

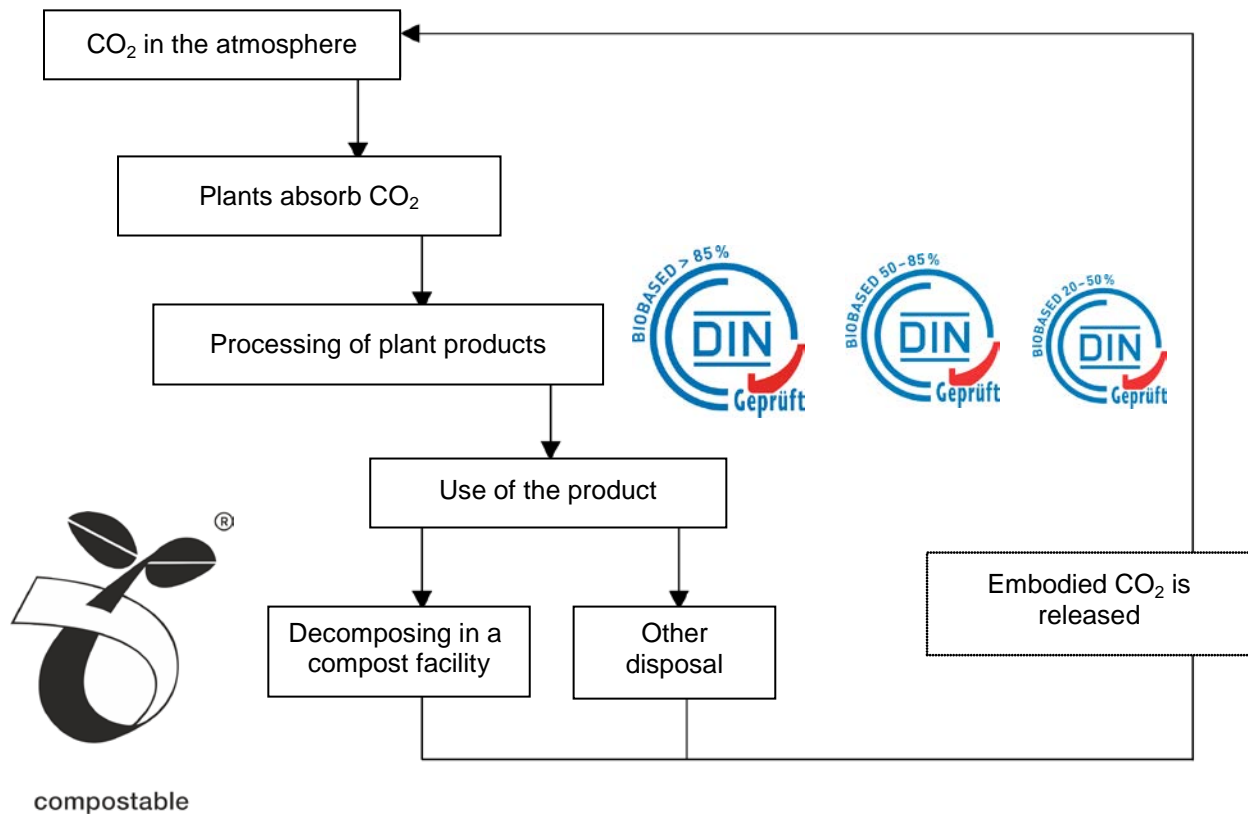
## Data sheet on bio-based products and the <sup>14</sup>C-method

### Sustainability

Ecological sustainability aims to preserve the environment and resources for future generations. All organic material, whether of animal or plant origin, produces CO<sub>2</sub> emissions that are hazardous to the environment, for instance, when decomposing or being burned. Sustainability means minimizing CO<sub>2</sub> emissions and also protecting resources and making minimal use of finite raw materials.

### Bio-based Products

Bio-based products are made from raw materials that have absorbed as much CO<sub>2</sub> during their short growth as they will release when they are disposed of and/or burned. The removal or replacement of fossil based products in a manufacturing process greatly reduces harmful effects to the environment. This is shown below as an example diagram.



Bio-based materials or products are completely or partially composed of renewable resources. Additionally, bio-based products could be biodegradable. This depends on the chemical composition and on further additives that may have been used. The compostability of a product can be proven by certification under the relevant schemes offered by DIN CERTCO.

### Examples of Product Groups

- Bio-based and biodegradable, e.g. polyesters formed by bacteria
- Bio-based and not biodegradable, e.g. polyethylene produced from bioethanol
- Of fossil origin and biodegradable, e.g. biodegradable plastics on mineral oil basis
- Of fossil origin and not biodegradable, e.g. polyethylene produced from fossil sources

### Determination of Bio-based Content

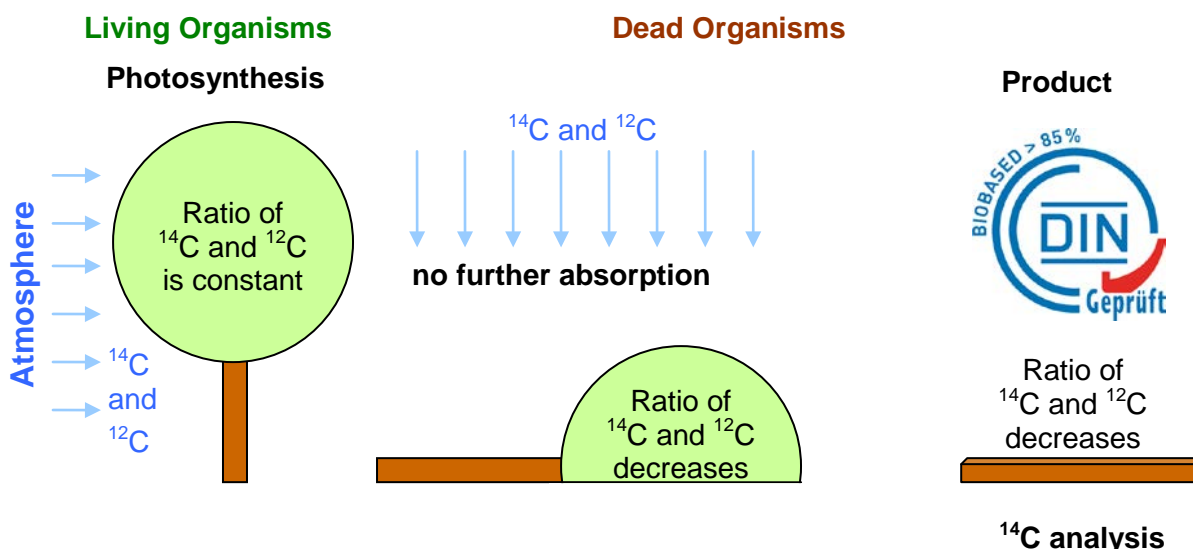
Using the  $^{14}\text{C}$ -method, the age of an organic resource is determined, and it is thus designated as fossil or bio-based.

### Organic Compounds

They consist of carbon, hydrogen and other atoms. All animal and vegetable-based materials, (also called biomass), contain organic compounds.

### Isotopic Ratio

$^{12}\text{C}$  and radiocarbon ( $^{14}\text{C}$ ) are carbon isotopes: carbon atoms with various atomic masses. The ratio between  $^{12}\text{C}$  and  $^{14}\text{C}$  is the same in a living organism as it is in the atmosphere. Living biomass absorbs  $^{12}\text{C}$  and  $^{14}\text{C}$  isotopes during metabolism through food or photosynthesis. If the metabolism of an organism stops, no further radiocarbon is absorbed. The isotope ratio decreases with time, because the  $^{14}\text{C}$  isotope decays within a half-life of 5730 years. However,  $^{12}\text{C}$  is a stable carbon isotope and shows no decay.



### $^{14}\text{C}$ -method

Using the  $^{14}\text{C}$ -method, the content of  $^{14}\text{C}$  isotopes in an organic material is determined. The method is a recognized and safe process that is specified in testing standards and has proven its usefulness, for instance, in archaeology for determining the age of bones.

The  $^{14}\text{C}$ -activity shows the bio-based carbon content of the product as a percentage.