Biobased Content

What is Bioplastic?

The term ‘bioplastics’ is often used for a group of different materials based on biomass or the biodegradable character of a plastic. (*However, it is important to note that these two aspects of a plastic – bio-based &* ***bio-degradable*** *– are not synonymous*). Bio-based plastic is a class of plastics which contain organic carbon of renewable origin in part or whole which are derived from plant-biomass (the biomass can have undergone physical, chemical or biological treatment) like:

- Agricultural crops and residues
- Marine and forestry materials
- Bio-waste
- Algae, fungi, etc.

And, the bio-based content of plastics is defined as the % of renewable carbon (i.e. of vegetal origin) over the total carbon content of the material considered bio-based. .image-formula { width: 468px; height: 104px; } @media only screen and (max-width:550px) { .image-formula { width: 100%; height: auto; float:none; margin-left: 0px; margin-bottom: 10px; margin-right: 10px; } }

$$\text{\% of Bio-based content or \% renewable carbon content} = \frac{\text{Bio Carbon}}{\text{Total Carbon}} \times 100$$

It is measured via the 14C method that adheres to CEN/TS 16137 or ASTM 6866 standard.

Continue Reading or Check Out More on Bio-based Content:

» Bio-based Content for Several Plastics
» Different Types of Bioplastics
» Bio-based Labels, Standards and Certifications

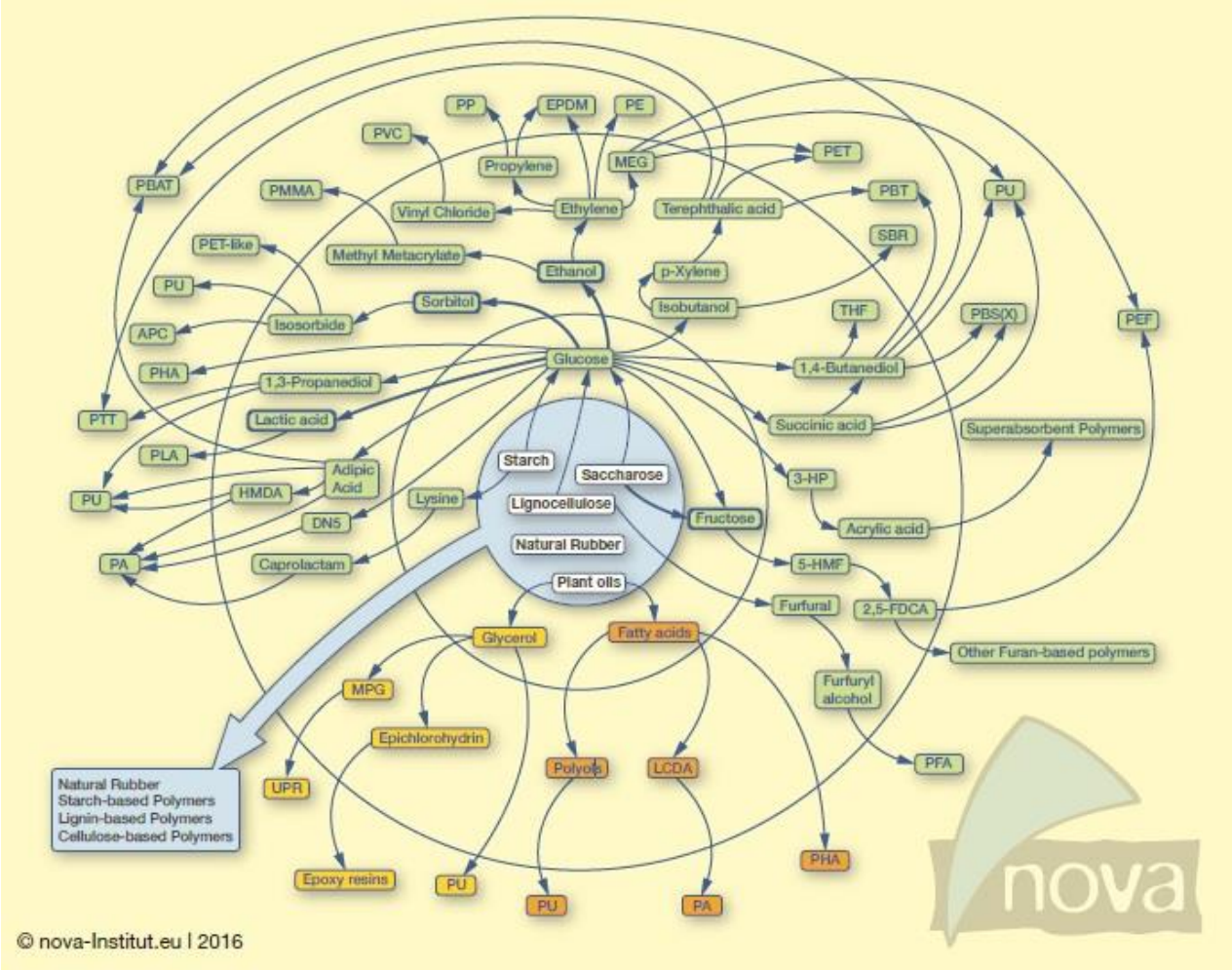
Different Types of Bioplastics

Bio-based plastics can contribute to lowering

- Greenhouse gas emissions
- Demand for fossil resources but contribute to increased use of natural resources

Bio-based plastics are not necessarily biodegradable/compostable and all biodegradable-compostable plastics are not automatically bio-based

Type of Plastic Grade	Petrochemical-derived	Partly Bio-based	Bio-based
Non-Biodegradable	PE, PP, PET, PS, PVC	Bio-PET, PTT	bio-PET, bio-PE, PEF, bio-PP, bio-PAs
Biodegradable	PBAT, PBS(A), PCL, PVA	Starch Blends	PLA, PHA



Pathways to Bio-based Polymers

Some of the important bio-based feedstocks and the polymers that can be produced using these feedstocks:

- Sugarcane: PLA, PHAs, bio-PBS(A), bio-PET, bio-PE, PEF, bio-PP, bio-PAs, PTT
- Sugarbeet: PLA, PHAs, bio-PBS(A), bio-PET, bio-PE, PEF, bio-PP, bio-PAs, PTT
- Corn: PLA, PHAs, starch blends, bio-PBS(A), bio-PE, PEF, bio-PP, bio-PAs, PTT
- Potato: PLA, PHAs, starch blends, bio-PBS(A), bio-PE, PEF, bio-PP, bio-PAs, PTT
- Wheat: PLA, PHAs, starch blends, bio-PBS(A), bio-PE, PEF, bio-PP, bio-PAs, PTT
- Castor seed oil: bio-PAs
- Biomass: PBAT, PBS

» Select the Suitable "Bio-based" Plastic Grade Meeting your Requirement

Bio-based Labels, Standards and Certifications

Existing standards of measuring bio-based content (refers to bio-based carbon content) using 14C content measurement are:

- The European norm **EN 16785-1** "Bio-based products – Bio-based content - Part 1: Determination of the bio-based content using the radiocarbon analysis and elemental analysis"
- The European standard, **EN 16640, 2015**. Bio-based products - Bio-based carbon content - Determination of the bio-based carbon content using the radiocarbon method
- The American standard **ASTM D6866** “Standard Test Methods for Determining the Bio-based Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis”
- The ISO standard **ISO 16620-4:2016** Plastics – Bio-based content - Part 4: Determination of bio-based mass content

(Of course, there exist several other methods as well, but they are not discussed here)

In the polymer industry, this approach is widely used as a fast and reliable protocol for assessment of the “bio-based” content at different stages of the industrial process, such as:

- The control of the raw materials
- The optimization of the synthesis process

- The certification of ready-to-market products, as well as
- The control of the bio-content in products already on the market

ASTM D6866 and USDA Bio Preferred Program

The bio-based carbon content of products is determined independently and unequivocally using radio carbon analysis as codified in international standard **ASTM D6866**.

It is the most widely used test method to assess the pMC (percentage of Modern Carbon which means of vegetal origin) vs the fossil carbon content. It uses radiocarbon (C14) content detection techniques.

This standard utilizes two methods to quantify the bio-based content of a given product:

a. Accelerator Mass Spectrometry (AMS) along with Isotope Ratio Mass Spectrometry (IRMS); or
b. Liquid Scintillation Counters (LSC) using sample carbon that has been converted to benzene

USDA Certified Bio-based Product label certification program, which is voluntary, determines product and package bio-based content for participants worldwide; it uses a process that requires independent laboratory testing according to ASTM D6866.

CEN European Standards/Specifications for Bio based Products

The technical specifications of measuring bio-based content - CEN/TS 16640, CEN/TS 16137 and CEN/TS 16295 – are released by European Committee for Standardization (CEN) Technical Committee:

- **CEN/TS 16295** – Declaration of the Bio-based Carbon Content of Plastics
- **CEN/TS 16137** – Measuring the Bio-based Carbon Content of Plastics
- **CEN/TS 16640:2014** Bio-based products. Determination of the bio-based carbon content of products using the radiocarbon method

These three technical specifications are based on radiocarbon analyses. CEN/TS 16640 is applicable to all bio-based products whereas CEN/TS 16295 & CEN/TS 16137 are only applicable to plastics and polymers.

The bio-based carbon content in a material can be measured according to e.g. ISO 16620-4 or EN 16640. The bio-based content of a material can be determined with EN 16785-1.

The EN 16640 standard expresses the carbon as a percentage of total carbon
The ASTM D6866 standard as a percentage of total organic carbon

Few examples of labels to indicate bio-based content of material:

Bio-based Content for Several Plastics

Polymer Name	Min Value (%)	Max Value (%)
Bio Polyether Block Amide, PEBA(28-32%renewable carbon)	28.0	32.0

Bio PEBA(44-48% renewable carbon)	44.0	48.0
Bio PEBA(62-66% renewable carbon)	62.0	66.0
Bio PEBA(77-81% renewable carbon)	77.0	81.0
Bio PEBA(87-91% renewable carbon)	87.0	91.0
Bio PEBA(93-97% renewable carbon)	93.0	97.0
CA - Cellulose Acetate	100.0	100.0
CAB - Cellulose Acetate Butyrate	100.0	100.0
CP - Cellulose Proprionate	100.0	100.0
PA 11 - (Polyamide 11) 30% Glass fiber reinforced	100.0	100.0
PA 11, Conductive	100.0	100.0
PA 11, Flexible	100.0	100.0
PA 11, Rigid	100.0	100.0
PCL - Polycaprolactone	0.0	0.0
PE/TPS Blend - Polyethylene/Thermoplastic Starch	0.00	39.0
PGA - Polyglycolides	100.0	100.0
PHB - Polyhydroxybutyrate	100.0	100.0
Poly(hydroxybutyrate - co- valerate) PHB-V(5% valerate)	100.0	100.0
PLA - Polylactide, Fiber Melt Spinning	100.0	100.0
PLA, Heat Seal Layer	100.0	100.0
PLA, High Heat Films	100.0	100.0
PLA,injection molding	100.0	100.0
PLA, Spunbond	100.0	100.0
PLA, Stretch blow molded bottles	100.0	100.0

TPS/PE BLend - Thermoplastic Starch/ Polyethylene Blend (30 micron films tested)	40.0	59.0
TPS, Injection General Purpose	100.0	100.0
TPS, Water Resistant	100.0	100.0