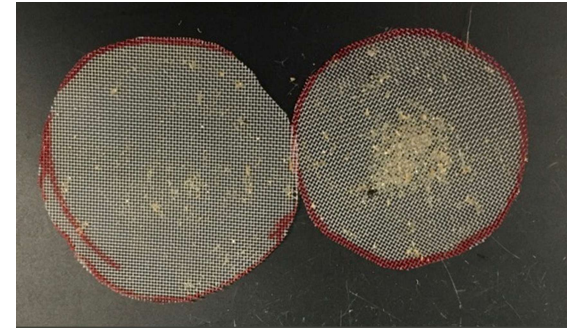
(a)



(b)

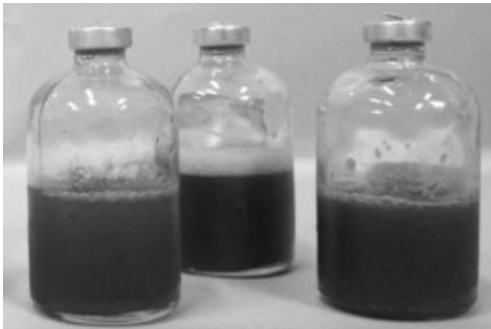
## Methods - Nalgene Bottle Sieve

- Nalgene Reuseable Filter Units
  - Use 400 micron nylon woven mesh as "sieve"
  - Mesh weighed before sieving
  - Subtract weight of mesh from weight of dried solids (Sludge + microbeads)
  - Bleach Samples to reduce the amount of solids on filter



# The Simple on Methods

- Incubate



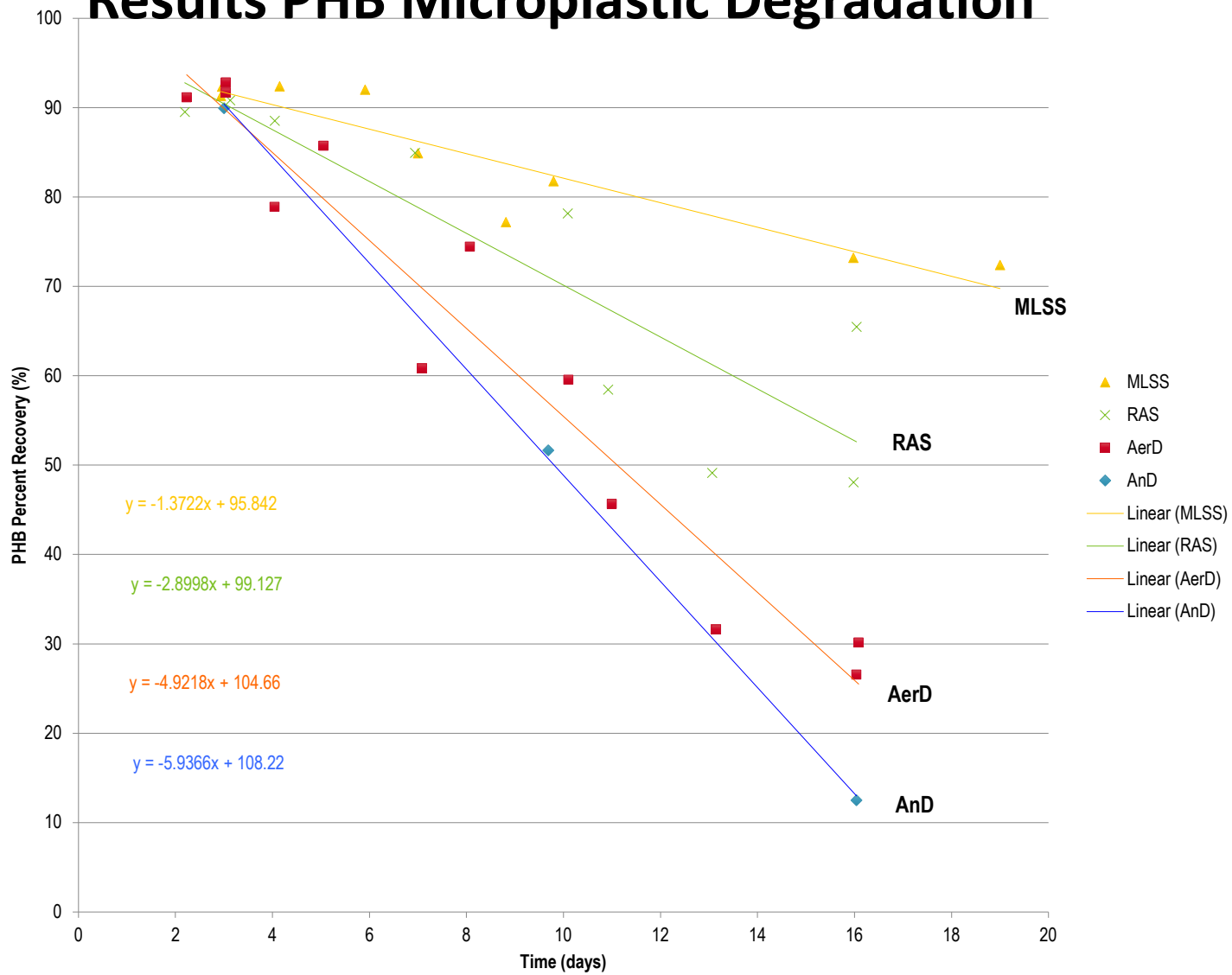
- Remove the Sludge



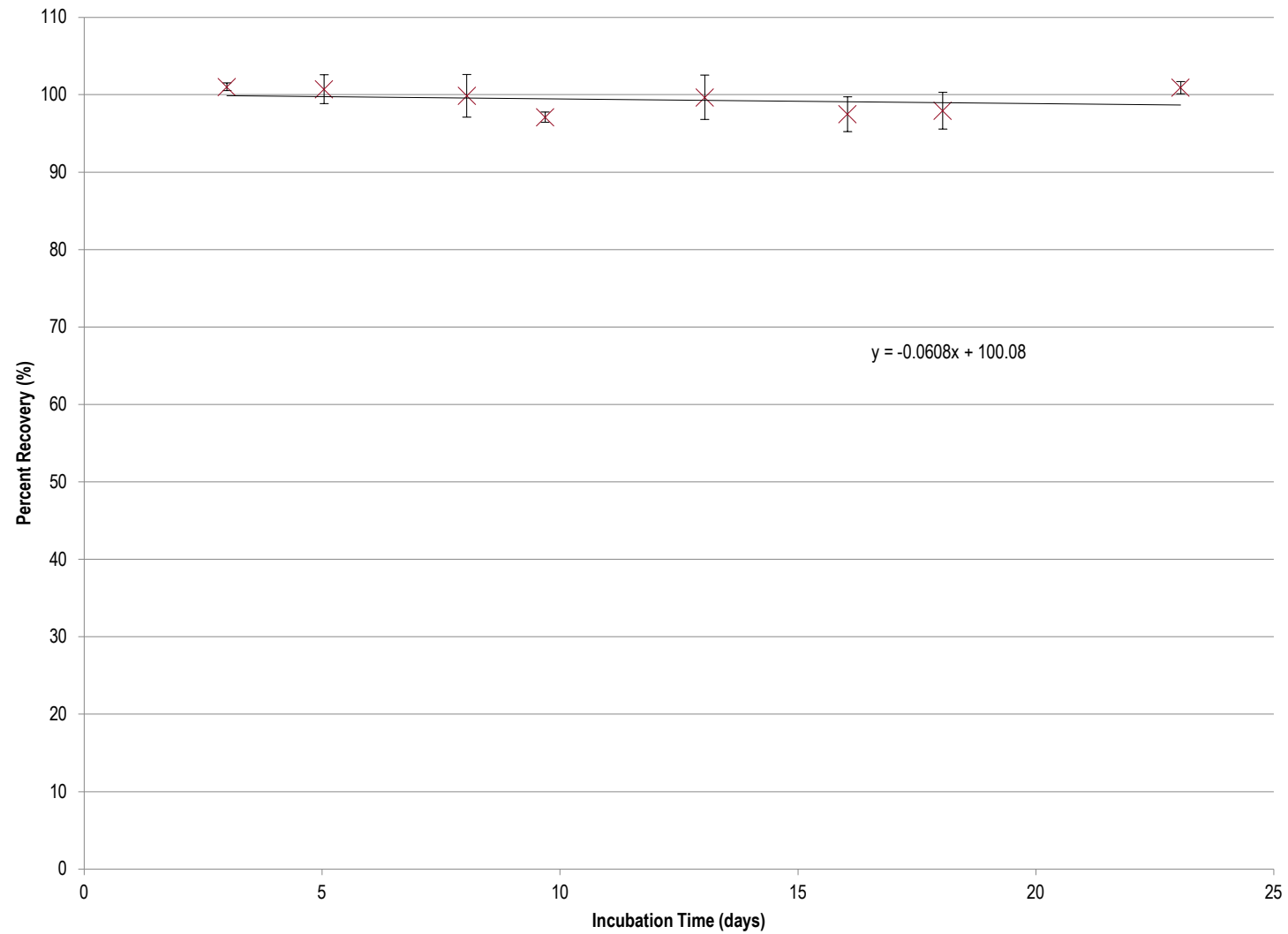
- Weigh What's Left of the Microbeads



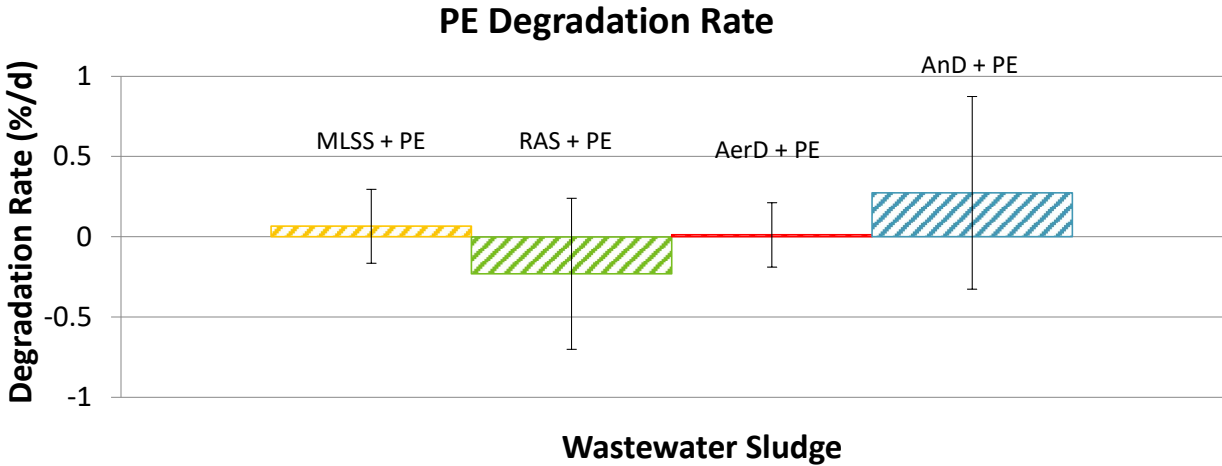
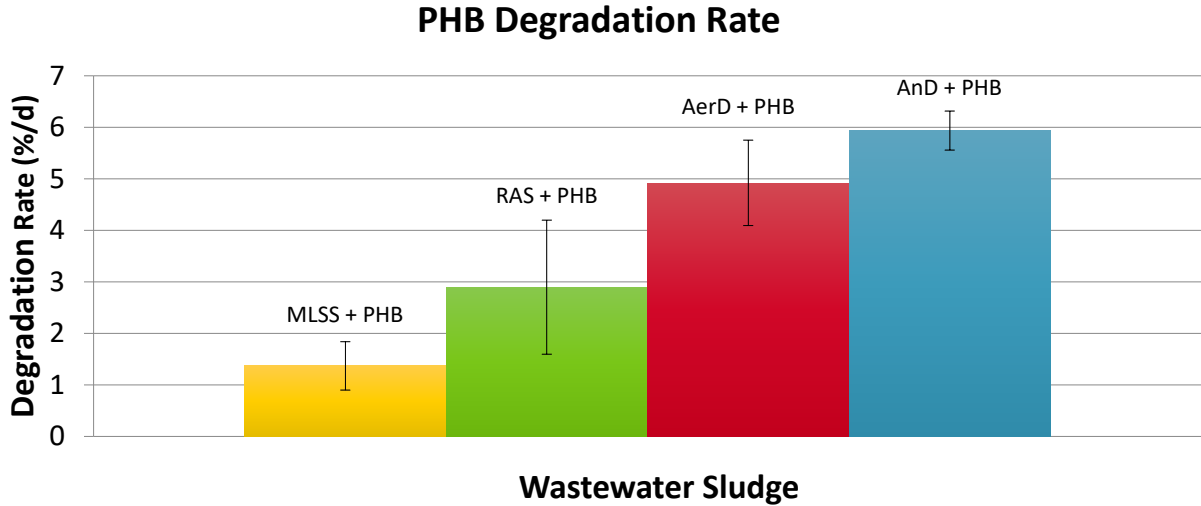
# Results PHB Microplastic Degradation



# Results PE Microplastic in Anaerobic Digester Sludge



# Degradation Rate Comparison of PE and PHB

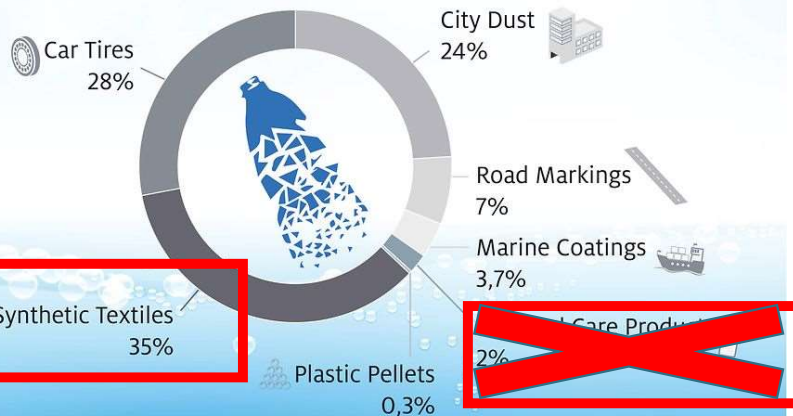




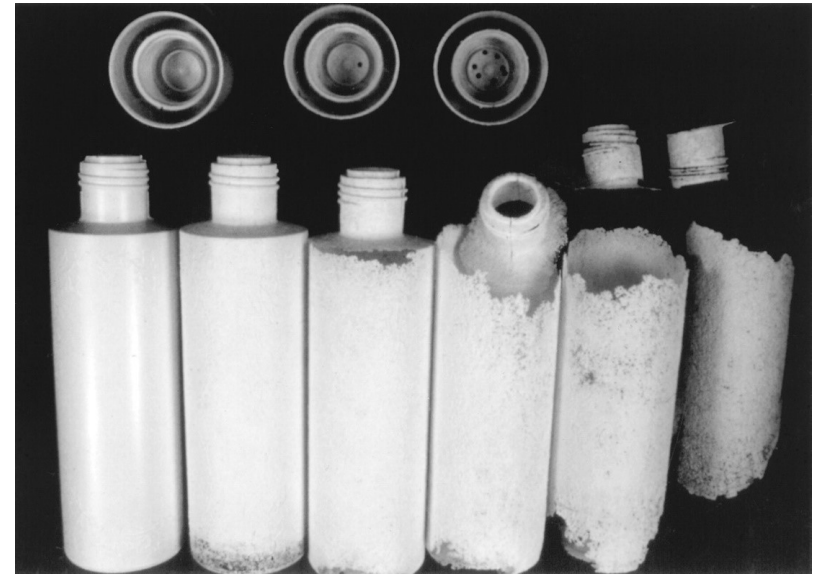
# What's the take-away?

- Our presence = Microplastics
  - Minimize the affect on the environment with change
  - Prioritize quality
  - Biodegradable plastics degrade in wastewater treatment

## Where do microplastics in our oceans come from?



Source: IUCN 2017



## Estimated fibers released from wash



Source: Marine Pollution Bulletin

# Questions??



HDR