A Process for Manufacturing Fibrous and Particulate Fillers from Lignocellulosic Biomass

A.J. Kozlowski[1], A. Goel[1], S. Gupta[2]

[1] Omtec Inc., Ridgetown, ON

[2] E&M Engineering, Mississauga, ON

OFFICE
170 Bristol Road East
Mississauga, Ontario, L4Z 3V3
☎ 905-502-1504 🖷 905-502-1508

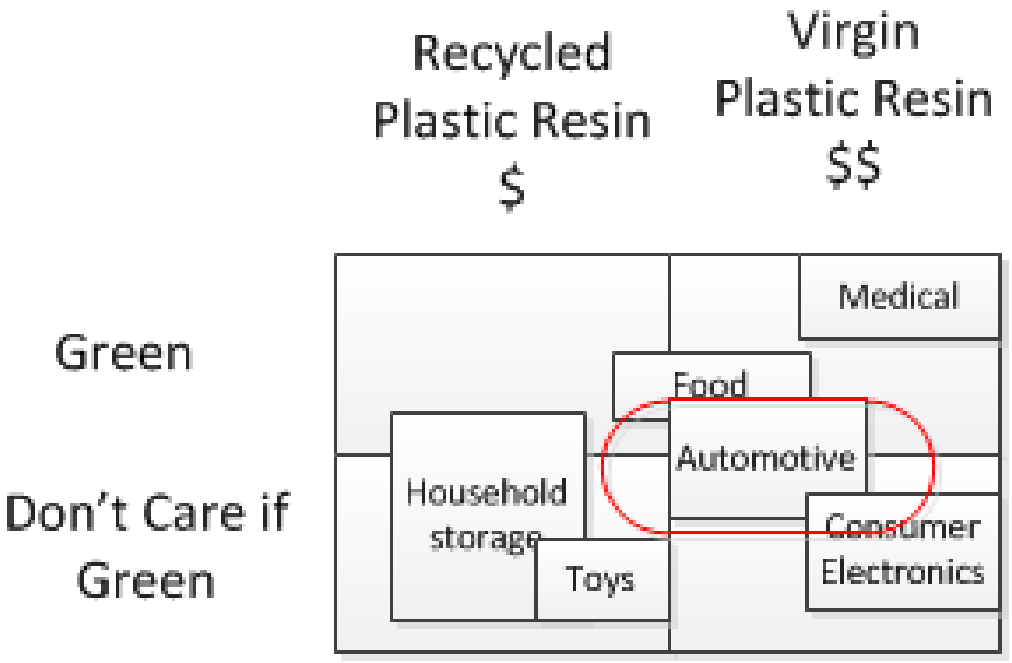
PLANT
73 Marsh Street, P.O. Box 578
Ridgetown, Ontario, N0P 2C0
☎ 519-488-1421 🖷 519-397-9091

Wheat Straw Applications

- soil fertilizer replacement (high N): $0.01-$0.02c/lb
- fuel liquid/bioethanol
- erosion control
- livestock bedding
- mushroom compost substrate
- animal feed
- solid core interior (home) door fillers
- low cost building panels walls (load/non-bearing), floors and ceilings (Romania)
- biosorbent/metal ion removal (e.g., Cr)-wastewater
- biofiller
- fuel log (replacing coal)

Wheat Farming

Wheat Straw Target Markets



Green:

1. Less petroleum use during manufacture
2. Less carbon emissions

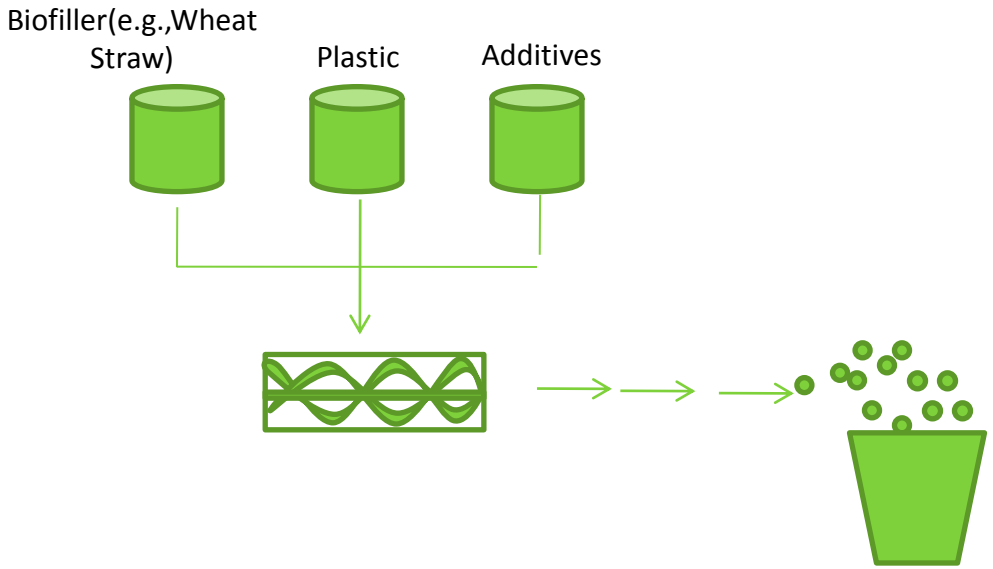
OMTEC Product Development Pipeline

- Biofiller ->
- Fuel Pucks ->
- Plastic Composites

- Production Goal: Zero Waste process

OMTEC Product Development Pipeline

BIOFILLER



Biofiller

Markets – Automotive Plastic Composites

- 1920s – Ford uses hemp for prototype parts
- 1941 – Ford "hemp" car
- 1950 - almost no plastic in cars
- 2012 (today): average of about 120 kg of plastic in every car built
- 2020: bio-based plastics could replace up to 90% of the total amount of petroleum-derived plastics consumed globally in 2007 [European study]

Biofiller

Omtec's WS Biofiller in Ford Flex 2009 and later :

- interior storage bins
- 20% wheat straw
- weight down by about 10%*
- reduced petroleum usage and associated CO2 emissions 30,000 pounds per year.

- * fuel economy increases ~ 6%-8%[1]

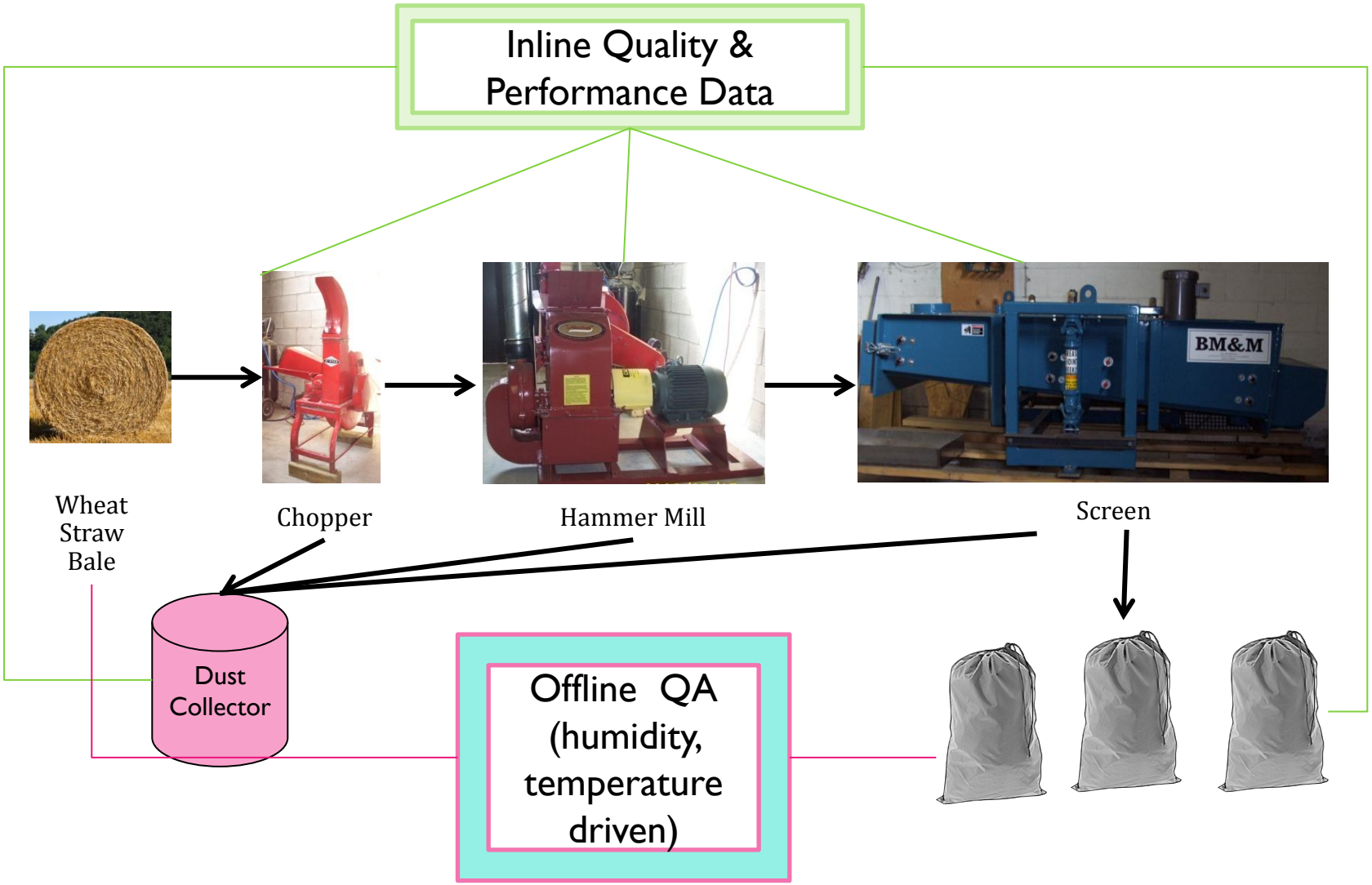
Biofiller Plastic Composites

- Cost Driver: Biofillers cost less than petroleum based products like polypropylene (PP)
  - Example: PP: ~$0.80/lb (virgin)
  - Wheat Straw Cost – less (see next slide)
- Inorganic fillers (calcium carbonate, talc) $0.25-$0.50/lb
- Environmental Driver: use less plastic pellets means less petroleum

Wheat Straw Cost Model

Item	$/lb	Notes
Wheat Straw (raw material)	$0.05-$0.08/lb	In volume, min. 20 lbs
Incoming QC		Wheat must not be exposed to weather (excess moisture, rot)
Transportation	$	
Processing	$$	Cost will depend on volume, and quality specifications
Total	$$	

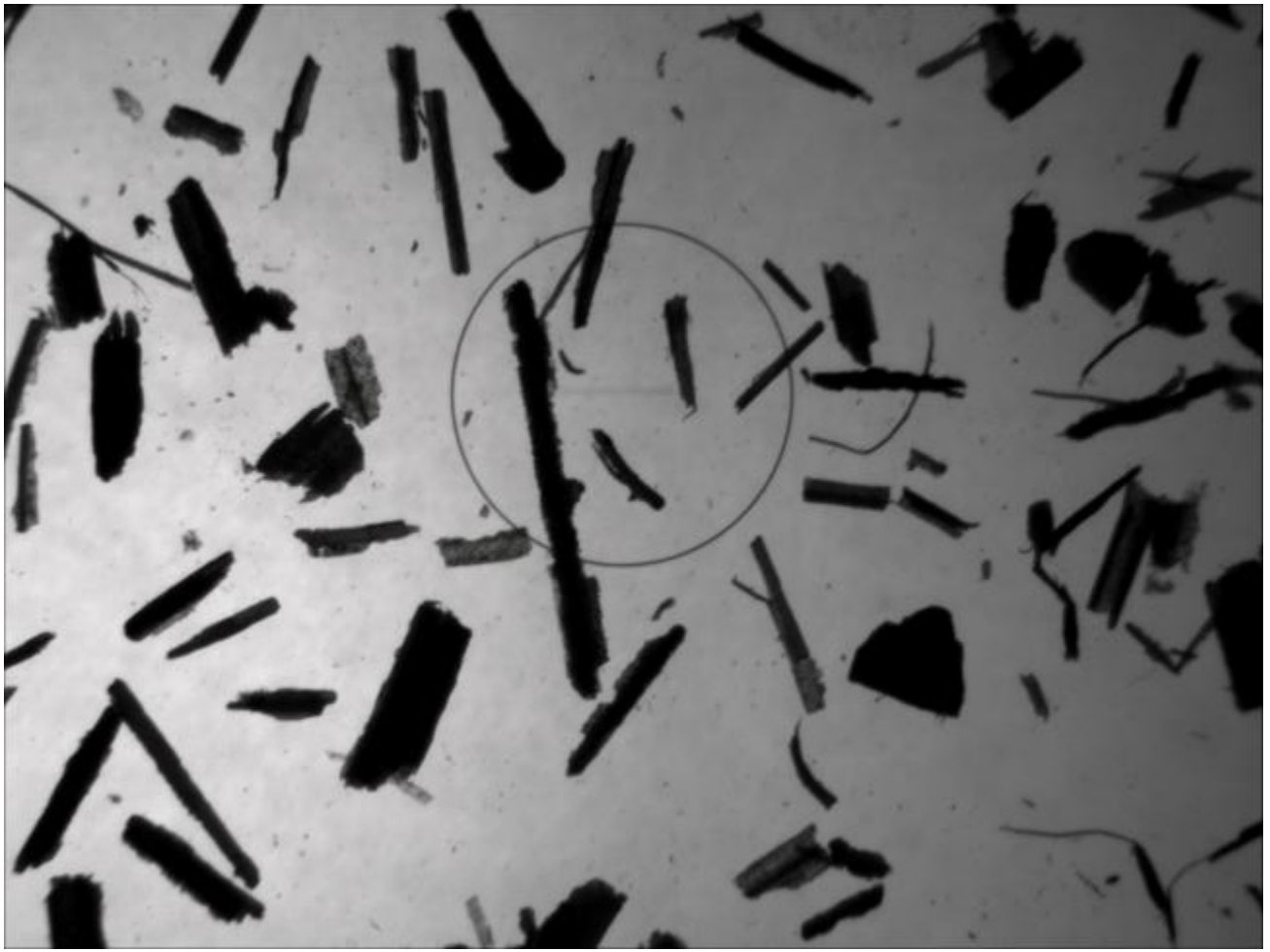
Biofiller Production



OMTEC Biofiller Grades (2012)

Grade	Size (Mesh/um)	Nominal Avg Length	OMTEC Application	Price (Qty/Sold)
WSBF-TH (chopped straw)		5+ mm		Internal
WSBF-15 (large fibers,#2)	>16 mesh	3.5 mm	Fuel Pucks	Internal – fuel "pucks"
WSBF-25 (medium fibers, #1)	16 – 35 mesh	2 mm	Automotive Plastic	Sold.
WSBF-35 (fine fibers,#3)	< 35 mesh	0.75 mm	Automotive Plastic	Sold.
WSBF-45 (dust)		< 0.1 mm	Fuel Pucks	Internal – fuel "pucks"

WSBF-25 biofiller – Image (0.65x)



OMTEC Capacity & Costing

- Current capacity (equipment limited):
  - 1 ton/day (~300 tons/year) limited by Sieve
  - Raw material cost of $0.04/lb -> $24,000/year to local farmers.
- Have capacity to expand to 10 tons/day:
  - Raw material $240,000/year

OMTEC Product Development Pipeline

FUEL PUCKS

Wheat Straw Biomass Combustion

- Target Market: Cofiring with coal.
  - Reduce use of fossil fuels
  - Environmental taxes and *credits may be available*

Wheat Straw Biomass Combustion

- The Good:
  - annual replenishment cycle vs fossil fuels
  - less sulfur than coal -> lower sulfur emissions (NREL)
- The Bad:
  - more potassium and chlorine than coal (NREL)

Wheat Straw Fuel Pucks

#	Issue	Mitigation	Notes
1	low bulk density of unprocessed biomass	Compressed Briquettes/Pucks	< 200 km economical radius if unprocessed (Preto)
2	high ash content (4-10 wt-%)	Cofiring with coal	Vs <1% for wood, 10% coal [3]
3	clinking (3-8 wt-% silica SiO2)	Remove leaves?	Deposits reduce heat transfer and increase slag formation.
4	water absorption (7-15% moisture)	Use pucks vs pellets – less moisture [4]	Vs 7-15% for wood Vs up to 30%-45% for lignite)
5	chlorine (Cl, 0.6 – 3.5%)	Work with University to strip chlorine	
6	flyash	<10% wheat straw [5]	Elevated alkaline content (Na,K)

Densification (bulk density)

Wheat Straw Format	Metric kg/m3	English lb/ft3	Source
Bulk Wheat Straw	18	1.1 (1x)	OMAFRA (2011)
Baled Wheat Straw (6' round bales)	98	6.1 (5.5x)	OMTEC (2011)
Bulk Biofiller (WSBF-25)	160	10 (9x)	OMTEC (2011)
Puck (Compressed)	480-640	30-40(~32x)	OMAFRA (2011)

Reference: coal at 700 kg/m3 (44 lb/ft3)

Heating Value

Wheat Straw Format	Metric MJ/kg	English BTU/lb	OMTEC data (calorific value)
Natural gas	39(50-55)	16,700	
Coal	25(-30)	10,800	
Wood (hardwood)	17-21	7300-9000	7425 (maple)
Wheat Straw	15-17	6400-7300	7260

Lehra Briquetting Press

MODEL NO.	PRODUCTION	POWER REQUIRED
LBP 100	2600 kg/h	89 HP

- 4” diameter ram type press
- 75HP main motor

Summary

Omtec is targeting:

- Biofiller applications
  - High value: Automotive, Medical and defense
  - Low cost: Domestic use
- Fuel Pucks
  - Internal use first.
  - Greenhouse cofiring with coal (greener)

Questions?