Which is the best definition for the biodegradable FADs?

Zudaire I.[1], Suarez M.J.[2], Grande M.[1], Retolaza J.[2], Santiago J.[3], Murua J.[3], Tolotti M.T.[4], Dagorn L.[4], Ramos M.L.[5], Baez J.C.[5], Moreno G.[6], Murua H.[1]

[1]AZTI, Pasaia, Spain
[2]GAIKER, Zamudio, Spain
[3]AZTI, Sukarrieta, Spain
[4]MARBEC (IRD, University Montpellier, Ifremer, CNRS), Séte, France
[5]IEO, Santa Cruz de Tenerife, Spain
[6]ISSF, Washington DC, USA

Abstract

The use of non-entangling and biodegradable components-based FADs (i.e., BIOFAD) by the tropical tuna purse seine industry is promoted by tuna Regional Fisheries Management Organizations through different recommendations and resolutions published during the last years. This implies the development of an accurate definition of what a BIOFAD should be, and specially the conditions to be met by the materials used in their construction when applying biodegradability requirements for permitted materials. This document tries to address specific conditions to be considered when the word biodegradable is applied to define the materials used for BIOFAD construction.

1. Introduction

Fish Aggregation Devices (FADs) were first introduced in the Indian Ocean in the early 90s (Fonteneau et al., 2013). Since then, the use of FADs by the tropical tuna purse seine fishery has been increasing progressively up to 2015 when FAD limitations started to be implemented in the region (IOTC Res. 15/08, 16/01 and 17/08). In parallel, in the last decade, the Indian Ocean Tuna Commission (IOTC) has made efforts to eliminate FADs with high entanglement risk characteristics, as it is believed that this may affect negatively sensitive species like sharks, and other associated non-target species. Currently most FADs deployed are made with synthetic materials (e.g., nylon ropes or small pelagic fishing nets) which contribute to the increase of marine litter (Dagorn et al., 2012) and other potential negative impacts for the ecosystem, such as FAD beaching (Maufroy et al., 2015, Zudaire et al., 2018). Along these lines, the IOTC has defined procedures on FAD Management Plans through resolution 13/08, with Annex III called for the reduction of synthetic marine debris, by promoting the use of natural or biodegradable materials for FADs (IOTC, 2013). Similarly, tuna RFMOs in other oceans, have also addressed these impacts and adopted several recommendations and resolutions to gradually replace existing FADs with non-entangling FADs and promote research on biodegradable FADs (ICCAT Rec. 16-01 and IATTC C-17-02).

FADs can be classified according to the type of materials and the configuration of the components used in their construction, and several FAD definitions have been proposed. For example, the International Seafood Sustainability Foundation (ISSF) defines 4 different FAD types (ISSF, 2015). The first three refer to their entanglement risk, focusing on the absence or presence of netting material and mesh size (i.e. stretched mesh > or < 7 cm) in the FAD (i.e., HERFAD, LERFAD and NEFAD), while the fourth one (i.e., BFAD) classifies FADs based on their material construction with natural or biodegradable materials (ISSF, 2015). Other names such as BIOFAD, ECOFAD, NED, etc. have also been used to refer to those FADs made with non-synthetic materials. The use of the terms natural or biodegradable to refer to those FADs is widely accepted by tuna RFMOs (IOTC Res. 17/08; ICCAT Rec. 16-01; and IATTC C-17-02). However, its implementation when constructing FADs is not so straightforward, as a biodegradable material is subjected to certain preconditions and the definitions currently used by RFMOs are vaguely described, lacking accuracy.

The main goal of this document is to propose a first tentative definition for BIOFADs (non-entangling and biodegradable FADs) and to open the discussion to address minimum necessary conditions (e.g. materials, derived-components and environmental considerations) to be considered when the term biodegradable is applied to define the materials used for BIOFAD construction.

2. Requirements for biodegradable materials

The term “biodegradable” is applied to materials or substances that are subject to a chemical process in which microorganisms in the environment (sea, soil, etc.) convert the original materials into natural substances such as water, carbon dioxide, and compost. The process of biodegradation depends on the surrounding environmental conditions (e.g. location or composition of the media, humidity and temperature), on the type of material and on its application (i.e., thickness) (https://www.european-bioplastics.org/).

Organic materials completely disappear on land because they are a food source for soil organisms, however, this behavior may not be the same in marine environments. To claim that a material is biodegradable in marine conditions (or other environments) it is necessary to account for the time frame required to consider it as “biodegradable”. This time frame is generally defined according to specific standards.

In this section, we will take plastics as an example, as they are the materials for which standards are best defined, both in terms of definitions of testing methods and certification scales. There are various international standards for certification of compostable (organically recycled) plastics in industrial composting plants and other natural environments (i.e., soil or marine):

Some examples of industrial composting standards:

- EN 13432:2000 Plastics for packaging
- EN 14995:2006 Plastics in general
- ISO 18606 Plastic for packaging
- ISO 17088 Plastics y general
- ASTM D 6400 (USA standard for plastics compostable in industrial or municipal facilities)

- AS 4736 "Australian Standards, for "Biodegradable plastics suitable for Composting and other microbial treatments".

There is also the possibility for "biodegradable in soil" (i.e., EN 17033) or "marine" (i.e., ASTM D6691, ASTM D7881) certification, depending on the testing conditions. These are the requirements that need to be validated under European standards (i.e., EN 13432 or EN 14995):

- **Chemical test:** Disclosure of all constituents, i.e., threshold values for heavy metals that need to be assessed to.
- **Biodegradability in controlled composting conditions (oxygen consumption and production of CO2):** Proof must be made that at least 90 percent of the organic material is converted into CO2 within 6 months.
- **Disintegration:** After 3 months' composting and subsequent sifting through a 2 mm sieve, no more than 10 percent residue may remain, as compared to the original mass.
- **Practical test of compostability in a semi-industrial (or industrial) composting facility:** No negative influence on the composting process is permitted.
- **Ecotoxicity test:** Examination of the effect of resultant compost on plant growth (agronomic test).

Despite the above mentioned and considering that ASTM D7081 has been withdraw (without replacement for the moment), there is no accepted standard for biodegradation of plastics in marine environments which can provide a pass/fail criteria. However, there are companies like Tuv Austria (former VinÇootte) that offers a certification scheme based on ASTM D7081, which demands, in a simplify way, a biodegradation of at least 90% of the material in a period of 6 months. In addition, the previous ASTM 7081 stablishes that the materials also had to pass the compostability standard of ASTM D6400.

3. Implementation of biodegradable term in FADs

The absence of a clear regulatory framework defining the standards and test methods for biodegradable materials in the marine environment prevents a clear definition for the type of materials that could be permitted in BIOFAD construction.

Besides regulatory issues regarding FADs, an important question is if the term biodegradable should then be applied to the materials themselves or to the final product (i.e., FAD) that is composed of various parts. In the latter, each of them may have different functionality/duration (timeframe), shape (thickness) and environmental associated impacts, as the FAD can become a potential residue as whole or disaggregated into parts.

To establish the potential definition for BIOFADs, the following points have been considered:

- **Type of materials and configuration:** use of naturally occurring materials (e.g., bamboo, cotton, or vegetal fibers), or in their absence, prioritizing bio-based/biodegradable compounds able to subject to certain assessed requirements complying with international standards. In any case, materials meeting previous requirements must be always non-entangling following ISSF criteria for NEFADs.
- **The environmental impacts:** for example, cumulative impacts by plastics or other synthetic materials from FADs (e.g., long-term accumulation in coastal and marine environments), as well as the high number of whole FADs lost should be considered to assess real impacts.
- **Durability and functionality:** a time frame for biodegradability should be determined, always considering fishing industry functional requirements to achieve a sufficient working lifetime of a FAD (e.g. estimated at 1 year). FAD material disintegration velocity should be compatible with the requirements of compostable regulations described according to specified standards.
- **Technical feasibility:** for different FAD parts to be replaced by biodegradable alternatives (depends on the material but also on the physical characteristics of the material used, such as its thickness).

The following is the first tentative BIOFAD definition taking into consideration all the above-mentioned. This definition has been developed from a material point (e.g., *lignocellulosic materials and/or bio-based biodegradable plastic compounds*) of view rather than the final product (e.g., floats or the FAD itself):

A BIOFAD will be composed of non-netting form renewable lignocellulosic materials (i.e. plant dry matter) and/or bio-based biodegradable plastic compounds, prioritizing those materials that comply with international relevant standards or certification labels for plastic compostability in marine, soil or industrial compost environments. In addition, the substances resulting from the degradation of these materials should not be toxic for the marine and coastal ecosystems or include heavy metals in their composition. This definition does not apply to electronic buoys attached to FADs to track them.

Acknowledging the difficulties inherent to the implementation of this definition for FADs, the following three points would be interesting for discussion:

- The possibility that the definition of BIOFAD should include a minimum proportion (i.e., determined by the percent of total weight or surface) of biodegradable material required for the term biodegradable or utilization of certain biodegradable parts. The term bio-based could be applied to all the parts, including plastics if these are finally allowed and always that they meet with BIOFAD definition.
- Based on the previous point and subjected to the method selected to establish the biodegradable proportion of a FAD, different levels/categories of BIOFADs could be defined, for example similar to ISSF classification for FAD's entanglement risk (ISSF, 2015), and targeting 100% biodegradable FAD established in the definition.
- The possibility of applying an ecolabel or hierarchy scheme in the definition of biodegradable FADs according to results from Life Cycle Analysis for types

of materials used in different BIOFAD constructions. This selection could be defined according to functionality criteria providing technical solutions for the different parts such as tail structure, floating elements, etc. and prioritizing the materials according to:

- Certified as Biodegradable in the marine environment or compostable.
- Bio-based or obtained from natural resources but also recycled in a circular economy frame (“from marine water to marine application”).
- Materials reducing carbon footprint (from marine waste).

4. Reference

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