PlasticsEurope
Association of Plastics Manufacturers

MASS BALANCE APPROACH TO ACCELERATE THE USE OF RENEWABLE FEEDSTOCKS IN CHEMICAL PROCESSES

Climate protection, reduction of greenhouse gas emissions and saving of fossil resources are key elements for a more sustainable future. The use of renewable feedstocks in historically solely fossil based chemical processes can contribute to meet these challenges. This view paper aims to introduce key criteria when applying mass balance and to ensure a verifiable and certified approach is applied for companies willing to accelerate the use of renewable feedstocks along the value chain. Standards owners should show the application of these key criteria in their standards.

In those so-called mass balance approaches, renewable feedstocks are used instead of fossil feedstocks in existing efficient, complex and interlinked multi-step chemical production systems and supply chains thereby contributing to the bio-economy, the renewable segment of the circular economy.

This view paper focuses on mass balance approaches for renewable feedstocks.

Background

Mass balance is one of several well-known Chain of Custody approaches which can be used to trace the flow of materials through the value chain resulting in associated claims. Other chain of custody models include: Identity preserved, segregation and book and claim with certificate trading within open markets. These different Chains of Custody vary in terms of detailed knowledge of the source of the product, the complexity of implementation, and the renewable content in the end-product, which will in turn affect the allowed claims.

For the use of renewable feedstocks, specific production technologies may be developed and applied, which transform a renewable feedstock like e.g. sugar, vegetable oils, wood waste in segregated production plants into a bio-based chemical being used in various applications. The Chain of Custody linked to those approaches is identity preserved or segregation. Those approaches are not part of this view paper because they are covered by the CEN/TC 411 ”bio-based products” standard.

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The plastics industry is committed to accelerate the uptake of renewable feedstocks. By using such feedstocks in its existing production plants and supply chains, the demand and supply of renewable materials will be further enhanced all over the value chain by means of large scale, resource efficient installations. However, as the renewable feedstock is processed together with non-renewable feedstock, it might not be physically traceable throughout the production processes. Therefore, there is a need to attribute the renewable feedstock to an end-product in a fully transparent and auditable way. This approach can be seen as complementary to other efforts in the production of bio-based chemicals/plastics. It allows a drop-in solution in existing chemical installations and logistics. In this case, the mass balance Chain of Custody approach is applied.

Due to the temporal and/or geographic dispersion and (initial) volumetric dilution effects of such multi-step production processes on the original renewable feedstock, the final products are not bio-based according to the CEN/TC 411 “bio-based products” definition [1]. Products under this view paper cannot therefore be called “bio-based”. The actual carbon molecules in the chosen chemical/plastic may not be bio-based, but through a third-party certificate, the use of the renewable feedstock and the corresponding attribution to certain amounts of chemicals/plastics can be verified. This view paper serves to gain acceptance and credibility of this mass balance approach to the market.

Book and Claim Chain of Custody with certification trading on an open market is not part of this view paper.

Scope

This view paper describes key criteria companies should adhere to when applying the mass balance approach in chemical processes. This is about the use of renewable feedstocks in the production of chemicals/plastics leading to a gradual substitution of fossil resources by renewable feedstocks and attribution along the value chain.

Current Focus

The mass balance approach can either be based on physical connections globally applicable or geographical transfer of product characteristics without physical connection currently limited to Europe. This latter transfer of product characteristics can be an option when renewable feedstock availability or quality at the entry point would be inadequate and/or complicated company internal material supply chain logistics can be avoided. Similar logistic considerations hold for the availability and efficient use of process units and supply chains that convert renewable (attributed) intermediates into products reducing transport and hence enhancing supply chains. The condition for such transfer of product characteristics is that the transfer takes place between sites producing the same substance under special contractual agreements. In the latter case, the focus is today limited to Europe to test the approach.

[1] https://standards.cen.eu/ - CEN/TC 411 – Bio-based products

Outlook

If the approach of geographical transfer without physical connection currently limited to Europe is successful, the objective will be to expand it to a global scale. To do so, it will be necessary to agree on a process that will lead to such a decision, taking elements such as legal, social and economic impacts (including European industry competitiveness) into consideration. The final decision to go global will have to be unanimously taken by the PlasticsEurope mass balance task force members.

Further to renewable feedstocks, the industry will also tackle waste and recycled materials applying the mass balance approach to accelerate the use of this alternative feedstock in the production of chemicals/plastics. This will be published in a separate view paper.

Key criteria when applying mass balance approach

Companies applying mass balance in their chemicals and plastics production processes will ensure the following key criteria are met and auditable by an independent third party thus guarenteeing credibility of the claim.

1) **Feedstock qualification:** A clear description of the qualification of the responsibly sourced renewable feedstock and how it contributes to a measurable greenhouse gas saving compared to its fossil counterpart.

2) **Chain of Custody:** The system boundaries and scope to the chain of custody shall be clearly defined. Material flow along the Chain of Custody and bill of materials shall be third party auditable. Each Chain of Custody approach shall require a publically available standard.

3) **Product claims:** The product claims shall be verifiable and certified. These products are Renewable Attributed Products and must not be called “bio-based products”.

Those key criteria are compulsory and further described in the appendix.

Recommendation

PlasticsEurope recommends the development of a harmonised standard for mass balance approach which includes mutual recognition of possible different standards.

Acknowledgement

A special thank goes to the experts from ISCC, TÜV Süd, RSB and EY for providing comments and guidance in the technical discussions.

We are also grateful to stakeholders along the value chain who provided insightful comments during this journey. Some PlasticsEurope member companies are already applying the mass balance approach. Through this work we continue to learn. We know we will need to work closely with all stakeholders going forward to gain further acceptance of the mass balance approach as described in this view paper. We hope that you will join us in this journey and invite you to continue providing comments on our view paper.

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Appendix – Current Focus

1) Feedstock qualification

- Feedstocks shall be responsibly sourced and shall be certified renewable by independent third party certification bodies based on existing multi-stakeholder standards and/or legislation based labels and schemes

- Greenhouse gas savings compared to replaced fossil feedstock: It shall be proven and auditable that the renewable feedstock chosen has a measurable greenhouse gas saving compared to its fossil counterpart

2) Mass balance approach - Chain of Custody

- System boundaries and scope for Chain of Custody shall be defined for the included options:
    - Physical transfer (of chemicals) through production plants and sites (physical connection e.g. pipelines, trucks, trains, ships,...)
    - Geographical transfer of product characteristics without physical connection and flow if transfer takes place between production sites for the same substance under special contractual conditions to avoid double-booking. Those certificates must not be traded on the open market but within the same holding company in a contractually defined B2B relationship. This transfer is to take place for now only in Europe to test this approach (see the outlook section regarding the envisioned potential future extension)

- Bill of material for each product shall be third party auditable
    - Indicate what % of fossil feedstock has been replaced[2] by renewable feedstock for the product
    - Describe calculation rules for attribution and transfer of biomass units to the bill of materials based on:
        - An energetic determination or
        - The chemical reaction of the process taking the efficiency/losses, respectively the relationship of the feedstock and the product (yield) as well as additional inputs of the process into account

- Describe any significant additional energy needed compared to the baseline scenario (i.e. fossil production), GHG emissions or losses that may occur during the processing of the renewable feedstock

- Standardisation and certification
    - Each mass balance approach shall require a publicly available standard
    - Each standard shall comprise the following criteria:

[2] This is about balancing feedstock and not utilities

- Regular audits (annual) (checking Input-Output-Balance)
- Materiality should be described
- Booking period (e.g. 1 calendar year) should be described in the standard

- Negative balance is not allowed beyond 3 months
- Expiration date of biomass attribution units shall be described in the standard and is not depending on the booking period
- Biomass attributed along the value chain shall be controlled in order to avoid double counting: the underlying standard has to ascertain and explain it

3) Product claims according to ISO 14021[3]

- The products under this paper are "Renewable Attributed Products"
- Claims shall reflect the Chain of Custody
- Further claims are derived from exchanging fossil feedstock by renewable feedstock in the process as described above. Possible claims include:
  - fossil resource savings (e.g. x % of fossil resources are replaced by biomass) or;
  - fossil carbon savings (e.g. x % of fossil carbon are replaced by bio carbon)
  - Optional: in case of GHG reductions, a LCA standard needs to be used. (e.g. x % of GHG saved according to standard xyz)

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[3] https://www.iso.org/standard/66652.html

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Glossary

Attribution: the action of a virtual transfer of a quality or feature of the process input (feedstock) as characteristic to the process output (product).

Bill of Materials: A bill of materials or product structure (sometimes bill of material, BOM or associated list) is the list of the raw materials and quantities of each needed to manufacture an end product as referred to the Product Environmental Footprint Category Rules Guidance, Version 6.3 of December 2017.

Certification: the action or process of providing someone or something with an official document attesting to a status or level of achievement.

Chain of Custody: Chain of Custody is a general term for making a connection between sustainability information or claims regarding raw materials, intermediate and final products. In practice, this is about implementing and verifying control mechanisms for each economic operator in the chain. Each party in the supply chain must comply with this process, otherwise the Chain of Custody is lost. Different Chain of Custody methods are available for the handling of sustainable materials along the supply chain.

Mass Balance: in mass balance, renewable feedstock is attributed to selected products, according to their individual formulation taking into account all yields and losses. Only raw materials used as feedstock (but not for energy) for the production should be considered for mass balancing.

Materiality: Within auditing, materiality is the concept that identifies the significance of a quantity. Within the context of this paper, materiality refers to which inputs and outputs of a chemical process are significant.

Renewable Feedstock: Materials that have been produced from a source, usually plant or animal biomass, that can be renewed by short- to medium-term regeneration as referred to in ISO 24699 section 3.1.1

Renewable Attributed Products: are selected products to which the renewable feedstock has been attributed to.