Maeve Thornberry & Associates

Oyster Bag Waste Management

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Introduction

Bord Iascaigh Mhara (BIM) is Ireland's seafood development agency, and provides technical expertise, business support, funding and training to those directly involved in the fishing and seafood industry. It also promotes responsible environmental practices by those engaged in the seafood sector and it is under this remit that the project was conceived. BIM works closely with the majority of oyster growers operating around the coastline of Ireland and they have advised that a common waste management issue is finding the most environmentally-sound end-of-life process for oyster bags which are no longer in use.

While one major supplier of oyster bags to growers in Ireland offers a take-back scheme and recycles the bags in Spain, BIM decided to fund a project to explore recycling and re-use options for the bags which could be found closer to home.

Background and Context

In the decades since the use of plastics became widespread, the management of plastics as they reach end-of-life, has not kept up pace with their consumption. As a result, tonnes of waste plastics have been finding their way into the marine environment for more than 50 years. While many environmentalists and scientists have been highlighting the perils of using the oceans as a dumping ground for more than four decades[1] it took a wildlife documentary narrated by Sir David Attenborough, which aired in 2017[2], and publications from NGOs and other organisations, such as the Ellen MacArthur Foundation[3], to drive home a message to society at large that the current use of plastics cannot continue unabated and improved waste management practices are vital in order to stem the flow of plastics and other litter into the seas.

The BIM-coordinated Fishing for Litter Programme[4] highlighted the issue of fishermen finding rubbish in their nets; the programme is designed to improve port reception facilities in harbours around the coast and therefore encourage fishermen to bring items of litter back to shore where facilities to segregate and collect the litter items have been developed. Building on the success of the Fishing for Litter campaign the Minister for Agriculture, Food & the Marine launched the Clean Oceans Initiative[5] in January 2019 as Ireland's first coordinated scheme on land and at sea to collect, reduce and re-use marine litter and clean up the marine environment.

[1] Ryan P.G. (2015) A Brief History of Marine Litter Research. In: Bergmann M., Gutow L., Klages.M. (eds) Anthropogenic Litter. Springer Cham. Available at: https://link.springer.com/chapter/10.1007/978-3-319-16510-3_1 Accessed 28 June 2019

[2] Available at: https://www.bbcearth.com/blueplanet2/ Accessed 28 June 2019

[3] World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, *The New Plastics Economy – Rethinking the Future of Plastics.* Published 2016. Available at: https://www.ellenmacarthurfoundation.org/our-work/activities/new-plastics-economy/2016-report

[4] Available at: http://fishingforlitter.org/ireland/ Accessed 14 June 2019

[5] Available at: https://www.agriculture.gov.ie/press/pressreleases/2019/january/title,123244,en.html Accessed 9 October 2019

Other Factors

EU Directive June 2019

More recently, the publication of the EU Directive 2019/904[6] on 5 June 2019 "on the reduction of the impact of certain plastic products on the environment", commonly referred to as the Single Use Plastics Directive, has focused attention, not only on consumer single-use products, such as coffee cups and takeaway food containers, but also on fishing gear.

Per the Directive, the definition of "fishing gear" means any item of equipment that is used in fishing or aquaculture to target, capture or rear marine biological resources or that is floating on the sea surface and is deployed with the objective of attracting and capturing or of rearing such marine biological resources. This definition leads to the conclusion that oyster bags are included in all references to fishing gear.

As oyster bags are in use for anywhere between 5-15 years however, they could not be construed as single-use; however, based on the definition above they fall into the category of fishing gear, and as such, will be subject to the requirements under the Directive i.e. an Extended Producer Responsibility (EPR) Scheme, once it is transposed into Irish law. The deadline for the implementation of this part of the Directive is 31 December 2024. In theory this means that the manufacturers of the bags will have to ensure that there is a take-back system or suitable alternative in place for end-of-life bags; in reality, it is unclear exactly what obligations will have to be met and how they will be fulfilled.

Origin Green programme

In a bid to demonstrate their high level of environmental performance and to further develop their sales and marketing efforts, many Irish oyster growers are, or are in the process of becoming, Origin Green[7] verified companies. The sustainable food programme, run by Bord Bia, has a number of strict criteria which must be met in order for companies to use the Origin Green logo as part of their marketing materials. Currently it requires its member companies to manage their waste responsibly and set targets for improvement. Finding a recycling and/or reuse solution for their end-of-life oyster bags could become crucial for successful verification by oyster growers in the future.

Lack of waste management options

Disposing of any waste has generally become more difficult and expensive in recent years, with the closure of most landfill sites in Ireland. The cost of paying a registered waste contractor to collect

[6] "Directive (EU) 2019/204 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment". Available at: https://eur-lex.europa.eu/eli/dir/2019/904/oj

[7] Bord Bia Origin Green Programme, available at: https://www.origingreen.ie/ Accessed 19 June 2019

waste and landfill same can be significant. Waste-to-Energy, through incineration, is now the disposal method for much of Ireland's "black bin" waste, but incinerator plant managers don't necessarily want large amounts of plastic entering their feedstock streams; plastics have a higher Calorific Value than general waste, and in large amounts can raise the average Calorific Value of material for incineration, above the optimum value at which both incineration plants in Ireland operate.

It is against this backdrop that that oyster growers find themselves under increased pressure to explore responsible ways of disposing of their end-of-life oyster bags; given that HDPE is fully recyclable, bags no longer in use should be viewed as a resource rather than waste material.

High Density Polyethylene (HDPE) – Recycling & Re-use

Oyster bags are generally produced from High Density Polyethylene, commonly known as HDPE. It is a particularly strong and durable plastic and can be injection- or blow-moulded into a variety of forms[8].

Like most plastics, HDPE is fully recyclable, through a granulation process[9], though much depends on what additives have been used during the initial production process and any contamination arising from use. According to tests[10] carried out in 2018 by a European company, ESE World BV, HDPE can be recycled up to 10 times without losing its characteristic strength.

On this basis the project team took the view that there was potential value in the end-of-life bags, for recycling purposes. Based on the general durability of HDPE, options for re-use of the bags were also examined.

Oyster bags and suppliers

Irish oyster growers require several thousand bags to operate at any one time, and it would appear that they have little selection in terms of purchasing their oyster bags; there are a relatively small number of suppliers to choose from (see Table 1 below).

The main supplier is Intermas, part of the Intermas Group, a large plastics company with plants in both France and Spain, that supplies direct to (the larger) oyster growers and through a distribution agent in Sligo (Triskell Seafood).

[8] The Association of Plastics Recyclers, available at: https://www.plasticsrecycling.org/hdpe Accessed 19 June 2019
[9] Plastic Expert, available at: https://www.plasticexpert.co.uk/plastic-recycling/hdpe-plastic-recycling/ Accessed 8 July 2019
[10] ESE World, available at: https://www.ese.com/en/ese-world/ese-news/news-details/article/hdpe-multiple-recycling-proven-in-an-experiment/ Accessed 28 June 2019

The reminder of the bags are generally supplied from China; It's understood that growers who source their bags from China are doing so on the basis that they are selling their product into the Chinese market, have attended trade shows and visited growers there, and so have used their connections to develop relationships with Chinese bag suppliers.

The provenance of the bags brought in from China is more difficult to determine, as their manufacturing processes are not subject to the same stringent regulations as factories operating in the EU. While it's unlikely that materials, other than HDPE, are used in the manufacture of the bags, there's no way of guaranteeing this is the case without subjecting the bags to a rigourous testing exercise. It was decided to include testing of samples of both Intermas and Chinese-supplied bags within the project parameters. The details and conclusions are included in the Plastics Testing section below.

Table 1. Oyster bag suppliers to Ireland

TYPE	COMPANY NAME	COMPANY WEBSITE	LOCATION
Manufacturer	Glory Aquaculture	http://www.oystermeshbags.com/about.htm	China
Manufacturer	Shijiazhuang Taoni Import & Export Trading Co.	https://moonlightli.en.ec21.com/Products--4241011.html	China
Manufacturer	Intermas	http://www.intermasgroup.com/en.html	France
Manufacturer	CNG Emballages	http://www.cngemballages.fr/en/oyster-mesh-bags/	France
Supplier	Triskell Seafood	https://www.triskellseafood.com/	Ireland
Supplier	Atlantic Weave	https://atlanticweave.com/	Ireland
Supplier	Deise Aquaculture	None	Ireland
Supplier	Carrymacarry Net Works	http://www.carrymacarry.com/page8.html	Ireland
Supplier	Silver Strand Rope Works	http://silverstrandropeworks.com/	Ireland
Supplier	SA Cooperative Maritime Des Pecheurs et Ostreiculteurs	https://www.comptoirdelamer.fr/	France
Supplier	Bakker	http://www.wbakker.com/index.php/en/home	Netherlands

Oyster bags in use

Oyster seeds start in the "nursery" under controlled conditions; once the seeds have grown sufficiently in size, they are placed in fine mesh bags to commence the maturation process. As they grow, the oysters are separated or "thinned" and moved into larger mesh bags.

Oyster bags, once the oysters have been placed in them, are strapped, using hooks and elastics, onto trestles on the foreshore, so they are covered in water when the tide is in, and exposed to the air when the tide is out. There are hundreds of trestles in operation, each carrying a number of

oyster bags. The oysters are regularly tended, which involves agitating them in the bags to ensure that they don't grow into one another and the bags themselves are turned over.
As oysters can take up to three years to mature fully, the bags are exposed to the elements for long periods of time. As a result of wear and tear, rips can develop which are repaired using cable ties and other materials.

Bags on average are about 75cm in length and 35cm in width. The design is similar to that of an envelope; the bags are sealed on three sides with an opening at the top for access.

The bags each weigh between 650 and 800 grammes. Young oysters are grown initially in finer mesh bags and then transferred to larger mesh bags as they develop. This means that growers have two or more different mesh sizes in their stock-piled bags.

Photo 1. Trestles and oyster bags on the foreshore

Photo 2. Oyster bag with hooks, rubbers and cable-tie repair

Number of bags & Locations

The main oyster growers, responsible for about 65% of Ireland's total production, can be found in five counties:

- Donegal
- Sligo
- Louth
- Waterford
- Wexford

These counties are where the majority of the bags are stockpiled, albeit there are smaller growers operating in other coastal counties as well, with smaller clusters of end-of-life bags.

A survey of these larger growers (see Appendix D for details) was conducted by telephone by BIM, to ascertain more specific details about the number of bags in use, their bag supplier(s), the proportion of bags coming to end-of-life each year and an estimation of the number of end-of-life bags each has stockpiled.

Number of bags in use

The number of bags in use varies between the growers, depending on the size of their foreshore sites; the smallest grower surveyed has about 30,000 bags in use while others have 200,000 bags or more. Using the survey results, it's estimated that oyster growers around the coast of Ireland have in the region of one and a half to two million bags in use at any one time. As growers operate year-round with little seasonal variation, these figures would not fluctuate year-on-year. However, with oyster production expected to rise in the next five years, due to increased market demand, particularly from France and Asia, the number of bags required to operate will also increase.

BIM's Aquaculture data manager interrogated the information he gathers every year to complete a suite of reports. His analysis is that in the region of 4-6 million bags are in use, although he advised that there were a number of assumptions made to produce this figure, which could be over-stated. Either way, the number of oyster bags in use at any time is likely to be at least two million, a considerable amount when one considers the relatively small size of the industry here.

Number of bags reaching end-of-life annually

The estimated number of bags coming to end-of-life on an annual basis varies again, from between 1% and 5% of the total in operation. Using an average of 3%, this would indicate that somewhere between 45,000 and 60,000 bags (based on the lower estimated number of bags in use figure above) come to end-of-life collectively by all growers each year. It should be noted though, that growers tend to buy large batches of bags periodically, perhaps every 3 or 5 years. If all the bags are put to use around the same time, this means that there are likely to be spikes and dips in terms of bags coming to end-of-life.

Number of bags stockpiled

Here the number of "waste" bags that the individual growers have fluctuates considerably. Some have few or no bags stockpiled at all, while others have several thousand stored on their premises. As the bulk of Irish oyster growers are concentrated in the five counties of Donegal, Sligo, Louth, Wexford and Waterford, this is also where the largest concentrations of stockpiled end-of-life bags are. Based on the survey findings, it's estimated that there are at least 50,000 bags stockpiled, but the figure could be as high as 100,000.

Current alternatives to stockpiling

Where growers have no stock-piled bags, they were asked to advise what measures had been taken to manage the bags. There were three main avenues for "disposal" cited:

a) Recycling: About three of the growers have sent large numbers of bags sent back to the supplier (Intermas) through the free take-back system offered by this company. The bags are shipped to Spain where they are recycled (full details about the Intermas recycling service are included later in the report).

b) Waste Disposal: One grower said they had been advised that the bags were not suitable for recycling; on this basis their contracted waste management company had taken between 15,000 and 20,000 bags and disposed of them in landfill. The cost to the grower of this method of waste management was not disclosed.
The fees for waste collection vary between waste contractors and the counties in which they operate. Based on an average of 1,350 bags (approximately) per tonne and an average collection cost of €198 per tonne, it's estimated that the cost to the grower of this method of disposal was somewhere between €2,200 and €3,000, a not insignificant amount of money.

c) Re-use: Most growers indicated that bags are repaired to extend their life, some pass on their old bags to smaller oyster farm operators for re-use and some advised that old bags formed an integral part of fencing and laneway foundations on their own adjacent agricultural farms.

Ultimately each individual oyster grower will have to decide how to best manage the waste stream of their end-of-life bags; given the potential value of the HDPE plastic contained within the bags, alternatives to stockpiling them in yards around the coast, or disposing of them in landfill, should be available.

Plastics Testing

Once the research commenced, it became apparent that comparison testing of the bags supplied by Intermas and bags supplied from outside the EU (and therefore subject to less stringent production regulations) would be of value to the project and to confirm that the bags are made solely from HDPE.

There are a small number of plastics testing facilities operating in Ireland; three were contacted and quotes were received from two of them. On the basis of the quote information received, the Centre for Industrial Services and Design (CISD), which is part of Athlone Institute of Technology, was chosen to conduct comprehensive testing of a range of bags that are currently, or have been, in use by the Irish oyster-growing industry.

The sample bags provided to CISD were:

1. A new Intermas oyster bag
2. A new oyster bag of Chinese origin
3. A weathered Intermas bag

The tests carried out included:

- FTIR Analysis
- DSC Analysis
- ADMTA Analysis
- Tensile Strength
- Tear Strength Test
- TGA Analysis
- GMCS Analysis
- GPC Analysis

The main test results to note are as follows:

- FTIR Analysis – this is a chemical analysis which confirmed that the material in all three samples was at least 99% polyethylene based.
- DSC Analysis - this is a chemical analysis which confirmed that the material in all three samples was High Density Polyethylene (HDPE) with similar melting points.
- Mechanical Test – all samples tested to the same mechanical properties.
- GCMS analysis – this analysis confirmed that there was no presence of Volatile Organic Compounds (VOCs) nor Semi-Volatile Organic Compounds (SVOCs) in any of the samples.

In conclusion the testing process confirmed that the Intermas bag and the bag of Chinese origin were equivalent in terms of all relevant factors. The full test report is included in Appendix F.

RECYCLING OPTIONS EXPLORED

Recycling – Ireland

There are a number of plastics recyclers operating in Ireland so it was important to establish if any of these companies would have an interest in the material. Recyclers generally focus on one or two specific types of plastic i.e. not all of them re-process HDPE. An initial desktop search indicated that there are about 10 plastics recycling companies operating in Ireland (detailed in Table 2 below), all of whom were contacted, initially via email.

Table 2. Plastics Recyclers operating in Ireland

NAME	LOCATION	WEBSITE
PolyFab	Cootehill, Co. Cavan	http://polyfabplastics.ie/
Munster Polymers	Waterfall, Co. Cork	http://www.mpltd.ie/
ROC Recycling	Portlaoise, Co. Laois	http://www.rocrecycling.com/index.aspx
Leinster Environmental	Dundalk, Co. Louth	http://www.lerecycle.ie/index.html
Rehab Recycle	Tallaght, Dublin 24	http://www.rehabrecycle.ie/recycling-services/
ADN	Carrickmacross, Co. Monaghan	http://www.adnmaterials.ie/#Home
Wellman International	Kells, Co. Meath	https://www.wellman-intl.com/
Shabra Plastics	Castleblayney, Co. Monaghan	http://www.shabra.com/
Walsh Waste	Oranmore, Galway	https://www.walshwaste.com/
IFF Plastics	Cree, Co. Clare	https://iff-plastics-limited.business.site/

A number of the companies that were contacted confirmed that HDPE was not a material of interest. As a result, only three companies indicated their willingness to engage with the project.

Those three companies asked for samples in order to review the material; they were sent a number of bags for testing to see if they were suitable for recycling. It's important to note that businesses like these normally operate on a constant supply of waste plastics for recycling and a one-off stock-pile might not be suitable nor feasible for processing.

The samples requesting for testing varied from a small number of bags to a one tonne quantity of material, delivery of which was arranged by BIM.

To date some recycling options, devised through the interaction and engagement by the research team with the Irish recycling companies, are open to the oyster growers. They are detailed in the section below.

Polyfab tested the material and indicated that it did not work well for them.

Three of the companies contacted advised that they are not interested in processing HDPE and a further two did not respond to contact requests.

Table 3. Plastics Recyclers by response

Confirmed - interested in HDPE	
ROC Recycling	Portlaoise, Co. Laois
Stuart Nets Ireland / Green Marine (working with a recycler in Ireland)	Castletownbere, Co. Cork
Munster Polymers	Waterfall, Co. Cork
Confirmed - not interested in HDPE	
Rehab Recycle	Tallaght, Dublin 24
ADN	Carrickmacross, Co. Monaghan
Wellman International	Kells, Co. Meath
Shabra Plastics	Castleblayney, Co. Monaghan
PolyFab	Cootehill, Co. Cavan
No response to contact	
Leinster Environmental	Dundalk, Co. Louth
Walsh Waste	Oranmore, Galway
IFF Plastics	Cree, Co. Clare

Recycling – Ireland

Green Marine (Stuart Nets) has advised that they should be able to offer bag collection service to growers, either for free or at low-cost. The company works with a recycling company in Ireland and would be able to provide certification of same. Green Marine is already in the business of collecting waste fishing nets and ghost gear from coastal communities and so already has a good understanding of both the fisheries/aquaculture industry in Ireland and the waste management landscape for what can be viewed as hard-to-recycle materials.

Munster Polymers has advised that it would be interested in taking in bags for recycling; however, it will only accept batches of bags in large volumes, which would not suit many of the growers. As BIM has no plans to get involved in the specific waste management logistics of individual growers, the contact details of this company have been passed onto Green Marine (see above) to see if they can discuss possible synergies.

Recycling – Abroad

ROC Recycling has indicated its interest in accepting the bags. However, the company has made it clear that it would clean, prepare and bale the bags and then export them for recycling abroad as they cannot undertake this last stage of the process themselves. There would be a cost to growers if they chose this option, in terms of a gate fee for acceptance at ROC Recycling's premises, of €90.00 per tonne. Growers would also have to arrange transport of the bags to their site (ROC Recycling has advised it could arrange the collection bags for an agreed fee).

Recycling – Spain

Since 2015, Intermas, a large plastics supply company headquartered in Spain, has arranged for a number of containers to be shipped to Ireland to collect palletised and cleaned oyster bags from growers. The bags have been shipped to France for recycling preparation and then transported to Barcelona in Spain where the bags were recycled into another plastic product. Initially the bags were cleaned by a social enterprise in southern France but Intermas now employs its own staff to undertake the preparation process in the recycling plant in Spain.

Intermas provides this service free of charge and will collect not just its own oyster bags, but oyster bags made by any supplier as long as they meet the collection criteria. A meeting was held with the Aquaculture Sales Manager of Intermas, Christian Guyomar, to discuss how the service works, the rationale for Intermas to provide such a service free of charge and the company's long-term intentions. The meeting details, together, with the specific collection criteria for the end-of-life bags are contained in Appendices C and E.

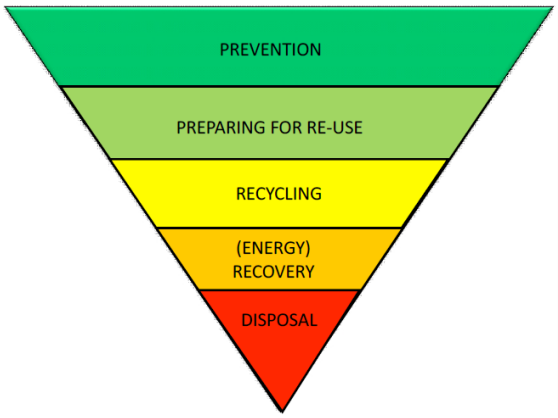
The service provided by Intermas can be accessed through Triskell Seafood Ltd (for growers who purchase their bags from this supplier) or directly with Intermas itself.

Recycling – UK

One company was located in England which appears to specialise in HDPE recycling; however, several attempts made to contact the company went unanswered. While the situation regarding the UK's departure from the EU remains uncertain, pursuing a recycling option that involves shipping end-of-life bags to mainland UK may be unwise; on this basis no other companies were UK–based contacted.

RE-USE OPTIONS

Figure 3 – Waste hierarchy



Source: European Commission.

As preparing for re-use sits higher up the waste hierarchy, it was decided to explore options for re-use for the oyster bags, in their current state. As the bags have been deemed end-of-life by the growers the project team was aware that it would not be feasible for them to be used in another aquaculture setting. However, as the plastic used in the bags, HDPE, is extremely durable and hard-wearing, other uses were considered and a range of agencies, identified as having potential for re-use of the bags in their current format, were contacted. The details of those contacts are outlined below.

Re-Use Options Explored

IFA Aquaculture[11]:

While this stakeholder could not suggest re-use options for the bags within their own area, they proposed that the bags could be used to lay out tracks in temporary car-parks for events like out-door festivals where vehicles are parked in neighbouring fields.

Follow-up enquiries were made to a State-sponsored advisory centre, which is run under the auspices of the Local Authority Prevention Network (LAPN); it offers advice to the many indoor and outdoor festivals that take place across Ireland.

Green Your Festival[12]:

This is a service, provided under the National Waste Prevention Programme, by the Clean Technology Centre in Cork. Eileen O'Leary was contacted and she noted that it is an advisory service only, which provides guidelines and toolkits for the organisers of the many different types of festival which take place around the country; specific materials are neither prohibited nor recommended.

The idea of the use of the bags for "roadways" and spaces in temporary car-parks was discussed in detail but a number of obstacles became apparent, including:

[11] W: https://www.ifa.ie/sectors/aquaculture/
[12] W: https://greenyourfestival.ie/

- how the bags would get delivered and by whom;
- who would be responsible for putting them in place, and then collecting them;
- how and where would they be stored between festivals;
- would there be an insurance issue, for instance, if a bag caused a tyre to puncture.

Eileen suggested contacting the Environmental Awareness Officers in each of the counties where there is a large stock-pile of bags. She advised they have an excellent network of contacts in their local area and particularly with the Tidy Towns Committees, which may have some ideas for re-use, in areas like community gardens and allotments.

Environmental Awareness Officers (EAOs):

Contact was made with EAOs in Sligo, Louth, Wexford and Waterford. The results of those contacts are outlined below. There was no response from the EAO in Donegal.

Louth - Barry Eaton EAO

Barry Eaton advised that his network of Tidy Town representatives from the whole of the county meets regularly. He arranged for some sample end-of-life bags to be collected from the growers based in Carlingford so they could be examined in detail at a Tidy Towns committee meeting that was due to take place in September.

Sligo - Pete Murtagh EAO

Pete Murtagh has a real interest in the re-use options of the oyster bags and feels his Tidy Towns Committees may have a use for same. Arrangements were made for sample end-of-life bags to be collected from one of the Sligo-based oyster growers. The Tidy Towns Committee was due to meet in September and the sample bags were to be available for examination.

Waterford - Ella Ryan EAO

Ella Ryan indicated her willingness to explore re-use options with her Tidy Towns Committees. She was provided with contact details of the oyster growers in Waterford so she could contact them directly to arrange some sample end-of-life bags.

Wexford - Cliona Connolly EAO

Cliona Connolly is also willing to engage with the Tidy Towns community to explore re-use options for the bags. She arranged for one of her Council colleagues to collect some bags from local growers.

Re-use Options Explored – Deemed Not Viable

Several other re-use options were explored, based on suggestions from stakeholders and other contacts. A number of organisations were communicated with and the details of the bags were made available to them. The outcomes are detailed below.

Community Reuse Network Ireland[13]:
This network represents a number of reuse and recycling businesses around the country and advocates for reuse at a national level. Claire Downey, the Executive Co-ordinator, has been supplied with details and photographs of the bags and may include a piece in the next quarterly newsletter. However, at the time of writing she had no expressions of interest from any of the network members or contacts.

National Ploughing Championships:
It should be noted that while the weather for the 2019 Championships[14] was generally very dry, in previous years, inclement conditions have led to many car-owners needing assistance to get their cars out of the temporary car-parks, which are usually set up in fields adjacent to where the ploughing exhibition takes place. On this basis, it was thought they may have an interest in having an exploratory discussion but emails requesting a telephone call to discuss the potential for the use of end-of-life bags in temporary carparks were not responded to.

Bord na Móna:
While Bord na Móna[15] (BnM) was once best known for its peat harvesting business, it has diversified into other commercial sectors in recent years, particularly the area of renewable energy. BnM has recognised that its land bank of milled bogs has the potential to become its most valuable resource; its Powergen[16] programme aims to construct a number of wind and solar farms over the next decade. As this will involve building foundations on bog land, it was thought that there could be a requirement for the type of material from which the oyster bags were made; however, following preliminary discussions with one of their senior ecologists, the company advised that the bags would not be suitable for re-use by BnM.

Transport Infrastructure Ireland (TII):
TII[17] was contacted with a view to its requirements for sturdy and durable material for its programme of roads development and motorway maintenance and upgrades. Given that tree and shrub planting now forms part of road upgrades and new motorway development, and the mesh of the bags might suit that purpose, the project team decided to explore the re-use potential for the bags.

[13] W: https://www.crni.ie/ Accessed September 2019
[14] W: https://www.npa.ie/ Accessed August 2019
[15] W: https://www.bordnamona.ie/ Accessed 19 June 2019
[16] W: https://www.bordnamona.ie/company/our-businesses/powergen/ Accessed 19 June 2019
[17] W: https://www.tii.ie/ Accessed August 2019

A telephone call was arranged with the Head of Environmental Policy & Compliance. He indicated that while the HDPE material might be of interest, the individual bags themselves would not be suitable for use. The materials required for large-scale road projects, would need to be in a roll format which could be measured and cut to size, but with rolls available in lengths of several hundred meters. TFI suggested that local county councils, with responsibility for managing smaller road projects, might be interested in the HDPE material.

Mountain Meitheal:

This is a volunteer organisation[18] that works in conjunction with landowners across the country, such as farmers, National Parks & Wildlife (NPW) and Coillte, to repair and maintain trails on popular mountain walks. In its publication[19] "A Guide to Planning and Developing Recreational Trails in Ireland", the National Trails Office refers to the use of geo-textiles in a section under Trail Construction techniques for the construction of a Turnpike or Raised Causeway Trail. They also reference *The Handbook of Trail Design and Construction* which is published by Mountain Meitheal (MM).

The details of the bags were sent and a telephone call took place with a volunteer. They advised that they would not have a use for the bags; MM volunteers work with a number of different agencies and often in Special Areas of Conservation so there are very strict rules about what materials they can use. The geo-textile referred to in their trail construction handbook was used in one particular trail but hasn't been used since. They also pointed out that MM has no storage facility so the logistics of keeping the bags for future use would present a major challenge.

Irish Trails:

The Irish Trails office[20] is run under the auspices of the Irish Sports Council. As they are also involved in the development and maintenance of new and existing trails, the head of trail development, policy and management was contacted to discuss the potential for the bags to be used. However, having initially indicated that they would have an interest in the bags, they have not responded to further contact requests.

[18] W: http://mountainmeitheal.ie/ Accessed 26 June 2019

[19] Available at: https://www.irishtrails.ie/Sport_Ireland_Trails/Publications/Trail_Development/A_Guide_to_Planning_and_Developing_Recreational_Trails_in_Ireland.pdf

[20] W: https://www.irishtrails.ie/ Accessed July 2019

OPTIONS FOR OYSTER GROWERS

The research to date indicates that there are four options available to oyster growers, all of which involve either re-use or recycling of the bags; disposing of the bags into landfill or sending them for incineration/waste-to-energy (WtE) should not be a requirement for any oyster growers, regardless of the size of their operation. The details below could form the basis of an information sheet for growers.

Option 1. Collection for recycling (Ireland) – Green Marine

Green Marine (Stuart Nets) will offer a bag collection service to growers, which will be free or low-cost, depending on the demand for its services, the quantity of bags available for collection and the location of same. The company works with a recycling company in Ireland and will provide certification of the bags having been recycled.

Preparation of the bags, to their required standard, is essential for any grower to avail of this service.

CONTACT:

- *Company: Green Marine / Stuart Nets*
- *Contact Name: Mike Murphy*
- *Email: stuartnetsireland@gmail.com*

Option 2. Collection for recycling (Spain) – Intermas

Intermas will arrange a bag collection service to growers at no charge. The company transports the end-of-life bags to Spain where they are recycled. Collections can be arranged through Triskell Seafood (if growers purchase their bags from them) or directly with Intermas.

Preparation of the bags, to their required standard, is essential for any grower to avail of this service.

CONTACTS

- *Company: Triskell Seafood Ltd (Website: https://www.triskellseafood.com/)*
- *Contact Name: Niamh*
- *Email: info@triskellseafood.com*

OR

- *Company: Intermas (Website: https://www.intermasgroup.com/)*
- *Contact Name: Christian Guyomar*
- *Email: cguyomar@intermasgroup.com*

Option 3. Collection for re-use (Ireland) – Environmental Awareness Officers /Tidy Towns Committees

The Environmental Awareness Officers (EAOs) in counties Sligo, Louth, Wexford and Waterford have been contacted and indicated their willingness to explore re-use options with their local Tidy Towns Committees. While the initial contact may be with the EAO, growers may need to deal directly with representatives of the Tidy Towns Committees or others to arrange collection/delivery of end-of-life bags.

CONTACTS

Louth

- *Organisation: Louth County Council (Website: https://www.louthcoco.ie/en/home/)*
- *Contact Name: Barry Eaton, Environmental Awareness Officer*
- *Email: Barry.Eaton@louthcoco.ie*

Sligo

- *Organisation: Sligo County Council (Website: http://sligococo.ie/index.html)*
- *Contact Name: Pete Murtagh, Environmental Awareness Officer*
- *Email: pmurtagh@sligococo.ie*

Waterford

- *Organisation: Waterford City & County Council (Website: http://www.waterfordcouncil.ie/index.htm)*
- *Contact Name: Ella Ryan, Environmental Awareness Officer*
- *Email: eryan@waterfordcouncil.ie*

Wexford

- *Organisation: Wexford County Council (Website: https://www.wexfordcoco.ie/)*
- *Contact Name: Cliona Connolly, Environmental Awareness Officer*
- *Email: cliona.connolly@wexfordcoco.ie*

Option 4. Collection for recycling (abroad) – ROC Recycling

ROC Recycling will accept end-of-life bags. They will clean, prepare and bale the bags and then export them for recycling abroad as they cannot undertake this part of the process themselves. There will be a cost to growers if they choose this option, in terms of a gate fee at ROC Recycling's premises, of €90.00 per tonne. Growers will also have to arrange transport of the bags to the site (ROC Recycling has advised it could arrange the collection bags for an agreed fee).

CONTACT

- *Company: ROC Recycling (Website: http://www.rocrecycling.com/index.aspx)*
- *Contact Name: Susan O'Brien*
- *Email: susan@rocrecycling.com*

Preparation of bags for any of the above options

One issue that became apparent during the course of the research is the absolute necessity for bags to be prepared properly in order to be suitable for recycling and indeed for reuse. In the case of recycling, it's vital that any contaminants are removed prior to the bags going through the recycling process.

While dirt and residue, such as barnacles and shells, will generally be removed during the washing process, it's the items such as hooks, rubbers and cable ties that are viewed as potential contaminants. Hooks and rubbers can cause issues during the shredding process. Cable ties are made from Polypropylene (PP), a plastic material which does not react well with HDPE in a plastics recycling process.

Intermas has prepared a comprehensive document which they supply to any grower who expresses an interest in availing of their collection service. It lays out very clearly the criteria which must be met for it to collect bags for recycling. The full document is included in Appendix E but in brief it states that:

- Bags must be clean with:
  - No shells
  - No metallic parts
  - Nothing inside the bags
- Bags must be correctly packed on pallets, stacked to a height of no more than 2.1 metres.

The Irish companies that have expressed an interest in providing a collection and/or recycling service have also iterated that a certain level of preparation of the bags is essential in order to provide services. It will be vital to communicate the importance of this preparation to the oyster growers. In some cases oyster growers are already taking steps to ensure that their bags are stripped of all items prior to storage but it needs to become a standard operating procedure for all growers.

OTHER CONTACTS

While carrying out the research, efforts were made to identify recycling and re-use practices in other countries where there is a healthy oyster-growing industry. It appears however, that there are no specific solutions in place for end-of-life HDPE oyster bags. No response was received to emails sent to two of the largest oyster farming operators in France, Satmar and France Naissain, to ask if they have specific procedures in place for their end-of-life bags.

Details of successful contacts made are below:

USA

Net Your Problem[21] is a Seattle-based organisation which works with fishermen with nets to dispose of and recyclers, in order to turn the waste nets into new products. A video call was arranged with the Coordinator, Nicole Baker.

Nicole has been examining the issue of both end-of-life aquaculture products and nets for some time, trying to find a sustainable waste management / end-of-life solution. Currently the only recycling option available is one where the items are shipped to a company in Denmark that specialises in hard-to-recycle plastics.

Nicole was sent a sample of some end-of-life oyster bags and included them in her shipment of material to Plastix[22] in Denmark. She reverted in November to advise that Plastix had run its own set of tests on the samples provided and also confirmed that the material is HDPE.

AUSTRALIA

Environex™ is a plastics recycling company based in Tasmania, off the coast of Australia. They specialise in recycling materials, such as waste HDPE, into new products. Jenny Brown, the Managing Director, advised that while they do recycle oyster bags they found the presence of other materials, such as nylon cable ties, to be an issue. They will now only accept oyster bags once they are fully stripped of cable ties, rubber and hooks. Any residue such as barnacles is removed easily during the washing process which takes place prior to recycling. Jenny indicated that the bags are not especially easy to recycle.

[21] W: https://www.netyourproblem.com/#/

[22] W: https://plastixglobal.com/

CONCLUSIONS

The oyster growing industry is performing well in Ireland, with growth forecasted based on increased demand for the product, mainly by France and Asia. The industry is dominated by about 15 growers with a much larger number of smaller operators. While the number of bags stockpiled may not be quite as high as originally envisaged, there are many thousands of bags lying in oyster growers' yards around the coasts.

The fact that oyster bags are made from a good quality plastic that is suitable for recycling means that there are recycling options available for oyster growers and for this to be carried out in Ireland. At least one reuse option may also be open to them. While the re-use route may not result in many bags being used in this fashion, it's an opportunity for growers to connect their businesses with the local community.

Correct preparation of bags for re-use and recycling is key and the importance of communicating this to oyster growers cannot be overstated.

The testing of the bags confirmed that, regardless of origin, the bags are indeed made from HDPE and are fit for purpose, even after a prolonged period of time.

The transposition of the Single Use Plastics Directive could have an effect on the supply and cost of oyster bags in the future, especially those of non-EU origin.

RECOMMENDATIONS

While it's accepted that BIM cannot become involved in the waste management practices of individual oyster growers, it can provide support in terms of information and data, to assist growers to make informed decisions about their end-of-life oyster bags.

Now that the options for growers have been identified, it important that growers be given the information in a format which details clearly and succinctly the choices available to them.

In addition, BIM could liaise with Origin Green Programme managers to discuss the potential for specific waste management requirements, such as re-use and recycling, for successful verification of oyster growing operations in the future.

APPENDIX A – CONTACTS

MEETINGS / SITE VISITS COMPLETED

- Triskell Seafood, Sligo – Marie-Aude Danguy (MD) and Niamh Doyle, April 2019
- Wild Atlantic Shellfish Ltd, Sligo – Charlie Kelly (Owner), April 2019
- Intermas, Dublin – Christian Guyomar (Sales Manager – Aquaculture), August 2019

SEMINARS ATTENDED

- BIM - Workshop on Improving the Circularity of Plastics in Fishing Gear, June 2019
- Webinar – Centre for Sustainable Design, UK - Creating Business Opportunities from Waste Fishing Nets, July 2019

CONTACTS MADE

- Stuart Nets / Green Marine – Mike Murphy
- ROC Recycling – Susan O'Brien
- Munster Polymers – Zaneta
- Polyfab Plastics – Gerard
- Rehab Recycling – Ian Styles
- ADN – Ciara Carolan
- Wellman International – James Campbell
- Shabra Plastics – Aideen Hoey
- IFA Aquaculture – Teresa Morrissey, Aquaculture Executive
- Green Your Festival – Eileen O'Leary
- Local Environmental Awareness Officer, Wexford – Cliona Connolly
- Local Environmental Awareness Officer, Louth – Barry Eaton
- Local Environmental Awareness Officer, Sligo – Peter Murtagh
- Local Environmental Awareness Officer, Waterford – Ella Ryan
- Community Reuse Network Ireland (CRNI) – Claire Downey, Executive Coordinator
- Irish Social Enterprise Network – Chris MM Gordon, CEO
- Repak – Brian Walsh, Packaging Technologist
- Bord na Móna – David Fallon, Ecologist
- Transport Infrastructure Ireland – Vincent O'Malley, Head of Environmental Policy & Compliance
- Irish Trails – Cormac MacDonnell, Trail Development, Policy & Management
- Mountain Meitheal – Pauline
- JFC Marine – Colin Concannon
- Applied Polymer Technology – Alan Murphy, Senior Research Officer
- Metlab Testing – David O'Flaherty, Operations Manager
- BHP Laboratories – Niall Purcell
- Net Your Problem (USA) – Nicole Baker
- Environex (Tasmania, Australia) – Jenny Brown, Managing Director

APPENDIX B – MEETING DETAILS, TRISKELL SEAFOOD

Meeting with Triskell Seafood Ltd, Collooney, Co. Sligo - 16 April 2019

Attended by: Marie-Aude Danguy, Triskell Seafood

Niamh Doyle, Triskell Seafood

Gráinne Devine, BIM

Maeve Thornberry, Maeve Thornberry & Associates

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a) What is the current status with Intermas in terms of returning bags for recycling? How many bags/by weight have been sent back for recycling to date? 2 batches have been sent back, from the same grower (Waterford Oysters), approximately 12,000 bags in each batch. (This grower produces about 300 tonnes per year).

b) What are the logistics involved? Is Intermas back-filling their own truck(s)? No, Intermas sent a container for the return of the bags.

c) Does each oyster grower need to:
   - Send their stockpiled bags to Triskell? No
   - Send the bags direct to Intermas? But arrangements made through Triskell

d) What is the requirement for acceptance of the bags by Triskell / Intermas:
   - Clean bags only? Yes, but note that they are still cleaned thoroughly on arrival in France, prior to transport to Barcelona for recycling.
   - Loaded onto pallets? Yes

e) Is there a charge for returning the bags? No
   If so is the charge calculated: n/a
   - By weight?
   - By volume?

f) Will Intermas accept:
   - Their own bags? Yes
   - Other manufacturers' bags? No

g) Will Triskell accept bags <u>not</u> purchased from Triskell? Ideally no.

h) Are the Intermas 50% recycled content bags 100% recyclable? MA to find out.
The recycled content bags are lighter, about 600gr and have a brown strip on the bottom for easy identification (could be very important depending on answer to above).

Other Notes:

French oyster production 140,000 tonnes per annum, Ireland about 9,000 tonnes.

Wear and Tear – the handling of the bags, whether the hooks & rubbers are attached to the bags or to the trestles, and the conditions of each individual site will all determine how long the bags can be used for.

Triskell selling about 200,000 Intermas bags every year, but average waste bags at back-end about 1,000 per year per grower? But Triskell do not sell to every grower.

Some growers buy direct themselves from Intermas (the bigger operations?) and others buy from other manufacturers, with some coming in from China.

Cleaning – Intermas has the bags cleaned at a social enterprise in France, manual process, wire brushes used to remove material – MD to provide more details / MT to contact Intermas recycling manager

Action Points:

Check out sites for availability and cost of bags from China and other European suppliers.
Completed

Any other bag manufacturers offering a recycling service? No

Where else is oyster production carried out? Mainly France, no details found of any recycling being carried out, other than by Intermas.

APPENDIX C – MEETING DETAILS, INTERMAS

Meeting with Intermas, BIM offices Dun Laoghaire, Co. Dublin – 17 September 2019

Attended by: Christian Guyomar, Intermas

Gráinne Devine, BIM (via Skype),

Maeve Thornberry, Maeve Thornberry & Associates

Notes from meeting with Intermas

i) What is the current status with Intermas in terms of returning bags for recycling? How many bags/by volume and/or by weight have been taken back for recycling from Irish growers to date?
Approximately 20 containers per year for the last 3-4 years. Each container takes either 20 (each 2.1 metre high) or 40 pallets (each about 1 metre high, one stacked on another).

j) What are the logistics involved?
Intermas will only collect a full load from one premises, so if a grower does not have a sufficient number of pallets, they need to organise to get the remaining number required from another grower delivered to their yard.

k) Does each oyster grower need to liaise directly with Intermas to arrange to avail of the take-back service?
Intermas' preference is that growers who have a stock of end-of-life bags readied for collection contact Triskell Seafoods so Intermas only has to deal with one organisation in the arranging the logistics.
However, CG accepts that this may suit every grower so he can be contacted directly via email to make the arrangements for a collection.

l) What is the requirement for acceptance of the bags by Intermas:
- Clean bags only? Yes, ideally with all rubbers and hooks removed and all large pieces of debris.
- Loaded onto pallets? Yes, either to a height of 2.1 metres (Intermas' preference) or to a height of a metre. Intermas will provide full written details and photographs of how the pallets should look when the bags are correctly stacked.

m) Is there a charge for returning the bags? No

n) Will Intermas accept:
   - Their own bags? Yes
   - Other manufacturers' bags? Yes

o) What processes do the bags undergo in France to prepare them for recycling?

   For the initial deliveries of end-of-life bags, Intermas was using the services of a social enterprise to clean and prepare the bags for recycling in Spain. However, the enterprise is very small and was unable to cope with the number of bags. Now, all preparation for recycling is done in Spain.

p) What recycling process does Intermas use in Spain to recycle the bags?

   The bags are put through 4 processes prior to being recycled. Each bag takes about 20 minutes to prepare for recycling.
   1. They are cleaned by hand (removing hooks, rubbers, any debris). This is slow and difficult work carried out by Intermas employees, not by a social enterprise.
   2. The bags are put through a washing process.
   3. The bags are then shredded.
   4. The shredded material is then put through an intensive washing process to remove any remaining contaminants. The material is then recycled.

q) Is the recovered/recycled material then used to make new oyster bags or other products?
   Both. Some of the material is used in the manufacture of new oyster bags. Much of the recycled material is used in the manufacture of other meshes that Intermas produces for areas such as agriculture.

r) Are the Intermas 50% recycled content bags 100% recyclable?
   Yes. However, it's not possible to make oyster bags or any other mesh from 100% recycled material.

   <u>Other Notes</u>
   CG indicated that Intermas is willing to continue providing the free take-back and recycling service to its own customers and even those oyster growers who do not use Intermas bags, as they feel it is the responsible thing to do and it's a good marketing tool for Intermas.
   We discussed the Single Use Plastics Directive; CG seemed to be unaware of the potential for Intermas to be subject to an Extended Producer Responsibility (EPR) Scheme once the Directive is transposed into national legislation in EU member countries.

APPENDIX D – SURVEY QUESTIONS

Oyster farmers were asked to provide details on a range of operational areas.

Annual Oyster Production

- Number of oyster bags in use (numbers are approximate)
- Number of trestles in use
- Bags per tonne
- Total number of oyster bags (in use and stored for reuse)
- Life span estimate (years)
- Number of stored "end of life" Oyster Bags
- Number of "end of life" bags generated annually
- % generated annually

Waste End of Life Bags

- Condition of stored bags (clean / dirty / hooks / rubbers / seals/fouling)
- Storage method (stacked /pallets /wrapped)

Uses for End-of-Life Bags

- Repair (for own use / by other oyster farmers)
- Re-purposing (roads, fencing etc)
- Recycling (company / location / costs)
- Disposal (waste company / local authority /disposal costs)
- Source of oyster bags (Intermas/ agent/ China)
- Observations on variations in quality and durability of bags from different sources

APPENDIX E – INTERMAS COLLECTION CRITERIA

APPENDIX F – CISD PLASTICS TESTING REPORT