The Global Organization for PHA - GO!PHA
Oudebrugsteeg 9
1012JN Amsterdam
The Netherlands
info@gopha.org
www.gopha.org

Preventing Plastics Pollution with PHA in "The Circular Economy"

Part 2: Carbon and The Plastics Pollution

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Author: Anindya Mukherjee

In Part 1 of this Series we touched upon the size and scope of Plastics Pollution. Here we talk about Carbon and other emissions to the environment, Plastics' share of that carbon emission and how a natural and biodegradable material can help.

GHG and Climate Change in numbers

Carbon dioxide is a greenhouse gas that absorbs and emits thermal radiation, resulting in global warming. Carbon dioxide concentration in the atmosphere has increased from around 275 ppm in 1616 to 410 ppm in 2018, and it is rising continuously. Between 1945 and 2018, the earth's median temperature has increased by 0.6 ^{o}C which is expected to rise by 4.1-4.8 ^{o}C by 2100 without any climate change policies [1] . It would rise 3.1-3.7 ^{o}C with current policies, and 2.6-3.2 ^{o}C with the pledges made to date. In order for us to limit the temperature rise to 2 ^{o}C by 2100, outlined in The Paris Climate Agreement, we need to cut our carbon emissions to around 10 Bil. tons of carbon dioxide equivalent per year, equal to a quarter of our current emissions. The current carbon dioxide equivalent emissions are over 50 Bil. tons per year. [1] Limiting global warming to 2°C would avoid catastrophic "runaway" consequences. [2]

Energy generation (55%), Transportation (17%) and Industry (7.5%) are the largest emitters of carbon dioxide. [1] The Ellen MacArthur Foundation report on Plastics mentioned that plastics consumed 6% of fossil fuels in 2014 which includes feedstock, energy for production, transportation and 14% of plastics incinerated for electricity/heat generation. [3] The 6% fossil fuel consumption for plastics contributes about 1% of the total carbon emission budget according to background data from The Paris Climate Agreement. By 2050, without any major mitigation efforts plastics' portion of fossil fuel usage would amount to >20% and represent 15% of the carbon budget. Therefore, it is clear that in order to meet the 2 ^{o}C rise by 2100, fossil carbon consumed by plastics needs dramatic reduction.

Besides carbon dioxide, methane and nitrous oxide are two additional major greenhouse gases responsible for climate change. Methane contributed 7.26 Bil. tons (20%) of Carbon dioxide equivalent and nitrous oxide contributed 3.06 Bil. tons (6%) in 2008. Methane is 28 times more potent over a 100-year period (84 times over 10 years) and nitrous oxide is 265 times more potent GHG than carbon dioxide over a 100-year period. [4,5] Therefore, mitigating the release of methane and nitrous oxide sooner would have an even greater effect on climate change.

The primary anthropogenic methane emission sources are Agriculture (50% - rice cultivation, livestock), Fossil Fuels (30% - recovery and transportation leakage), and Waste Treatment (20% - landfills, wastewater/sewage treatment). The primary anthropogenic nitrous oxide emissions come from agriculture (~ 72%), with energy, industry and waste being the next largest sources. Nitrous oxide is primarily given out from inefficient fertilizer and manure usage. Currently the world uses >50% more nitrogen-based fertilizer than is needed thus causing excess nitrous oxide emission. [6] Overuse of nitrogen containing fertilizer has the added consequence of water pollution, excessive algae bloom and large dead zones in the delta area due to field runoffs. A large portion of this emission can be controlled if fertilizer usage is optimized through controlled release methods and by denitrification of the soil. [6]

Using renewable carbon to produce biodegradable, compostable and recyclable natural materials can reduce carbon and other GHG emissions as well as address plastics pollution, and that would make for a true Circular Economy.

Closing the loop naturally with PHA.

PHA or PolyHydroxyalkanoate is a versatile class of natural material, they are renewable, biodegradable in soil, fresh water & marine environment, and home compostable. Their properties can be tailored to numerous target applications including the denitrification of soil, thereby reducing nitrous oxide emission. They can be manufactured using recycled carbon dioxide as well as methane, thereby helping to mitigate, not only carbon dioxide and methane, but nitrous oxides as well.

References:

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4. https://ccacoalition.org/en/slcps/methane
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Global Organization for PHA

The Global Organization for PHA is a member-driven, non-profit initiative to accelerate the development of the PHA-platform industry. Polyhydroxyalkanoate polymers (PHAs) provide a unique opportunity as a solution for reducing greenhouse gases and environmental plastics pollution, and establishing a circular economy, by offering a range of sustainable, high-quality and natural products and materials based on renewable feedstocks and offering diverse end-of-life options.
GO!PHA provides a platform for creating and sharing experiences and knowledge and to facilitate joint development initiatives.

Become a member or sponsor to start sharing, contributing and collaborating to accelerate the PHA-platform industry.

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