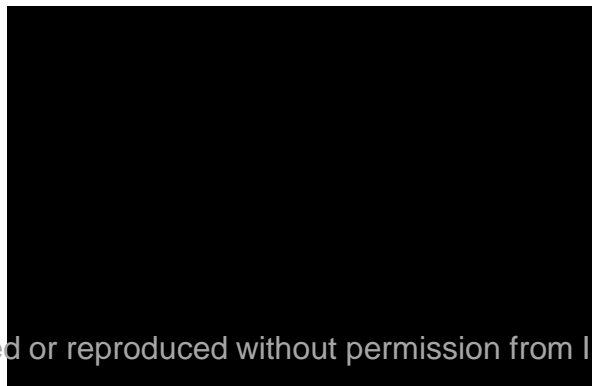


Hemp Derived Biochar

Viability of Hemp
Based Biochar and a
Quick Overview of
Biochar and Biochar
Applications

February 7, 2019
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Biochar Definition



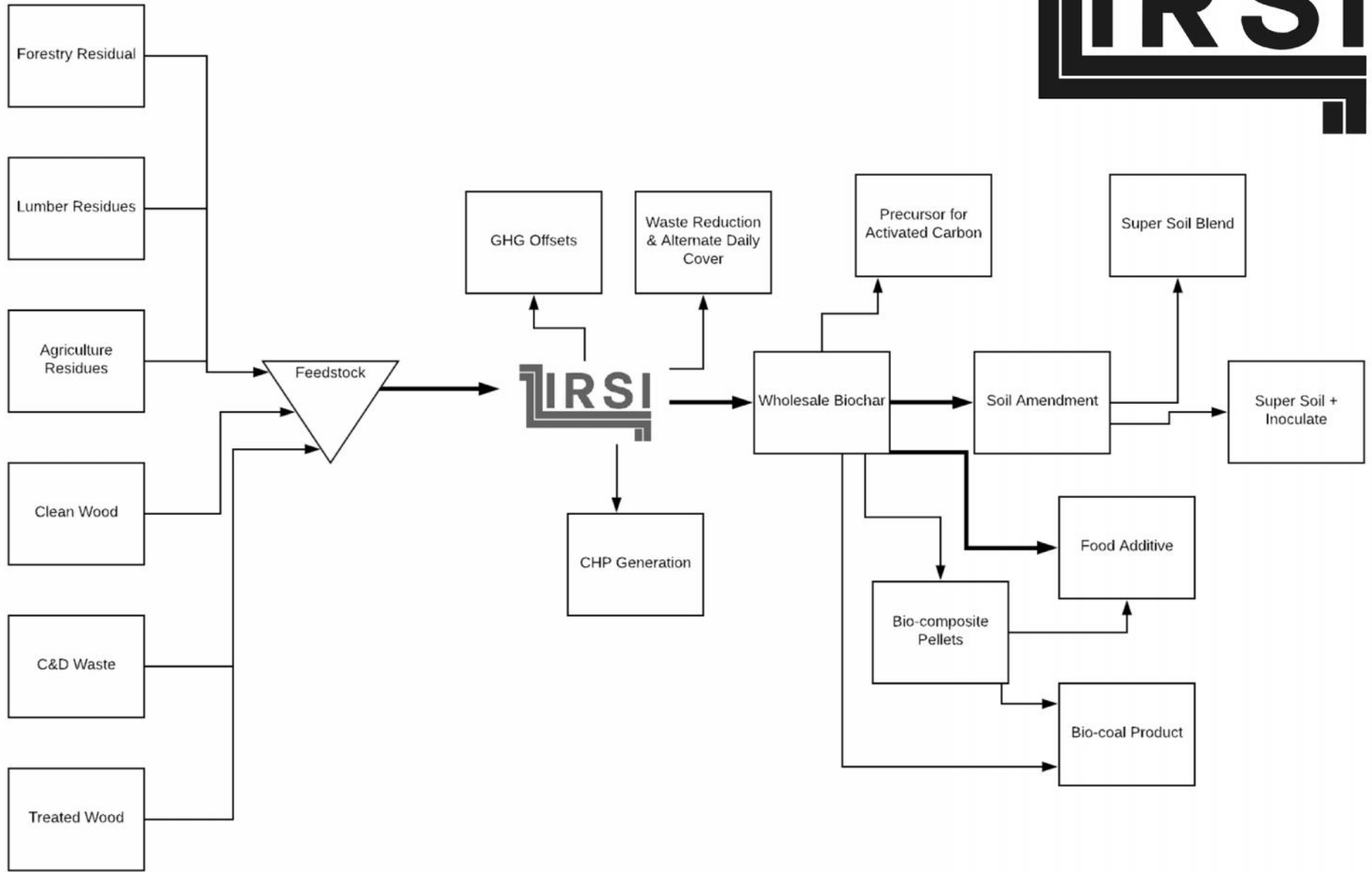
International Biochar Initiative: Biochar is a solid material obtained from thermochemical conversion of biomass in an oxygen-limited environment.

European Biochar Certificate: Biochar is a heterogeneous substance rich in aromatic carbon and minerals. It is produced by pyrolysis of sustainable obtained biomass under controlled conditions with clean technology and is used for any purpose that does not involve its rapid mineralization to CO₂ and may eventually become a soil amendment.

Biochar Applications:

1. Soil amendment
2. Food additive for livestock
3. Precursor for activated carbon
4. Cosmetic applications
5. Coal replacement
6. Absorbent
7. Bio-filter
8. Pozzolan replacement in concrete
9. Bio-composite additive
10. Plastic reinforcement additive
11. Organic growth medium
12. Sustainable insulation additive
13. Compost additive

Raw Biochar Value Chain



U of A Hurd Test Results



Elemental Analysis

Samples	C		H		N		S		O*	
	Wt.%	SD	Wt.%	SD	Wt.%	SD	Wt.%	SD	Wt.%	SD
Clean wood	45.65	0.17	5.76	0.07	0.23	0.00	0	0	46.65	0.21
Hurd	45.60	0.11	5.81	0.04	0.36	0.03	0	0	46.60	0.27
Bamboo	45.97	0.08	5.88	0.11	0.36	0.03	0	0	45.79	0.06

Proximate Analysis

Samples	Moisture		Volatile		Ash		Fixed Carbon	
	Wt.%	SD	Wt.%	SD	Wt.%	SD	Wt.%	SD
Clean wood	6.49	0.22	75.93	0.22	1.47	0.05	16.10	0.41
Hurd	6.92	0.07	76.01	0.37	1.19	0.03	15.89	0.31
Bamboo	5.76	0.17	74.52	0.31	2.67	0.69	17.05	0.24



Addressable Markets



Market	\$/ton	Opportunity	CAGR (%)
Waste Disposal Fees (AB)	\$70	\$294,466,760	6% ¹
Biochar (N.A. & EU)	\$3,354 ²	\$167,700,000	15%
Soil Remediation (AB) ³	\$40-70	\$2,007,250,000	n/a
Activated Carbon (N.A.)	\$7,150	\$4,180,000,000	11.9% ⁴
Total		\$6,649,416,760	



IRSI Stage of Development



Raw Biochar Testing



Parameters		Planer Shavings Feedstock	Biochar	IBI guiding values
Bulk Density (kg/m ³)	Untapped	82 kg/m ³ , wet basis 94 kg/m ³ , dry basis	94 kg/m ³ , dry basis	Not Applicable
	Tapped	129 kg/m ³ , wet basis 149 kg/m ³ , dry basis	131 kg/m ³ , dry basis	Not Applicable
Proximate Analysis on a dry basis	Volatile Matter	85.18%	17.85%	Declaration
	Ash	0.30%	1.43%	Declaration
	Fixed Carbon	15.11%	83.58%	Declaration
Ultimate Analysis on a dry basis	Carbon	49.01%	81.86%	These major soil enhancement qualities are required to use as follows: Biochar Class 1 ≥ 60% organic C, Class 2: < 60 to ≥30% C _{org} and Class 3: < 30% to ≥10% C _{org} H/C _{org} Molar Ratio: < 0.7 required
	Hydrogen	6.13%	2.92%	
	Nitrogen	<0.1%	0.14%	
	Sulfur	<0.1%	<0.1%	
	Oxygen	44.36%	13.55%	
Heating value on a dry basis	(MJ/kg)	19.5	30.1	Not Applicable
	(kW/kg)	5.41	8.37	Not Applicable
Bioassay (germination tests using radish seeds)		Not Applicable	Passed, 100% germinated (93-99% seeds germinated on controls)	Pass required
Concerning Heavy Metals (µg/g) on a dry basis	Arsenic	0.627	0.325	12 - 100
	Boron	2.26	7.88	Declaration
	Cadmium	0.140	0.122	1.4 - 39
	Chromium	1.50	1.25	64 - 1200
	Cobalt	0.0297	0.117	40 - 150
	Copper	4.18	4.07	63 - 1,500
	Lead	2.44	0.083	70 - 500
	Mercury	0.0047	0.0018	1 - 17
	Molybdenum	0.0326	0.136	5 - 20
	Nickel	0.575	0.607	47 - 600
	Selenium	< 0.10	< 0.10	1 - 36
	Silicon	27	81	Not Specified
	Sodium	7.98	6.67	Declaration
Zinc	8.2	31.6	200 - 700	

Table 5: Proximate & Elemental Compositions:

Sample ID	Proximate Analyses (% dry mass basis)			Elemental Analyses (% dry mass basis)						H/C Ratio	IBI
	Volatile matter	Ash	Fixed carbon	Carbon	Hydrogen	Nitrogen	Sulfur	Chlorine	Oxygen		
IRSI-BC	9.9	4.0	86.1	87.6	2.5	0.3	<0.1	0.02	5.6	0.17	P

ND = not determined; IBI = IBI Criterion: P = Pass; F = Fail;

10.0 CONCLUSIONS

Based on the current finding of this study, IRSI biochar characterized in this study meet the safety criterion stipulated by the (Canadian Food Inspection Agency) CFIA-Animal Feed Division's Regulatory guidance for contaminants in animal feeds and the IBI (international biochar initiative) guidance for biochar soil/land application.