



Market Analysis

Review of existing plastics markets for grain bags and twine

Final Report | October 25, 2019



The pilot project is led by the multi-stakeholder Agricultural Plastics Recycling Group; funds were granted by the Government of Alberta and are administered by Alberta Beef Producers.



Executive Summary

Recycling agricultural plastics can be especially challenging for two key reasons:

- 1) contamination of dirt, mud and other organic material that can accumulate as a result of regular use on farm, making the processing expensive; and,
- 2) mixed plastic types that are often used together on-farm - such as bale wrap and netting – cannot be sorted efficiently and are unrecyclable.

The collection program for agricultural plastics must be developed to minimize these issues in order to access the few recycling markets that exist today.

Market pressures

The Chinese national sword policy (2018) and subsequent importation restrictions in other Southeast Asian countries have caused a significant oversupply position for the recycling industry in North America. Domestic (North American) recycling markets are struggling to manage the supply of materials that are no longer being exported. New infrastructure is beginning to develop, but markets for agricultural plastics remain scarce. Prices for recycled material have fallen due to:

- Oversupply of recycled material in North America;
- Cheap virgin resins caused by increased global production of gas-derived ethylene and propylene;
- Increased cost of handling recyclables due to increasing transportation costs;
- Lack of demand for Post Consumer Recycled (PCR) content.

Current market status – grain bags and twine

International markets for agriculture plastics exist but import restrictions on scrap plastics have effectively prevented any international recycling. It is expected that international markets will be viable again in the future, but with increased oversight and due diligence. Today, there are limited options for recycling agriculture plastics recycling in North America.

Grain bags – Two facilities are recycling grain bags; one in Canada and one in the USA. Current markets are washing and pelletizing grain bags for use in other blow-molding applications. More infrastructure is currently being built in Western Canada.

Twine – Two facilities in the USA are recycling twine. One recycler is washing and pelletizing for remanufacture and the other is cleaning and shredding for use in the roofing industry.



Other agricultural plastics

Grain bags and twine represent 50% of all plastics generated on-farm in Alberta. The other 50% of plastics not included in the pilot collection are bale wrap and silage plastic, netting, supersacks, greenhouse film and high-density polyethylene (HDPE) containers. The market opportunities for each material vary:

Bale wrap and silage plastic – one known market exists in Canada (East Coast); charging a tipping fee for recycling. Overseas markets exist but import restrictions are prohibitive. Bale wrap and silage plastic collected by Cleanfarms through current pilot programs is sent for waste-to-energy incineration. Some recycling exists in Europe, but tipping fees are high.

Netting (net wrap) – made of mixed plastic types and generally heavily contaminated with organic material, netting is not recyclable. The current best option for netting is waste-to-energy incineration. Cleanfarms does not currently collect netting.

Supersacks – used for many different agricultural commodities, supersacks have varying levels of contamination and are challenging to recycle. No known markets exist in North America, but Cleanfarms is actively looking for recycling options for supersacks collected through current collection programs in Eastern Canada.

Greenhouse film and HDPE containers – Strong domestic end markets exist for greenhouse film and HDPE containers. Greenhouse film is high-quality with very low levels of contamination. HDPE containers collected through Cleanfarms programs have several strong markets in Canada and the USA.

Many organizations around the world (Europe, New Zealand) managing agricultural plastics are faced with the same market pressures as Canada. Recycling markets are scarce and where markets exist materials are subject to a tipping fee in order to be recycled.

Processing options

Under current market conditions, properly rolled grain bags do not require additional processing to be accepted for recycling. Twine must be baled before shipping. Preference on how twine is baled (loose or in collection bags) varies based on the end market.

An overview of known agriculture plastics recyclers can be found in Appendix A and B.

A list of acronyms can be found in Appendix C.



Introduction

Recycling programs operate based on two basic components - efficient and convenient collection and stable, sustainable end markets. The economic balance between the supply of material and the demand of the end markets will always fluctuate and react to local and global economic factors, but a recycling program cannot exist without collection (supply) and markets (demand).

Market accessibility is often influenced by the design of the collection program – how the material is collected can have significant impacts on where the material can be recycled, if at all. For agricultural plastics, the design of the collection process is paramount in ensuring the material remains clean enough to be marketable while being convenient and cost-effective enough to encourage farmers to participate.

Agricultural plastics can be especially challenging to recycle because of the contamination often present. Dirt, mud, manure, hay, grain and all other forms of organic materials found on farms will without a doubt end up mixed in with recyclable plastics when used on-farm. The high levels of contamination make the cleaning process more challenging and expensive. Aside from organic contamination, mixing plastic types (products often used together on-farm) causes serious issues where mechanical separation technologies do not exist. Mixing polypropylene (PP) twine and high-density polyethylene (HDPE) net wrap, or linear low-density polyethylene (LLDPE) bale wrap and HDPE netting is common, since all these products are used on farm and often together. Without an economically feasible method of sorting these materials from one another, mixed plastics are not recyclable. In order to ensure that agricultural plastics can be recycled at end-of-life, the most important factors are to design a collection system that a) minimizes organic contamination, and b) eliminates the mixing of different plastic types.

Recycling markets for agricultural plastics, both at home and abroad are scarce. Understanding the end markets and working to develop demand for these materials is necessary for a successful program. The following report outlines some of the major factors shaping the markets for agricultural plastics, the current status of markets available to Cleanfarms for agricultural films and twine, and an overview of the international ag plastics recycling programs with respect to end markets.

Background – Markets for Ag Plastics

Cleanfarms has been navigating the markets for agricultural plastics for more than thirty years. High-value material – such as rigid HDPE from pesticide and fertilizer containers – have stable markets at home in North America. Lower value agricultural plastics, such as LLDPE and LDPE film and PP twine, are dirtier and more expensive to process, have fewer end uses and fewer markets in Canada and the USA. Historically, end markets for LDPE and PP agricultural plastics have been abroad, with very few domestic market options available. While domestic markets are preferable, international markets can be viable and competitive due to the lower cost of labour and proximity to the manufacturing industry in Asia where the PCR resin is used.

There have been several disruptions in the end markets for agricultural plastics in recent years, fueled by the negative environmental and social impacts of the global trade of recyclables.



Chinese National Sword

Prior to 2018, 56 percent¹ of the world's plastic scrap was exported to China for processing and remanufacture. On January 1, 2018, the Chinese government implemented the National Sword policy, effectively banning the importation of all but the highest quality recyclables². The importation ban was a result of two contributing factors; the unregulated recyclers operating in China who were illegally polluting the environment through open burning of wastes and circumventing labour standards for workers, and; the illegal importation (smuggling) of highly contaminated materials and wastes. The Chinese government halted all imports of materials and started the process of re-licensing all the recycling facilities. Strict new import rules were established which remain in effect today.

This policy decision created a ripple-effect across Southeast Asia as plastic scrap was diverted to neighbouring countries who subsequently became overwhelmed by the volumes and implemented similar importation bans within the year. By the end of 2018, the international trade of plastic scrap had essentially stopped. Today, countries around the world have implemented new policies to control the import of materials and are cautiously allowing scrap imports with increased oversight.

Basel Convention Amendment

The Basel Convention – an international treaty restricting the transboundary movement of hazardous wastes between developed and less developed countries – has been adopted by 186 nation states across the globe. In 2018, the Norwegian Environment Agency put forth a proposal to amend the Basel Convention to include low-quality plastic waste as a waste category subject to the informed consent (Amber control) procedure required for the movement of hazardous wastes. The amendment was adopted in May 2019 and will shortly be ratified under the Treaty.

This amendment will further restrict the global trade of plastic scrap and will likely have a significant impact on the ability to freely trade agricultural plastics with international markets. The United States is not party to the Basel Convention but Canada is party to the Treaty. As such, even trade of plastic between Canada and the USA could be affected. To date, it is still unknown exactly how the Treaty will affect plastic trade between any two countries.

Impact on Price

The importation bans affecting the international markets have had a significant impact on the price of recycled materials. A glut of material in the North American market has depressed prices of scrap plastics. In addition to the oversupply, low demand for PCR resins, low virgin resin prices, and increased transportation costs are all contributing to the 'perfect storm' that is affecting the price of materials today.

¹ <https://www.dw.com/en/after-chinas-import-ban-where-to-with-the-worlds-waste/a-48213871>

² <https://www.nationalgeographic.com/magazine/2019/06/china-plastic-waste-ban-impacting-countries-worldwide/>



Oversupply of material and Cheap Prime Resins

Almost overnight, 56% of the world's recycling infrastructure evaporated when the Chinese National Sword policy was implemented. The other South East Asia nations provided some short-term relief, but today, one year later, nearly all exports overseas have come to a halt causing a significant amount of material to be stranded in the North American market without the physical infrastructure to manage it. North American recyclers are in a severe oversupply position which has depressed prices for scrap plastics. As new facilities come online the oversupply issue should slowly correct.

Cheap prime (virgin) resin has compounded the effects on PCR price. Prices of virgin resins have been driven down by the increased global production of ethylene and propylene due to the low cost of cracking natural gas liquids (NGLs), such as propane and butane, to produce the polymers. Within the last 10 years the number of facilities producing virgin resin inputs have increased from less than 5 to 33 globally with an additional 20 announced or under construction³. Although most of the growth is fueled by Chinese investment overseas, Alberta will see two of these facilities come online in the province by 2023.

Increasing Transportation Costs

The cost of transportation – domestically over-the-road (OTR) or internationally by sea – has been increasing, making the economic viability of recycling more difficult. OTR prices increased by ~20% between the end of 2017 and the beginning of 2019⁴. Retiring baby boomers, driver shortages, new regulations (E-logging) and increased demand (i.e. Amazon and other e-commerce transactions) are contributing the growing capacity shortages⁵.

Demand for PCR Resin

In addition to the market supply issues and increasing transportation costs is the stagnant demand for PCR resins. Although some large multi-national companies have begun to embrace the use of PCR⁶ (Adidas, P&G, etc.), demand is relatively low compared to demand for virgin resins. This demand disparity increases as the cost of virgin resins fall, since the competitive advantage for PCR is based on price in the free market. Without legislative mechanisms to boost demand for PCR – requiring a minimum percentage of recycled content in products and packaging – demand for PCR will remain low and prices will follow the virgin market.

Current Market Status for Cleanfarms Materials

There are several markets (domestic and international) that are currently accepting or have expressed interest in accepting agricultural films and/or twine for recycling. The table in Appendix A outlines the facilities that Cleanfarms is currently working with or intends to work with in the future. Some of the

³ <https://www.jwnenergy.com/article/2019/9/albertas-growing-petrochemical-opportunity-download-new-alberta-oil-gas-quarterly/>

⁴ <http://cgfi.ca/canadian-general-freight-index-results/>

⁵ https://www.logisticsmgmt.com/article/tackling_the_capacity_crunch

⁶ <https://www.businessinsider.com/companies-using-recycled-plastic-in-products>



facilities and/or traders have expressed interest in managing agricultural plastics, but additional due diligence (site visits, credit checks, etc.) are yet to be undertaken.

Today, there are two end markets accepting grain bags for recycling (one in Canada and one in the USA). Both are shredding, washing and pelletizing the material for sale into the manufacturing industry.

For twine, two viable end markets have been identified in the USA. One of the facilities is pelletizing the twine for sale to manufacturers and the other is hand-cleaning the twine, shredding and selling as an additive for the roofing industry. All other domestic markets that have been identified require pre-processing of the materials, unrealistic supply agreements or are not yet in operation (but expecting to be within the coming months).

Cleanfarms has worked with international recyclers in the past, but due to importation bans materials are not currently being exported. As regulations and handling procedures are developed, it is expected that the international markets will open once again but under more stringent controls. Malaysia was a key recycler of grain bags until the importation bans were enacted in 2018, and recent discussions with the Canadian Trade Commission and the government representatives in Malaysia have indicated that there is an appetite to continue fostering a trade relationship for recyclables under the new rules and standards for importation. Developing rapport through a government-to-government relationship facilitated by the Canadian Trade Commission is the first step in re-establishing these markets.

It is important to work with all end markets (domestic and international) to ensure the materials are traded at competitive rates. Cleanfarms is committed to working closely with international traders and recyclers to verify chain of custody and to ensure that all facilities are properly licensed and meet the environmental and labour standards regardless of where the facilities are located.

Other Agricultural Plastics

Grain bags and twine are two of several types of plastics used on farms in Alberta, accounting for approximately 50% of the total amount of plastic used on farms each year⁷. The other 50% of plastics - bale wrap, silage plastic, greenhouse film, net wrap, supersacks and HDPE containers – will also require solutions in the future. Grain bags and twine are the natural first step as the 'low-hanging fruit' because they have the strongest end markets and are relatively easy to collect with minimal contamination. The other materials present a different set of challenges. Cleanfarms has operated programs in different jurisdictions across Canada for all the other on-farm plastics (except for greenhouse film).

Bale wrap and silage plastic

End markets for bale and silage plastic have been limited and unstable in Canada and the USA, where several processors have gone out of business or stopped accepting these materials over the last three years. Currently, only one end market is accepting bale wrap in Canada for a fee. Cleanfarms is currently involved in collection programs for bale wrap and silage plastic in Manitoba, Ontario, Quebec and Atlantic

⁷ Alberta Agricultural Waste Characterization Study Update 2019, Cleanfarms Inc. (2019)



Canada, where the majority is being sent for energy recovery. International markets exist for these materials but import restrictions have eliminated international markets as an option in the short term.

Net wrap

There are no known North American or international recycling markets for net wrap. Net wrap is manufactured from several different plastic types that cannot be easily sorted (HDPE, LDPE, PP) and is highly contaminated with organic material when collected. Although net wrap is not formally included in the Manitoba collection program, any netting that is dropped off for recycling is sent for energy recovery.

PP supersacks

Cleanfarms collects supersacks used for seed and pesticides from farms across eastern Canada and is expanding the collection to western Canada over the next two years. Supersacks are used for seed, pesticide, fertilizer and feed packaging on-farm. Currently, all the supersacks collected by Cleanfarms are sent for energy recovery due to a lack of viable domestic markets. Supersacks are challenging to recycle because of contamination issues (including potential pesticide contamination), the use of LDPE liners for some products, and nylon contamination from the straps on some styles of bags. There are no known markets for supersacks at the current time, but Cleanfarms is actively seeking a recycling option in Canada or the USA.

Greenhouse film and HDPE containers

Greenhouse film is high quality material with very low levels of contamination. The for-profit industry has largely been managing these materials, which have a strong end market (domestic and international). Volumes of greenhouse film are low in Alberta, so operating a program independently for greenhouse film would likely not be feasible. Most HDPE containers are currently managed through existing Cleanfarms programs which also have strong domestic markets for recycling.

A summary table of the market situation for the other agricultural plastics can be found in Appendix B.

International Counterparts

Cleanfarms is one of many product stewardship organizations around the world managing agricultural plastics. Several European organizations, as well as New Zealand are already managing agricultural films and twine.

In Europe, markets for agricultural film and twine are more challenging than in Canada. Agricultural films and twine collection programs are operated in France, Germany, Ireland, Italy, Spain, Belgium, Netherlands and the UK.

Since the 2018 market disruption, some of the stewardship program operators have experienced the implementation of tipping fees at the recycling facilities, and in some cases have been forced to incinerate some agricultural films due to a lack of recycling options. Berry BPI Group (formerly RPC BPI) operates 5 recycling facilities in the UK for agricultural films (LLDPE and LDPE) which take in up to 17,000 MT per

⁸ Information on international organizations gathered through personal conversation with program managers



year at each facility⁹. Tipping fees at European recyclers can be as high as 100 euro per tonne. For incineration, fees are upwards of 175 euro per tonne. As an example of the impact this market disruption is having, in 2019 some of the European programs were required to increase fees by 30% to keep up with the increasing costs of managing these materials.

Plasback in New Zealand operates programs for LLDPE/LDPE films, PP supersacks and twine. A small percentage of material is being recycled in New Zealand with the balance of material being exported to recyclers overseas (where available) or stockpiled.

Processing Options to Meet Market Specifications

As with any commodity, processing the material before it is sold will add value to the final product. Processing the material into bales for shipping, shredding and washing the material, or pelletizing are all different levels of processing – all of which come at a cost. The level of processing required depends mainly on what the end market demands.

Grain bags, when properly rolled and loaded, do not require additional processing. With experienced loaders, trucks or containers can be loaded to maximum weight. Rolled grain bags are preferred by the two current end markets over baled grain bags based on the feed conveyors being used.

The two end markets for twine are flexible in the way the material is delivered. Twine that is baled in collection bags or baled loose is acceptable to both end markets. One of the markets sorts and cleans all the twine by hand and has also suggested shipping the twine loose (unbaled) in one-tonne supersacks to eliminate the need to break open bales at the receiving facility. Based on experience, shipping twine in supersacks can be problematic when clearing customs because the bags are opaque and cannot be easily inspected.

Conclusions

In summary, the markets for agricultural films and twine are scarce today, but as infrastructure continues to develop domestically and international markets reorganize, more market options will become available in the coming months and years. Cleanliness and contamination levels will remain a critical element contributing to the marketability of the materials, but these issues can be minimized by a strong grower-facing education and promotion campaign along with oversight and enforcement at the collection sites.

The most challenging factor facing agricultural plastics recycling today and in the future is the lack of demand for PCR resin as the price of virgin resin continues to fall. With new capacity for virgin resin production coming online over the next 2-3 years, PCR resin demand and prices will continue to struggle without a shift towards greater use of PCR in the manufacture of new products. Cleanfarms will continue to promote the message of increasing demand for PCR content within the industry and continue to work with its own members (brand owners and manufacturers) to encourage the use of PCR in the manufacture of new products whenever possible.

⁹ Peter Sundt, Secretary General, EPRO

Appendix A: Recycling Facilities for Agricultural Plastics

Location	Material Types	Capacity	End-use applications	Visited? (Y/N)
Bashaw, Alberta	LDPE Grain Bags/PP supersacks	150 MT+/month ¹⁰	Pelletizing	N/A
Hussar, Alberta	LDPE Grain Bags	80 MT+/month ¹¹	Pelletizing	Y
Delta, BC	Twine	Unknown	Pelletizing	Y
Stuttgart, Arkansas	LDPE Grain Bags	Unlimited	LDPE bags	Y
Brooks, Oregon	Twine	180 MT/month	Roofing materials	Y
Belmont, North Carolina	LDPE Grain Bags, PP twine	700 MT/month	Pelletizing	N
Lethbridge, Alberta	LDPE Grain Bags	Unknown ¹²	Fence posts, railroad ties, nailing strips	Y
Trader (Shipping to Malaysia)	LDPE Grain Bags	Zero (import bans)	Pelletizing	Y
Trader (Shipping to Malaysia, Bangladesh)	LDPE Grain Bags	Zero (import bans)	Pelletizing	N
Trader (Shipping to Malaysia)	LDPE Grain Bags	Zero (import bans)	Pelletizing	N
Winchester, VA.	LDPE	N/A (no wash line) ¹³	Decking	N
Albert Lea, MN	PP twine	190 MT/month	Pelletizing	N
Trader	PP Twine	Unknown	Pelletizing	N
Minnesota, Ecuador, Dominican Republic (owned facilities)	LDPE, PP	Unlimited	Pelletizing	N
Fort Ellis, Nova Scotia	LDPE/LLDPE	Unknown	Plastic lumber	N
Clinton, Ontario	LDPE/LLDPE	Unknown ¹⁴	Pelletizing	Y
Montreal, Quebec	LDPE/LLDPE	2,000 MT/month ¹⁵	Pelletizing	Y

¹⁰ Facility not yet in operation. Expected operational date: November, 2019

¹¹ Strict quality requirements

¹² Material must be pre-processed before delivery

¹³ Material must be clean and extruder-ready

¹⁴ Last contact indicated that the facility is no longer operational

¹⁵ Not currently accepting agricultural films, but plan to in the future



Appendix B: Markets for Other Agricultural Plastics

Stream	Recycling (North America)	Recycling (Overseas)*	Incineration (energy recovery)	Tipping fee (recycling)	Cleanfarms program?	Comments
Grain Bags	Yes	Yes	N/A	N/A	Yes	Some recyclers in Canada/USA; Other recycling options are developing in Canada.
Bale Wrap	Yes	Yes	Yes – up to \$150/MT**	Yes – up to \$50/MT	Yes	One recycler in Canada with tipping fee; other North American recyclers are no longer accepting bale wrap. Overseas markets exist but not currently accessible.
Silage Plastic	Yes	Yes	Yes – up to \$150/MT	N/A	Yes	Similar to grain bags, must be kept separate from bale wrap and kept clean. Can also be incinerated where markets are not accessible.
Greenhouse Film	Yes	Yes	N/A	No	No	Managed through private sector
PP Twine	Yes	Yes	N/A	No	Yes	Some recyclers in USA; high quality standards
Net Wrap	No	No	Yes - up to \$150/MT	N/A	Yes	No known recycling options; mixed plastic types (HDPE, LDPE, PP) and high contamination. Incineration is the only known option.
PP Supersacks	No	Yes	Yes – up to \$150/MT	N/A	Yes	Cleanfarms is currently sending supersacks for incineration but actively seeking recycling options in North America
HDPE Containers	Yes	N/A	N/A	No	Yes	Strong North American markets for HDPE plastic

*Facilities exist, but importation restrictions and pending Basel amendments limit trade

**Prices are FOB receiving facilities. Transportation costs can vary widely.

N/A denotes 'not applicable' where recycling markets currently exist

Appendix C: List of Acronyms

PCR – Post Consumer Recycled; describes resin made from post-consumer recycled plastic.

HDPE – High-density Polyethylene; ethylene polymer often used to produce rigid plastics.

LDPE – Low-density Polyethylene; ethylene polymer often used to produce film plastics.

LLDPE – Linear Low-density Polyethylene; LDPE with additive to promote stretch (shrink wrap).

PP – Polypropylene; propylene polymer used in production of twine and supersacks.

NGL – Natural gas liquids; hydrocarbons used to produce virgin plastic resins.

OTR – Over the road; describes transportation of materials via truck and trailer by road.

FOB – Free on board; shipping arrangement to include delivery costs to destination.