Plastic Degradation Effects in the Arctic Ocean

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Introduction:

There are a variety of different types of plastics which are inexpensive, light in weight, durable, strong, corrosion-resistant, and contain high thermal and electrical insulation properties. There are many benefits to the creation of plastics such as advancements in medicine and technology, but there is also a consequence that tags along. There has also been disadvantages of plastic that ends up as trash throughout the world, specifically oceans. "Researchers found a total of 17 different types of plastic in the sea ice and the most common plastics include polyethylene, nylon, polyester, cellulose acetate, paints, and micro plastics" (Briggs, 2018). There are many additives to the plastics that are created, inorganic fillers in particular, such as carbon and silica, plasticizers to render the material, thermal and UV stabilizers, flame retardants and colorings (Thompson 2009). Some additives also contain toxic chemicals such as lead and tributyltin in polyvinyl chloride but there is controversy about the extent to which additives such as BPA (bisphenol A) have adverse effects in animal or human populations. BPA has been a concern because it is found in many plastics in which are exposed to many humans as well as wildlife species. Specifically, they are found in polycarbonate plastics, which are found in plastic containers that store food and beverages as well as consumer goods. With that being said, studies show that BPA contains possible health effects on the brain, behavior and prostate gland of fetuses, infants and children as well as a correlation between BPA and hypertension (Bauer, 2019). Therefore, the plastics that are in the Arctic should be a huge concern as it has shown to impact and affect the marine life as well as the ecosystem as a whole. According to researchers, the amount of plastic in the Arctic ocean has tripled and is expected to continue increasing if the human population does not decrease it use of plastics or if we do not develop an alternative or possible solutions.

Research Questions and Hypotheses:

- How does plastic affect water quality in the Arctic and the organisms living in the ocean?

- How quickly do these plastics degrade in ocean water when exposed to sunlight and UV radiation?

Hypothesis:

Plastic bags will decrease in size quicker than water bottles because they are thinner, where as water bottles are thicker and more dense in relation to plastic degradation in the salt water from the ocean.

Methods:

Sampled tests of polyethylene (plastic bag and squeezable water bottles) were left in a tub. Approximately 35 grams of salt per liter of water was added in the tub mimicking the salt water in the Artic Ocean. The plastics were left in the tub for 8 weeks, and each week data was collected by weighing the bottles as well as observing the physical changes due to degradation. We weighed the plastic bottles every week to observe the weigh changes and physical changes. A second set of bottles were placed over an opened flame to help speed up the process of degradation. We weighed the plastic bottles every week to observe the weigh changes and physical changes.

Results:

❖ The graph to the right indicates the decrease change in plastics over the weeks we collected our data.

❖ The x-axis represents the initial week #1 where we recorded the starting weight all the way through week #5, our final recording.

❖ The y-axis represents the weight measured following per week for each plastic (WB = water bottle replicates 1-3; PB = plastic bag replicates 1-3).

❖ You can see on the graph, over the time we collected our measurements there was a small change in the plastic degradation.

❖ Overall, there was not much of a significant change, and every plastics goes at its own rate of degradation but similar amount of difference.

Towards the last two measurements the bottles #1 and #2 had flown away from the weather we had receive from Phoenix. So we were unable to collect the last data for bottles #1 and #2. However, for future references it would be best to leave the tray at a lower level of ground so the bottles could be picked up and used again to continue the experiment.

Discussion:

The main objective of this experiment was to determine how long it would take for the degradation process of plastic to occur. The hypothesis entering the experiment was that the plastic bags would decrease in weight at a faster rate than the water bottles when exposed to sunlight and ocean water conditions. The hypothesis was not supported, and this is due to several errors that interfered with our data collection, one being that we missed a week of collecting data which interfered with the consistency of the data being recorded. Another error includes leaving the tub without a lid, as this allowed two bottles and the bag to fly away due to weather/wind. Though we lost our bottles and a portion of data that could have been collected, the results showed a decrease in weight of the plastic bottles each week. As far as the plastic bags, only one bag remained and the weights recorded showed no consistent pattern. A factor that could have been done differently to improve the data that was collected was to leave the tub in a location that is suitable for maximum exposure and minimal external factors that could remove the bottles from the tub. As far as our data, there was not much of a significant difference or change of weight in the plastic bottles as it takes years for degradation to happen significantly. However, the fact that there is a change in mass does provide support that even in a small amount of time plastic could degrade when exposed to environmental factors.

References:

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