SUSTAINABILITY FROM A PLASTIC RAW MATERIAL SOLUTIONS PERSPECTIVE

IPAC-RS SUSTAINABILITY ROUNDTABLE PART 1, 30.11.2022

AVIENT - WHO ARE WE

WHAT WE CAN DO FOR THE HEALTHCARE INDUSTRY

- We supply modified polymer solutions to color and enhance the properties of plastics used in medical and pharmaceutical applications
- We have global expertise in healthcare technical and regulatory requirements
- Our healthcare portfolio is manufactured according to GMP/ISO 13485 protocols on 3 continents

SUSTAINABILITY CONCERNS IN HEALTHCARE - WASTE

- Continued pressure to replace plastics, despite proven efficacy, is catching up to the healthcare industry, leading to search for alternative materials
- Stricter regulations for plastic usage are being put in place
- Statistics show that healthcare plastic waste represents only a small share of global plastic waste
  - Global plastics waste ~303 million tons[1]
    Single-use biopharma ~30 kilo tons[2]
  - Healthcare polymer consumption <5% of plastic and represents an estimated 0.01% of waste stream

… but we cannot ignore it!

Source: #1Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science Advances, 3(7), e1700782
Source #2 estimate of landfill and incineration- Miilipore-Sigma / Triumvirate publicity – BioProcess International eBook series 2018.

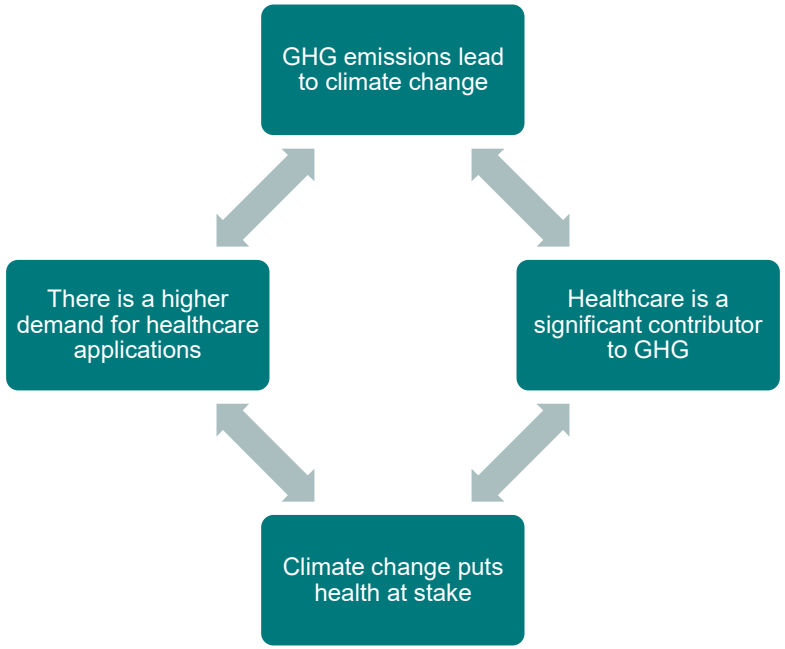
SUSTAINABILITY CONCERNS IN HEALTHCARE – CO2 FOOTPRINT

- Healthcare's climate footprint is equivalent to **4.4% of global net emissions** (2 gigatons of carbon dioxide equivalent).
- The top three emitters, the United States, China, and collectively the countries of the European Union, comprise more than half the world's total health care climate footprint (56%).

"Healthcare's Climate Footprint" by Health Care Without Harm with and ARUP[1]

- "Globally, if healthcare were a nation, it would be the fifth largest emitter."
- "The paradox is the healthcare sector is inadvertently helping to create new health problems—linked to pollution and climate change—in its effort to treat others."

Fiona Miller Miller, director of IHPME's Centre for Sustainable Health Systems and chair in Health Management Strategies[2]



[1] https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_092319.pdf
[2] https://medicalxpress.com/news/2021-11-net-zero-emissions-role-healthcare-sector.html

SUSTAINABILITY

FIRST STEPS AND FEASIBILITY WITH RAW MATERIALS

REDUCTION OF CARBON FOOTPRINT

Color/additive masterbatches and pre-colored formulations based on **bio-derived polymers**

REDUCTION IN MATERIAL USE

Chemical Foaming Agent (CFA) for lightweighting

PP wall thinning through nucleation

DESIGN FOR RECYCLABILITY

Design material and formulation to withstand multiple thermal and mechanical cycles

BIODEGRADABILITY

Predictable bio-degradation when there is no possibility of collection/recycling

?

RECYCLING AND RE-USE

Some challenges in collection, consistency and regulatory aspects!

?

REDUCTION OF CARBON FOOTPRINT

IPAC-RS
International Pharmaceutical Aerosol Consortium on Regulation & Science

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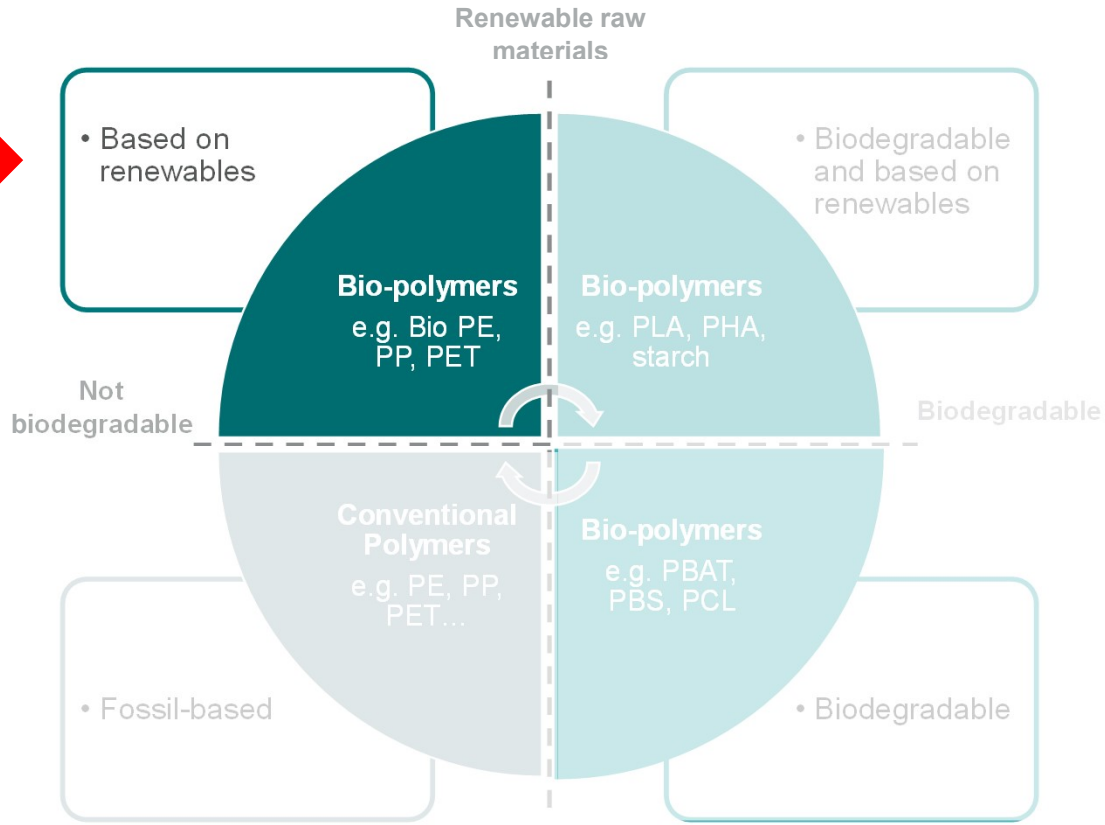
WHAT ARE BIO-POLYMERS?

BIO-POLYMERS ARE BASED ON RENEWABLES OR BIODEGRADABLES OR BOTH

Bio-based polymer solutions

The monomers of bio-polymers are obtained from biological resources instead of fossil-based. E.g., bio-based PE polymer allows up to **3.7 mt CO_2 savings per metric ton of polymer*** compared to similar fossil-based polymer



*Source: Plastic Europe ECO profiles

BIO-BASED POLYMER SOLUTIONS

CHALLENGES

- Most bio-based polymers in the market do not come with pharma-related declarations
- A limited range of bio-based healthcare polymers are (currently) available from resin manufacturers and the healthcare-related declarations cover only the virgin unmodified resin
- It’s advisable to check whether your masterbatch/pre-colored supplier offers a bio-based solution that fulfills your regulatory needs and minimizes risks for your final application

COLOR/FUNCTIONAL BIO-BASED SOLUTIONS WITH BENEFITS

- **Formulated with bio-based polymers**
  Bio content between 70% and 95% (up to 100% in some cases) depending on the polymer
- **Pre-tested raw materials**
  Same medical regulatory documentation as fossil-based medical products: USP, ISO, EP, ICH Q3D (elemental impurities)
- **Drop-in solutions**
  Can be processed the same way as fossil-based plastic grades → no additional investments
- **Recyclable**
  Can be recycled in the same recycling channels as conventional fossil-based polymers

BIO-BASED SOLUTIONS

WHAT IS AVAILABLE MAINLY ON MASS BALANCE APPROACH

	Polyethylene	Polypropylene	ABS	Polycarbonate	Styrenics
Current solutions	Polymer-based masterbatches and ready-to-use formulations Custom color and functional solutions				
Bio-content	• Up to 95%	• Up to 100%	• Up to 80%	• Up to 72%	• Up to 95%
Applications in Healthcare	 	 	 	 	 

REDUCTION IN MATERIAL USE

REDUCTION IN MATERIAL USE

- **Lightweighting**

  Chemical Foaming Agents (CFA) provide added sustainability for polyolefins and styrenics/ABS

- **Wall-thinning for polyolefins**

  Nucleation additives help maximize the properties of PP and PE

- **Full regulatory compliance support**

  Pre-tested raw materials help manufacturers achieve regulatory compliance of end articles:

  - ISO 10993-1
  - USP <87> and <88> (incl class VI)
  - Elemental impurities as per ICH Q3D
  - European Pharmacopeia and USP 661.1 (where applicable)

NUCLEATION

INCREASED PRODUCTIVITY AND WALL THINNING

Nucleation in polyolefins helps to improve performance and processing properties resulting in:

- Improved strength and stiffness, thereby enabling less material use in structural parts and reduction of wall thickness
- Reduction of material costs thanks to reduced material use
- Faster cooling time, thereby shortening the molding cycle time and reducing unit costs
- Weight reduction

DESIGN FOR RECYCLABILITY

DESIGN FOR RECYCLABILITY

- **Improve the ability of materials to be recycled**
  Functional solutions maintain the physical properties and processability of the plastic resin
- The stabilizer needs to be added when **the plastic is processed for the first time,** to ensure that the plastic withstands the thermal and mechanical stress of reprocessing during recycling
- **Full regulatory compliance support**
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  - USP <87> and <88> (incl class VI)
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SUMMARY

- **Reduce your carbon footprint with**:
  - Color/additive bio-based polymer masterbatches
  - Pre-colored and functional formulations
- **Reduce your plastic material usage with**:
  - Chemical foaming agents for light weighting
  - Nucleating agents for PP and PE – increased productivity & wall thinning
- **Design for recyclability**:
  - Add functional solutions that maintain physical properties and processability of the plastic resin
- **No compromise on regulatory compliance**:
  - Obtain full regulatory compliance support for all healthcare polymer solutions

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