

Hemp-based Absorbents: An Opportunity Review

Prepared for:

Alberta Agriculture and Rural Development

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HEMP-BASED ABSORBENTS: A MARKET OPPORTUNITY REVIEW

EXECUTIVE SUMMARY

INTRODUCTION

Hemp is an emerging crop for Alberta and during the past several years, hemp acreage in Alberta has increased from a few hundred hectares to more than 6,000 hectares. Most of the hemp production is of varieties cultivated for hemp's high omega-3 oil while hemp biomass is currently a low valued by-product. As a result, new ventures in hemp fibre processing are planning start-up operations in Alberta to take advantage of low cost feedstock and growing demand for natural fibre for applications such as building products, geotextiles, and insulation. The expectation is that a minimum of 30,000 – 40,000 tonnes of hemp straw processing capacity will be built by 2016.

Hemp fibre is historically valued for its long bast fibres but decortication for long fibre production generates a 45% percent yield of the woody core known as shive or hurd. In order to ensure that maximum value can be obtained from each straw fraction (chaff, hurd, bast), Agriculture and Rural Development requires information on alternative fibre applications, with a particular focus on Alberta markets. This study investigates the value of hemp fibre use in absorbent products whose applications include industrial (oil spill) absorbents, animal bedding, and natural fibre woven materials for personal care (adult hygiene products, baby diapers).

KEY FINDINGS

The results of this study confirmed that hemp fibre occupies niche positions in several absorbent market segments. There are companies operating in Europe, Australia, and in Canada that supply processed fractions of hemp fibre.

- Hurd shavings are targeted as bedding for a wide range of animals including commercial operations for horses, chickens, dairy, as well as for pet owners of birds, rodents, and reptiles.
- Short hemp bast fibre products are available as nesting material for rodents.
- Hemp fibre (hurd and possibly whole shredded straw) is used as a loose material for oil spill clean-up.

Detailed information about hemp performance and market potential was obtained by reviewing web sites of companies producing and marketing natural absorbents products, along with follow-up phone and email communications. Companies contacted included industrial (oil-spill) absorbent marketers, horse stable operators, pet stores, and cloth diaper manufacturers.

Key observations of the market are as follows:

- The Alberta market potential for hemp hurd shavings and possibly shredded whole fibre for agricultural and industrial absorbent applications is estimated to be in the 50,000 tonne range. The highest near-term volume application is expected to be the premium horse bedding market.

Longer term additional demand could come from the oil and gas sector for site clean-up and soil remediation.

- The primary competitive product in agricultural markets is wood chips and/or shavings. Wood shavings are low cost and widely available from existing forest products operations (saw mills) and can also be derived from urban wood waste (mainly spruce) and from beetle-killed pine. Wood shavings are also in demand from the oil and gas industry for erosion control and soil remediation.
- Melt-blown polypropylene products are the most widely used industrial absorbent material. The advantages of polypropylene are that it is durable, highly absorbent, and lint free. There is also a range of established environmentally sensitive products for oil spill control that includes recycled cotton, dried peat, and blends of natural fibres. Products are available both in loose form and as manufactured pads, socks, and booms.
- The use of absorbents in both agricultural and industrial settings is a technical solution that requires industry standard test results and field demonstration. This is a particularly important issue for introducing a new product, such as hemp, and an overall technical and operational advantage needs to be demonstrated in order to gain market acceptance.
- Suppliers of biobased industrial absorbents see value in expanding the use of land-based oil spill clean-up by using natural fibre absorbents for soil remediation. This is known as in situ oil spill control, where the natural absorbent removes the oil from the soil, and then accelerates the degradation to leave remediated soil.
- Several innovative companies were identified that operate their businesses in Alberta in the animal bedding and industrial absorbent markets. Each company expressed interest in receiving samples of hemp fibre in order to conduct product development testing and evaluations.
- Pricing of loose fibres for industrial absorbent applications (oil spill control) ranges from \$1 - \$4 per kg, packaged in bags of around 10 – 12 kg, however, based on claims of oil absorbency, the cost of each product is largely equivalent to, i.e., in the range of \$0.50 per litre of oil absorbed.
- One of the natural fibre industrial absorbent products on the market is made from kenaf core, which is similar to hemp hurd. The kenaf product is priced at \$4 per kg in 12 kg bags and this is considered a close comparator for a product derived from hemp.
- Listed distributor pricing of hemp hurd was found at \$2.30 per kg for orders larger than 250 kg. Detailed product specifications (fibre size, dust content, etc.) are not known. This pricing implies a bulk delivered cost to the distributor of \$1 – 1.50 per kg.

CONCLUSIONS/RECOMMENDATIONS

The primary conclusion of this study is that there is a clear market interest in hemp as a high performing natural fibre absorbent. Alberta has demand for natural fibres absorbents from two key market segments – animal bedding and oil spill control. This study suggests that the utilization of hemp fibre could generate \$50 – \$100 million in bulk processed fibre sales (hurd, fibre, chaff pellets) within 5 – 7 years, if hemp seeding grows to beyond 10,000 hectares. This fibre industry would generate farm gate revenue at a minimum of \$100 per tonne of hemp straw.

Advancing this industry in Alberta and maximizing its economic potential will require a significant and concerted effort from producers, processors, product manufacturers, and distributors. It is strongly recommended that ARD follow up with each of the individual companies that expressed interest in hemp fibre as part of an industry development initiative. These companies represent both the animal bedding and industrial absorbent markets and are specialists in their respective fields. It is believed that all of the technical needs and knowledge gaps to develop absorbent markets for hemp in Alberta can be addressed through collaborative product development projects with industry.

ARD's industry develop staff are well positioned to facilitate a hemp fibre initiative. Key issues can be addressed by the following actions:

- Maintain a clear understanding of the fibre fraction utilization plans of potential processors
- Maintain a clear understanding of regional hemp straw availability in terms of oil varieties, dual purpose varieties, and fibre varieties.
- Secure funding for fibre processing at ABDC for making samples of fibre available to the product manufacturing and marketing companies.
- Build the technical data base for hemp fibre to establish the product characteristics and specifications of each fraction as an industrial absorbent.
- Facilitate collaborations among processors and product marketers by assisting in obtaining funds for additional market development such as product application expansion, and identification of export opportunities. Longer term opportunities may include woven fibres for fibre hemp varieties, advancing the practices of soil remediation using hemp, as well as other oil and gas applications.

A summary of near term recommended actions to be taken by ARD is provided in Table I.

Table I. Priority Targets for Technology Development

Technology/Application	Recommended Action	Volume Potential
oil spill clean-up and bioremediation <ul style="list-style-type: none"> - require experience and internal capacity to develop industrial absorbents - evaluate hemp fibre as oil spill control and bioremediation material 	Establish a collaborative hemp fibre characterization project <ul style="list-style-type: none"> - generate fibre samples for testing - establish protocols for use as an industrial absorbent material - document potential for use soil remediation - explore other oil and gas (drilling mud) applications - facilitate business collaborations with Alberta hemp processors 	<5,000 T
natural fibre pads for oil spill control <ul style="list-style-type: none"> - product are sold and distributed across North America, including Alberta 	Hold discussions with interested companies to determine target performance criteria and fibre needs <ul style="list-style-type: none"> - determine potential for bast fibre for non-wovens, or hurd for absorbent filler - generate samples for evaluations - facilitate collaborations with Alberta hemp processors 	1,000 T
oil spill clean-up, and bioremediation <ul style="list-style-type: none"> - product specifications are expected to be similar 	Generate and supply hemp fibre samples for evaluations <ul style="list-style-type: none"> - maintain communications for optimization of fibre production specifications - facilitate collaborations with Alberta hemp processors 	1,000 T
animal bedding (equine, bovine, poultry) <ul style="list-style-type: none"> - require experience in developing healthy bedding material and practices - potential to establish a vertically integrated hemp business (raw hemp processing and product sales) 	Establish a collaborative hemp fibre performance documentation project <ul style="list-style-type: none"> - generate hurd shavings for testing in horse stables - establish processing conditions and specifications for shavings (shaving size, dust free) - facilitate discussion for building a supply chain 	>10,000 T

HEMP-BASED ABSORBENTS: A MARKET OPPORTUNITY REVIEW

A. INTRODUCTION

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Hemp fibre is historically valued for its long bast fibres but decortication for long fibre production generates a 45% percent yield of the woody core known as shive or hurd. In order to ensure that maximum value can be obtained from each straw fraction (chaff, hurd, bast), Agriculture and Rural Development requires information on alternative fibre applications, with a particular focus on Alberta markets. This study investigates the value of hemp fibre use in absorbent products whose applications include industrial (oil spill) absorbents, animal bedding, and natural fibre woven materials for personal care (adult hygiene products, baby diapers).

B. INDUSTRY ANALYSIS

Information about hemp performance and market potential was obtained by reviewing web sites of companies producing and marketing hemp and other natural absorbent products, along with follow-up phone and email communications. Companies contacted included industrial (oil-spill) absorbent marketers, horse stable operators, pet stores, and cloth diaper manufacturers.

B.1 OVERVIEW

The applications for hemp fibre are well known to those in the industry. Historically, hemp has been valued for the strength and durability of the long bast fibres for making fabrics and ropes and this industry continues today. Hemp fibre has advantages vs. other natural fibres and when blended with other fibres such as cotton, a durable yet soft woven material is produced with desirable properties for clothing, particularly when moisture control is required. Most of the woven products available in North America are imported from Europe and Asia.^{1,2,3,4}

In addition to hemp woven products, various hemp fibre products are available from wholesalers in the US. Hemp Traders provides comprehensive information about the products that they import and distribute, including list pricing.³ Figure 1 shows the various types of hemp fibre fractions that are

¹ <http://www.examiner.com/article/hemp-textile-wholesalers-the-u-s>

² <http://www.envirotextile.com/>

³ <http://www.hemptraders.com/aboutus.asp>

⁴ <http://www.simplififabric.com/pages/wholesale-custom-ordering>

available, which includes grades of bast fibre and hemp hurd. The list pricing of each product is provided in Table 1.

Figure 1. Processed Hemp Samples



Table 1. Hemp Fibre Pricing⁵

Hemp Material	Description	Typical Applications	Wholesale Price, \$ per kg, >250 kg orders
raw long fibre	uncombed, untreated, 7cm – 1 metre length fibre	paper, building materials, twine, rope	7.56
raw short fibre	uncombed, untreated, 1 cm length fibre	paper, insulation, stuffing, composites	9.45
de-gummed fibre	soft fine fibres, lignin removed	spinning, stuffing for upholstery, pet bedding	6.90
combed fibre	aka hemp sliver, fine spinnable fibre	crafts, cordage, yarn	13.16
hurd	chips	animal bedding, “wood” composites, hempcrete	2.30

source: hemptraders.com

As noted, in Table 1, hurd is priced at a much lower level than bast fibre (\$2.30 per kg vs. \$7 - \$10 per kg), which reflects the demand for long natural fibres for higher valued woven natural fabric. The lower pricing for hurd is also aligned with the industrial and agricultural absorbent markets. Additional pricing information with respect to these applications is provided in the subsequent sections of this report.

⁵ <http://65.110.83.8/media/pdf/2014%20PRICE%20LIST.pdf>

Alberta Perspective

In western Canada, it is estimated that 80% of the hemp grown is for oilseed production and common varieties are Finalo, CRS-1 and CFX, which are all high yielding grain varieties.⁶ These varieties are not developed and optimized to produce the long bast fibres that are valued for use in woven products and this scenario has several key implications.

- a) Most of the hemp industry in Alberta and western Canada will have a business model where the grain/oil is the primary revenue source and the fibre is a lower valued co-product.
- b) New applications of the shorter bast fibres from oilseed hemp varieties are required in order to create value from decortication of the straw.
- c) In the event of increased demand for Canadian-grown long fibre hemp varieties for woven applications, markets for the hurd will still be required as hurd yield from hemp straw is in the 40 – 45% range.

An on-line search for Canadian companies in the industrial hemp business identified numerous commercial activities and these are summarized in Table 2. It is clear that the animal bedding market, for horses in particular, is a primary target application for hemp hurd shavings.

Table 2. Canadian Hemp Fibre Producers

Company Name	Web Address	Location	Absorbent Products
Plains Hemp	plainshemp.com	Manitoba	<ul style="list-style-type: none">▪ general absorbents (no specific products)▪ horse bedding
Hemp Technologies	hemp-technologies.com	New Zealand (product is supplied from Manitoba)	<ul style="list-style-type: none">▪ hemp fibre and shavings for all industrial applications, including bedding for horses, chicken, and small pets (rodents)
Emerson Hemp Distribution Co.	emersonhemp.com	Manitoba	<ul style="list-style-type: none">▪ long fibres (4 – 6 inch) for bedding for nesting pets (rodents, pigs, birds)▪ hurd shavings, plus some fines for horse bedding
Stemergy (formerly Hempline)	hempline.com stemergy.com	Ontario	<ul style="list-style-type: none">▪ Hemp Chips™ hurd shavings for horse bedding

International Hemp Companies

Internationally, HempFlax operates a decortication plant in the Netherlands and has product distribution in multiple locations there, as well as in Denmark, Liechtenstein, and Australia.⁷ The HempFlax plant can produce a number of fibre types, i.e., hurd shavings, shredded hurd, bast fibres of a variety of lengths, and it markets its products to non-woven and loose fibre applications. HempFlax does not advertise any supply of longer fibres for woven materials, which suggests that its operations are in conjunction with hemp oil production that produces shorter bast fibres. In the area of animal bedding and absorbents, HempFlax markets the following products:

⁶ Communications with Hemp Oil

⁷ <http://hempflax.com/en/products>

- hurd shavings are used as a larger animal bedding material under the brand names Hemparade and BioBase.
- shredded hurd is used as a loose bedding in cages for smaller animals such as guinea pigs and rabbits
- loose hemp bast fibre is used as a nesting material for small rodents and birds
- hemp pads of bast fibre are produced for pet cage liners

Hemp Technology is a UK company that marketed a hemp bedding product for horses called Hemcore, but this company has gone into Administration (bankruptcy protection).

EcoFibre Industries is an Australian company that produces both large and small animal bedding from hemp fibre.⁸ Ecofibre claims to be Australia's leading hemp research, development and commercialization company. It also markets (and presumably produces) Kengro Biosorb oil spill containment products.

Kengro is a producer of biobased industrial (oil spill) absorbent materials, based in Mississippi.⁹ The focus of its products is soil remediation but it also markets biobased pet absorbents, including Dr. Hemp for pet rodents, etc.¹⁰ Kengro's BioSorb is a granular organic material absorbent made from fibre crops (believed to be kenaf).¹¹ It is surmised that hemp fibre can be used to manufacture BioSorb since EcoFibre, a hemp processor, is a distributor of the product in Australia.

B.2 ANIMAL BEDDING

Animal bedding is the dominant target market for Canadian hemp fibre. The value proposition for the use of hemp hurd shavings as animal bedding is consistent across all of the companies that market hemp products. A photo of hemp hurd fibre used for animal bedding is provided in Appendix A. The claimed benefits are:

- highly moisture absorbent
- odour absorbent
- reduced bedding use vs. wood chips
- forms a durable base (for horse bedding)
- longer lasting
- less labour due to less removal and replacement
- faster composting
- dust free

Horse Bedding

The economics of using hemp shavings for horses has been developed by several existing suppliers. A cost comparison from Hemp Technologies is provided as an Appendix B. This comparison suggests that

⁸ <http://ecofibre.com.au/>

⁹ <http://www.kengro.com/index.html>

¹⁰ <http://kengropet.com/>

¹¹ <http://ecofibre.com.au/kengro-biosorb/>

while hemp shavings are 20 times more expensive than sawdust and 8 times more than wood shavings, the net cost to the horse stable is less, based on reduced quantities purchased, reduced labour due to less full stripping of the stalls, and reduced storage and disposal costs. A summary of this comparison is provided in Table 3.

Table 3. Bedding Costs Assessment

	Hemp Shavings	Wood Chips	Pine Sawdust
Cost per litre	\$0.150	\$0.020	\$0.005
Annual Usage, litres	7,800	19,344	13,139
Annual Material Cost	\$1,171	\$387	\$66
Labour	\$589	\$1168	\$2624
Storage	\$136	\$462	\$344
Disposal	\$39	\$97	\$66
Total	\$1935	\$2114	\$3099

source: hemp-technologies.com

In Alberta, wood shavings from waste wood are the most common bedding materials used in horse barns. Within this product segment, pine shavings are considered a premium product. Sales to the Alberta horse bedding market are estimated at \$10 million annually. Expenditures by each moderately sized stable are \$15,000 - \$20,000 per year which makes bedding a significant cost item for each operation. Wood shavings can be purchased in bulk by the truckload, at approximately \$15 per cu yd (2 cents per litre) which is the pricing used for wood chips in the cost comparison in Table 3. Alternatively, pine shavings can be purchased in plastic bags of compressed material at reported pricing of \$3.84 per bag, which translates to 1.3 cents per litre on a loose fibre basis. This lower pricing for bagged product is attributed to more efficient shipping and storage of compressed and densified shavings. At this price point and holding other costs constant, the cost of wood shavings would be lower than indicated in Table 3, (\$1,984 per year) however, there would still be a small projected cost advantage for hemp shavings.

Discussions with the horse stabling industry suggested that there is an active interest in alternatives to wood shavings. Sourcing of pine, the preferred wood, is an ongoing challenge which could become even more difficult if “beetle kill” wood supply (pine that can’t be used for lumber due to damage by the mountain pine beetle) is not maintained. The bedding industry has become highly technical and there is a high level of awareness of the benefits of healthy bedding practices, which includes sensitivity to allergens, air quality, and general hygiene, in addition to cost control and availability. Some of the observations of the horse bedding industry are as follows:

- Parkland Chip is a major supplier of wood shavings for horse stables in Alberta. Its production capacity is estimated to be in the 100,000 tonne per year range. UFA is a major distributor for Parkland Chip.
- Strathcona Animal Bedding¹² is a large pine shavings distributor to animal bedding markets both within and outside of Alberta - mainly for horses, but also dairy and chicken barns.
- There is need for safe and healthy bedding products but at a competitive cost.
- Demand from the oil and gas industry may be driving up the price of wood chips.

¹² <http://www.strathconaanimalbedding.ca/>

- Advantages of hemp vs. wood chips may be marginal but if hemp shavings could be supplied at a lower net operating cost, market demand may be in excess of 50,000 tonnes per year.
- Hemp bedding could be of value to dairy and chickens as well as horses.

Pet Bedding

Natural fibre bedding for small pets is readily available at retail pet stores. The main application is for caged pets such as guinea pigs, gerbils, rabbits, ferrets, snakes, birds, and other small animal pets. There are several types of products typically found – recycled wood pulp, recycled paper, and wood shavings (usually pine or aspen). The important performance requirements are water absorbency, odour management, and hygiene. Package size ranges from just under 10 litres to 60 and 100 litres. Anecdotal evidence provided by retail staff is that pet owners prefer smaller package sizes presumably based on ease of handling and the volume requirements of a typically sized cage. Pricing of typical products are shown in Table 4.

Table 4. Pet Bedding Products

Brand	Description	Package Size (expanded)	Price	Price per Unit
Carefresh	reclaimed wood pulp	14 L	\$10	\$0.71 per L
		60 L	\$30	\$0.50 per L
Fresh n Comfy	recycled paper	50 L	\$44	\$0.88 per L
Living World	pine shavings	113 L	\$30	\$0.26 per L

The pricing for pet bedding/nesting products is significantly higher than the larger scale horse bedding market. For example, the price of pine shavings (\$0.26 per litre) is more than 10 times that of the same material sold into the horse bedding market. While the pet industry therefore represents a significant product margin potential, it also carries a much more involved business model that includes product marketing materials, distribution management, and product promotions.

B.3 PERSONAL CARE ABSORBENTS

Use of hemp fibre for woven materials is well established in the reusable cloth baby diaper market. Products available include fitted diapers, cloth folded diapers, and supplemental absorbing diaper liners. Examples of companies operating in this segment are as follows:

- Cotton Babies sells, among other items, Hemp Babie products, which are cloth folding diapers made from 55% hemp and 45% cotton.¹³
- AMP Diapers is a Manitoba-based company that produces reusable fitted diapers and liners.¹⁴ There are bamboo/cotton materials as well as those made from hemp/cotton blends. The bamboo fabric is actually a rayon derived from bamboo.
- Kanga-Care supplies hemp/cotton cloth diaper liners.¹⁵
- Baby Kicks Natural Hemp Fiber Products produces and markets a line of reusable baby diapers, diaper liners, wash clothes, and towels. The products are generally hemp/cotton blends, and the company uses hemp “because of its durability, absorbency, and its natural anti-microbial properties”.¹⁶

The main benefits claimed for hemp cloth diapers are softness and absorbency as well as being hypoallergenic and employing “chemical free” production practices. Baby diapers are a significant market for hemp fibre but virtually all of the hemp cloth products reviewed are manufactured from hemp/cotton blends of woven cloth supplied from Asia/China. Therefore, while hemp based woven materials have value, development of this market for Alberta hemp either involves export of raw bast fibre, or would require new infrastructure in Canada for weaving long bast fibre into cloth. The challenge would be to establish cost competitiveness vs. imported products.

B.4 INDUSTRIAL ABSORBENTS

The absorbents market for oil spill cleanup has been estimated in the \$2 billion range globally.^{17,18} As shown in Table 5, the industrial absorbent market includes several distinct product types, which can be categorized as

- manufactured products (pads, socks, booms),
- loose absorbents,
- universal (all liquids),
- oil only (which generally includes paints and other organics),
- absorbents for remediation.

¹³ http://www.cottonbabies.com/index.php?manufacturers_id=20

¹⁴ <https://www.ampdiapers.com/hemp-fitteds>

¹⁵ http://www.kanga-care.com/6r-Soaker-Inserts-Bamboo-Hemp-Microfiber_p_95.html

¹⁶ <http://babykicks.com/>

¹⁷ <http://www.bccresearch.com/market-research/plastics/polymer-absorbents-adsorbents-pls046a.html>

¹⁸ Monarch Green Inc., Absorbent Market Synopsis.

Table 5. Industrial Absorbents and Applications

	universal	oil/organics
manufactured products (pads, socks, booms)	melt-blown polypropylene recycled cotton non-woven hemp bast fibre	melt-blown polypropylene corn cobs recycled cotton (treated)
loose absorbents	dried peat bentonite clay vermiculite hemp hurd shavings diatomaceous earth	dried peat bentonite clay vermiculite natural fibres
remediation absorbents		corn cobs dried peat natural fibres

Overall, the two most commonly used materials are polypropylene (pads and socks, etc) and bentonite clay (granular “floor dry”). Most outdoor oil spills are contained using polypropylene products, where the pads, booms, or socks are used to soak up the oil and then are collected for disposal. Polypropylene absorbents are made using the melt-blown process, where melted polymer is passed through small orifices with cooling air that re-solidifies the polymer into fine filaments that become the absorbent material. The key advantages for polypropylene are the durability of the material, the absorbing capacity, and its hydrophobicity. This translates to easy use for floating booms and socks for water cleanup as well as the option to squeeze the absorbed oil out and reuse the product.

While the vast majority of pads and booms use polypropylene for oil spill containment, most absorbent material suppliers also include environmentally friendly products in their product lines. These products are typically made from recycled cotton or other cellulosic materials. Other biobased absorbents used are loose and/or granular products such as corn cobs and dried peat.

A key potential advantage of organic and/or natural fibre absorbing material is that it can be used in a scenario of in situ soil remediation. This refers to an oil spill control method where oil-contaminated soil is mixed with the natural fibre absorbent which aids in biodegradation of the oil. This process takes longer, but avoids costly contaminated soil removal as well as the cost of collecting oil soaked synthetic absorbents. There is a general sense in the industry that reclamation methods will increase in use, which eliminates that need to dispose of oil and absorbent material. A comparison of absorbent cost of use developed by S

Examples of environmentally safer absorbent are as follows:

- Nature’s Broom is a commercially available line of natural fibre-based absorbent materials that is targeted as an alternative to clay-based oil absorbents.¹⁹ It has USDA approval for meeting the requirements of the US BioPreferred procurement program. Nature’s Broom provides a reduced cost marketing strategy that is based mainly on a reduction of material needed on a weight basis, which leads to reduced costs in contaminated material disposal.

¹⁹ <http://www.natures-broom.com/>

- Kengro is a producer of biobased industrial (oil spill) absorbent materials, based in Mississippi.²⁰ The focus of its products is on remediation, but it also supplies socks and booms for spill control. Kengro's products are based on kenaf,²¹ although hemp is also used in some of its products, i.e., Biosorb, a loose fibre oil absorbent. Also of interest, is that Kengro markets its absorbent material as an additive for drilling muds, as a circulation loss preventer.
- Ecosorb International produces and markets a line of industrial absorbent products manufactured from recycled cellulose material.²² It markets both pads and loose absorbent and claims an oil absorbency capacity of 13 times its weight in oil for the pads, and 4 times its weight for loose fibre.
- Enretech produces and markets its line of treated cotton industrial absorbent products.²³ The product line includes cotton pads, socks, and booms, which are made from off specification ginned cotton. Enretech claims that their products have 70% higher oil absorbency on a weight basis as compared to polypropylene.
- Sphag Sorb/Earth Care Products markets industrial absorbent products based on dried peat.²⁴ Sphag Sorb is an Edmonton based company that has experience in developing biobased industrial absorbent products and soil remediation processes. Sphag Sorb provides a reduced cost marketing strategy that is based mainly on a reduction of material needed on a weight basis, which leads to reduced costs in contaminated material disposal (see APPENDIX C).
- Evolution Sorbent Products (ESPP) supplies a full range of pads, socks, booms, and granular absorbents that include products made from melt-blown polypropylene, recycled cotton, and recycled plastics. The cotton-based products are marketed as having higher absorbency performance and lower cost.²⁵
- Absorbent Products Limited markets diatomaceous earth products, which is a commonly used granular material for cat litter and "oil dry".²⁶ Key performance criteria vary across applications (agriculture, general industrial, oil and gas) and include ammonia control, moisture absorbency, clumping behaviour, and microbial control.
- Perlite Canada produces two naturally derived absorbent materials – perlite and vermiculite.²⁷ Perlite is an amorphous silicate that is widely used in horticulture as part of the growth medium. Vermiculite is a silicate material that expands upon heating to form light porous granules and one of its key applications is for chemical spill clean-up and as a packing material for shipping chemical containers.

A price comparison for common industrial absorbent products is provided in Table 6. The pricing data is published list and/or on-line pricing, and therefore it is likely that industrial customers pay a discounted price for most of the products. Nonetheless, the published pricing provides a starting point for comparing price points for available products.

As seen in Table 6, the common absorbent materials used in industry are polypropylene, recycled cotton or other cellulosic material, and natural lignocellulose fibres. Most products provide information on the

²⁰ <http://www.kengro.com/index.html>

²¹ <http://www.kengro.com/images/navykenaf.pdf>

²² <http://www.ecosorb.com/>

²³ <http://www.enretech.com.au/products/catalogue/>

²⁴ <http://www.earthcareproducts.com/Products.aspx>

²⁵ <http://www.esp-us.com/Technologies/ColdForm2>

²⁶ <http://www.absorbentproductsltd.com/>

²⁷ <http://www.perlitecanada.com/en/english.html>

maximum amount of liquids that can be absorbed and therefore, the cost of product to absorb a given amount of liquid can be determined, as shown in the last column of Table 6. The observations of pricing are as follows:

- Recycled cotton and other cellulose absorbents are the lowest cost, as seen by the entries from Evolution Sorbent Products.
- Sphag Sorb's dried peat products are reported to exhibit among the highest absorbing capacity, but has also been priced at the highest level.
- The natural fibre products from Kengro and Nature's Broom are competitively priced vs. other products on performance level. Interestingly, the Kengro product is priced nearly 4X higher than Nature's broom, but claims to absorb 4X more liquid, which results in a similar cost of use.

The potential value of hemp fibre products can be estimated using weight and performance claims of the products in Table 6. The loose absorbent fibre products from Nature's Broom and Kengro are the products most similar to a hemp fibre absorbent and fibres can also be used as filler for sock and pillow absorbent products as well as larger booms. Pricing for loose fibre ranges from \$1 – \$4 per kg, but the cost per litre of oil is consistent at around \$0.50 per litre absorbed. Therefore, once hemp is formally evaluated according to industry standard absorbency tests, its market value can be determined. Based on information of Kengro's products using kenaf, it is likely that absorbents made from hemp hurd will perform similarly and therefore would support a packaged price in the \$3 – \$4 per kg range.

Table 6. Oil Spill Containment Products Comparison

Product Type	Supplier	Composition	Max Absorbency	List Price	Material Cost, \$/kg	Cost per Litre Oil Absorbed, \$/L
15" x 19" pads	Absorbents Online	polypropylene	110 litres per 100	\$47.99 /100	8.12	0.44
16" x 18" pads	Evolution Sorbent Products	recycled cotton	91 litres per 100	\$30.25 /100	5.54	0.33
16" x 20" pads	Spill Control Technologies	polypropylene	117 litres per 100	\$58 /100	n a	0.49
3" x 48" sock	Sphag Sorb	dried peat	6 litres each	\$125.85 /20	n a	1.04
3" x 48" sock	Absorbents Online	polypropylene	3.2 litres each	\$29.99 /10	6.60	0.94
3" x 42" sock	Absorbents Online	corn cob	2.4 litres each	\$50 /40	1.06	0.52
3" x 48" sock	Spill Control Technologies	pp/cellulose blend	3.8 litres each	\$78 /40	n a	0.51
3" x 48" sock	Spill Control Technologies	polypropylene	3.8 litres each	\$92 /40	n a	0.58
18" x 18" pillow	Spill Control Technologies	polypropylene	5.6 litres each	\$86 /16	n a	0.96
18" x 18" pillow	Spill Control Technologies	pp/cellulose blend	7.5 litres each	\$78 /16	n a	0.65
18" x 18" pillow	Evolution Sorbent Products	recycled cotton	12 litres each	\$69/ 16	6.07	0.36
18" x 18" pillow	Absorbents Online	polypropylene	8.7 litres each	\$57 /10	10.45	0.65
18" x 18" pillow	Sphag Sorb	dried peat	4.7 litres each	\$113.50 /10	n a	2.41
loose, 20 lb bag	Natures Broom	natural fibres	2.4 litres per kg	\$9.95 /bag	1.09	0.45
loose, 2.2 cu ft bag	Sphag Sorb	dried peat	50 litres per bag	\$34.50 /bag	3.02	0.71
loose	Kengro	kenaf	8 litres per kg	\$4.03/kg	4.03	0.50
loose, 25 lb bag	New Pig	corn cob	4.4 litres per kg	\$23.10 /bag	2.03	0.46

source: company web sites and product data sheets

C. CONCLUSIONS

This study found that the potential performance benefits of hemp are well documented and other jurisdictions have established supply, processing, and sales. In Alberta, the use of hemp fibre absorbents is at an early stage of development, but there are two clear opportunities in absorbents applications – for animal bedding and for industrial (oil spill) clean-up and remediation. Alberta is positioned and has sufficient industry interest in hemp fibre to warrant further work to develop these two markets. A 10,000 hectare hemp industry could generate \$50 – 100 million in bulk processed fibre sales (hurd, fibre, chaff pellets) within 5 – 7 years, with margin potential that will support a minimum of \$100 per tonne of farm gate revenues for hemp straw.

Other conclusions are discussed further below.

- The primary market driver for hemp’s value for crop producers remains as healthy oil production for food. This sets the scenario that most bast fibre produced in Alberta will not be of the long fibre quality required for high-valued applications in woven products and alternative applications are required. From this perspective, there are options to consider for processing the hemp fibre i.e.,
 - a) to process (ret, clean, shred, or otherwise mechanically process) the whole fibre or
 - b) decorticate, and develop markets for shorter length bast fibre and hurd-based products separately.
- Based on discussions with the horse stabling industry, there is clear support to investigate the use of hurd shavings as an alternative animal bedding to wood shavings, however, since the cost of hemp shavings is much higher than wood shavings on a volume basis, local data and local testimonials will need to be developed to support a claim of competitive operating costs. Hemp shaving suppliers have developed this marketing support in Europe, but bedding practices in Alberta are different and therefore first-hand data will be required to market hemp bedding in Alberta.
- Retail sales of small animal bedding products and oil spill clean-up products for garages and homeowners represent higher margin business opportunities for hemp absorbents. However, the retail business is much more involved than business-to-business industrial sales, in areas of products, promotions, marketing literature, agreements for shelf space, packaging, distribution, and inventory management, and these are issues is considered outside of the scope of ARD. In addition, this study was unable to engage any pet store suppliers in a detailed discussion about hemp products. Nonetheless, it is likely that the companies that develop products and performance data for hemp absorbents will be well-positioned to pursue retail sales opportunities during their normal course of longer-term business and sales development.
- Personal care absorbent products (diapers and other hygienic absorbents) are not considered a priority for ARD and Alberta’s hemp industry at this time. These products are currently imported through established supply chains from Asian manufacturers, as is the case with the majority of textiles. Production of specialized long fibre hemp varieties may well have a future business case in Alberta in terms of displacing imported natural fibres and woven products. Critical barriers to developing this industry in Canada are higher labour costs and a lack of infrastructure.

- A critical aspect of developing a hemp fibre industry at this stage is the availability of fibre samples and this implies a need for funding for operation of the ABDC pilot decortication plant. Regardless of which hemp fibre application becomes of commercial interest, samples of product need to be made available for testing and evaluations by industry experts. In addition, various milling conditions will need to be explored for developing product specifications, which would be important for accelerating production at commercial scale.

- There is a large gap in technical knowledge and documentation of hemp fibre performance for absorbent applications. For developing a value proposition and a well-crafted technical marketing strategy, the following documentation will be required:
 - absorbency performance based on industry standard testing (ASTM methods)
 - absorbency of hurd vs. bast fibre vs. blends or whole fibre by mechanical processing (shavings, shredding, fibre size and length), by potential application (bedding, indoor absorbents, outdoor absorbents, loose absorbents)
 - cost implications for varying process methods (decortication, shaving/shredding, packaging)
 - cost implications based on product performance requirements by application
 - production specifications (i.e., moisture content, fines content, shaving size)
 - chemical composition as it relates to microbial activity, odour control, compostability
 - other performances information as determined by industry experts and specific applications.

D. RECOMMENDATIONS

The primary recommendation is for ARD to follow up with a range of companies that are found to have interest in hemp fibre. It is believed that all of the technical needs and knowledge gaps to develop absorbent markets for hemp in Alberta can be addressed through collaborative product development projects with existing industry players. This study identified several opportunities for hemp fibre evaluations where capacity exists to commercialize products. Recommended actions for ARD are summarized in Table 7.

Each of the companies listed in Table 7 expressed an active interest to be contacted by ARD in order to define a scope of work for evaluating hemp fibres. Details of the work required for each product area can be determined once dialogue takes place with each individual company. ARD's industry development staff is well-positioned to facilitate a hemp fibre initiative and it is recommended that ARD take an active role in facilitating the product development process in several capacities. Key issues can be addressed by the following actions.

1. Maintain a clear understanding of the fibre fractionation and utilization plans of potential processors. As potential processors move forward, it will be critical that those interested in hemp fibre products are able to work with the fractions that are available.
2. Maintain a clear understanding of regional hemp straw availability in terms of oil varieties, dual purpose varieties, and fibre varieties. The nature of the crops being grown is likely to impact the processing conditions, and the performance of the fibre fractions. In order to avoid future problems of product performance and fibre availability, an ongoing inventory of seeded hemp should be maintained.
3. Secure funding for fibre processing at ABDC for making samples of fibre available to the product manufacturing and marketing companies. This will require 100s of kg for industrial absorbency testing, and multiple tonne quantities for horse bedding evaluations.
4. Build the technical data base for hemp fibre to establish the product characteristics and specifications of each fraction in industrial absorbent applications. The key fraction of hemp is the hurd, which represents 40% – 45% of the total straw mass, and is the fraction that is marketed for its high absorbency in other jurisdictions. In order to establish its value as an industrial absorbent and to document product characteristics and specifications for the processors to work towards, industry standard data needs to be generated. The response from industry suggests that the majority of this data can be developed in collaboration with companies that have the capacity to commercialize applications for hemp.
5. Facilitate collaborations among processors and product marketers by assisting in obtaining funding for additional market development such as product application expansion, and identification of export opportunities. Longer term opportunities may include woven fibres for fibre hemp varieties, advancing the practices of soil remediation using hemp, as well as other oil and gas applications.

Table 7. Priority Target Companies for Technology Development

Technology/Application	Recommended Action	Volume Potential
oil spill clean-up and bioremediation <ul style="list-style-type: none"> - require experience and internal capacity to develop industrial absorbents - evaluate hemp fibre as oil spill control and bioremediation material 	Establish a collaborative hemp fibre characterization project <ul style="list-style-type: none"> - generate fibre samples for testing - establish protocols for use as an industrial absorbent material - document potential for use soil remediation - explore other oil and gas (drilling mud) applications - facilitate business collaborations with Alberta hemp processors 	<5,000 T
natural fibre pads for oil spill control <ul style="list-style-type: none"> - product are sold and distributed across North America, including Alberta 	Hold discussions with interested companies to determine target performance criteria and fibre needs <ul style="list-style-type: none"> - determine potential for bast fibre for non-wovens, or hurd for absorbent filler - generate samples for evaluations - facilitate collaborations with Alberta hemp processors 	1,000 T
oil spill clean-up, and bioremediation <ul style="list-style-type: none"> - product specifications are expected to be similar 	Generate and supply hemp fibre samples for evaluations <ul style="list-style-type: none"> - maintain communications for optimization of fibre production specifications - facilitate collaborations with Alberta hemp processors 	1,000 T
animal bedding (equine, bovine, poultry) <ul style="list-style-type: none"> - require experience in developing healthy bedding material and practices - potential to establish a vertically integrated hemp business (raw hemp processing and product sales) 	Establish a collaborative hemp fibre performance documentation project <ul style="list-style-type: none"> - generate hurd shavings for testing in horse stables - establish processing conditions and specifications for shavings (shaving size, dust free) - facilitate discussion for building a supply chain 	>10,000 T

APPENDIX A

Hemp Hurd Bedding Fibre



source: Plains Hemp

APPENDIX B

Horse Bedding: Comparative Costs

Assumptions:

Material Costs (per litre):	Hourly Wages for Stable Hand:	Storage Costs (M2/per annum)
HempBed \$0.150	\$ 20 per hour including benefits	\$ 50
Wood Shavings \$0.020		Disposal Costs (gallon)
Pine Saw Dust \$0.005		\$ 0.005

	Bag	Lt
HempBed	\$20.00	130
Wood Shavings	\$7.00	100
Saw-dust	\$320	16000

Material Use (Litres)

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Lt	Rate/ Lt	Total Cost
HempBed	1470	0	60	60	60	60	60	60	60	60	60	60	60	60	60	2250	0.150	\$ 338
Wood Shavings	1470	80	100	80	100	1470	80	100	100	120	1470	90	100	100	120	5580	0.020	\$ 112
Pine saw dust	1470	140	160	140	200	140	140	140	200	200	160	200	140	200	160	3790	0.005	\$ 19

Stable Hand Labour (minutes per week)

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Min	Rate/Hr	Total Cost
HempBed	40	20	35	30	35	40	30	35	35	40	30	35	30	35	40	510	\$20.0	\$ 170
Wood Shavings	80	30	70	60	70	80	60	70	70	80	60	70	60	70	80	1010	\$20.0	\$ 337
Pine saw dust	180	140	140	140	160	140	140	140	160	160	150	160	140	160	160	2270	\$20.0	\$ 757

Storage Costs (litres)

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Lt	Area	Cost	
HempBed	1470	0	60	60	60	60	60	60	60	60	60	60	60	60	60	2250	0.78671	\$ 39.34	Stored in Bags
Wood Shavings	1470	80	100	80	100	1470	80	100	100	120	1470	90	100	100	120	5580	2.66986	\$ 133.49	Stored in Bags
Pine saw dust	1470	140	160	140	200	140	140	140	200	200	160	200	140	200	160	3790	1.98776	\$ 99.39	Stored inside

Disposal (Litres)

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Lt	Lt Rate	Cost
HempBed	1470	0	60	60	60	60	60	60	60	60	60	60	60	60	60	2250	0.005	11.25
Wood Shavings	1470	80	100	80	100	1470	80	100	100	120	1470	90	100	100	120	5580	0.005	27.9
Pine saw dust	1470	140	160	140	200	140	140	140	200	200	160	200	140	200	160	3790	0.005	18.95

Total Costs : 1 stable, 15 weeks

HempBed	\$ 558
Wood Shavings	\$ 610
Pine saw dust	\$ 894

Total Costs: 1 Stable/Year

HempBed	\$ 1,935
Wood Shavings	\$ 2,113
Pine saw dust	\$ 3,099



Some Important Comparison Facts

- 1) Sphag Sorb has an extremely high absorbency rate, so the savings are recovered in the reduced amount of product that needs to be shipped. Although you may still be shipping a 55 gallon drum of waste, the Sphag Sorb drum will have higher oil to absorbent ratio than polypropylene, or clay absorbents (Floor Dry). For example 30 gallons of oil can be absorbed by Sphag Sorb and fill 0.85 of a 55 gallon drum, in comparison to clay products which would require 1.5 drums.
- 2) It should also be mentioned that there will be a savings in labor to clean up a spill because Sphag Sorb absorbs instantly and does not require someone to stand over and mix it as clay products do.
- 3) Sphag Sorb is much lighter and easier to work with for employees which are a benefit personally to them and the company.
- 4) It may also be an idea to find out right from the point of disposal exactly how disposal is taking place. If the products are all being incinerated there is a definite advantage as Sphag Sorb will require less energy to burn because it generates some of its own 7,500 BTU's. This could actually used as an alternate fuel source to incinerate other absorbents that do not burn (Clay). This would be a means of savings reduction at the incineration site by using Sphag Sorb rather than a cost, if this is worth checking out the incinerator may be happy to receive all he can for free (no disposal price?).
- 5) Clay products are unique in that they are seen as a very inexpensive adsorbent by the initial price, but are expensive at the back end in the amounts of waste that is generated and shipped. This is due to the fact that clay is bulky and requires so much more to pick up oil, where most absorbents are costly right up front.



APPENDIX C



These calculations are based on 30 gallons of oil absorbed for disposal.

Type # 1 Clay Absorbent

30 gallons of oil would require 12 bags of Type # 1 @

\$ 5.00 = \$60.00

This would need 1.5 55 gallon drums to carry it @

\$250.00 = \$375.50

Total \$435.50

Polypropylene

30 Gallons would require 350 pads @

\$0.75 (to adsorb) = \$262.50

This amount would require 1.75 – 55 Gallon drums @

\$250.00 = \$437.50

Total \$700.00

Sphag Sorb

30 Gallons would require 3 bags of Sphag Sorb @

\$29.95 = \$ 89.85

This amount would require 0.85 of a 55 Gallon drum @

\$250.00 = \$212.50

Total \$302.35

This results in a 31% savings in the total cost of disposal not just the price of absorbent.