

Biomass Upgrading Insights

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The added value of black pellets

- Torrefaction or steam explosion (combined with densification) enables energy-efficient upgrading of biomass into *commodity solid biofuels* with favourable properties in view of logistics and end-use
- Favourable properties include high energy density, better water resistance, slower biodegradation, good grindability, good “flowability”, homogenised material properties
- Therefore, cost savings in handling and transport, advanced trading schemes (futures) possible, capex savings at end-user (e.g. outside storage, direct co-milling and co-feeding), higher co-firing percentages and enabling technology for gasification-based biofuels and biochemicals production
- Applicable to a wide range of lignocellulosic biomass feedstock



Black pellet properties in perspective

	Wood chips	Wood pellets	Torrefied wood pellets	Steam expl. pellets	Charcoal	Coal
Moisture content (wt%)	30 – 55	7 – 10	1 – 5	2 – 6	1 – 5	10 – 15
LHV (MJ/kg db)	7 – 12	15 – 17	18 – 24	18.5 – 20.5	30 – 32	23 – 28
Volatile matter (wt% db)	75 – 85	75 – 85	55 – 80	72	10 – 12	15 – 30
Fixed carbon (wt% db)	16 – 25	16 – 25	20 – 40	ND	85 – 87	50 – 55
Bulk density (kg/l)	0.20 – 0.30	0.55 – 0.65	0.65 – 0.75	0.73-0.75	0.18 – 0.24	0.80 – 0.85
Vol. energy dens. (GJ/m ³)	1.4 – 3.6	8 – 11	12 – 19	~15	5.4 – 7.7	18 – 24
Hygroscopic properties	Hydrophilic	Hydrophilic	(Moderately) Hydrophobic	Hydrophobic	Hydrophobic	Hydrophobic
Biological degradation	Fast	Moderate	Slow	Slow	None	None
Milling requirements	Special	Special	Standard	Standard	Standard	Standard
Product consistency	Limited	High	High	High	High	High
Transport cost	High	Medium	Low	Low	Medium	Low

Abbreviations:

db = dry basis

LHV =Lower Heating Value

sources: ECN (table, fig.1, 3), Pixelio

(fig. 2, 6), Valmet (fig. 4), OFI (fig. 5),

ISO/TC 238 WG2 (table)



Current black pellet market developments

- First large-scale (capacity > 100,000 ton per year) black pellet plants are operational or under construction
- Total global production capacity is not large enough to call it a market
- Black pellet technologies are ready for broad commercial market introduction and the basic drivers to use these pellets are still in place
- However, several factors slowed down this introduction:
 - European utility sector is facing difficult times – co-firing perhaps not the best launching end-user market (also in view of scale) – smaller-scale industrial or district heat perhaps a better option?
 - It takes time and effort to build end-user confidence
 - Instead of yielding immediately the ideal feedstock, black pellet technology development had to follow a learning curve, in parallel with white wood pellets
 - Biomass in general is under debate and opinions on biomass use are subject to change

Black pellets: ECN Services and Technology

- Efficient biomass torrefaction technology with reliable product quality
- Technology to convert biomass with high moisture and/or ash content (grass, agricultural residues, etc.) into solid bioenergy carriers: TORWASH
- Lab- and pilot-scale torrefaction and densification equipment to assess feedstock behavior and produce test batches
- Know-how and infrastructure to test black pellet behavior during logistics, storage, handling and conversion (validated against industrial operations)



Torrefaction



Pelletisation



Future developments

- Torrefaction and steam explosion pellets produced at scale, and end use validated in industrial applications
- Gradually more commercial-scale black pellet plants will come online
- Mature black pellet technology developers are actively pursuing tangible projects
- Besides co-firing where black pellets displace fossil fuels, alternative outlets for black pellets will gain maturity where black pellets will displace white wood pellets
- Medium-term developments will probably be directed to alternative feedstocks:
 - Agricultural residues (e.g., straw, bagasse, palm oil residues)
 - Paper-plastic fractions and other “waste” streams

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