

# DATASHEET

## Input Feedstock - Torrefaction Process Temperatures - Output product

Input >98% renewable		TorCoal Process		Output	
classification according ISO 17225-1: 2014		process max. torrefaction temp.		torrefied product (*)	specification
1 Woody biomass 1.1 Forest, plantation and other virgin wood	fresh mixed woodchips West Europe	mild torrefaction	290°C	bio-carbon 100 D	1
		severe torrefaction	320°C	bio-carbon 100 G	2
			340°C	bio-carbon 100 G	3
		pyrolysis	400°C	bio-carbon 100 G	4
			450°C	bio-carbon 100 G	5
	eucalyptus woodchips Portugal	290°C		bio-carbon 100 G	6
		285°C		bio-carbon 100 G	7
	shredded acasia wood South Africa	290°C		bio-carbon 100 G	8
		290°C		bio-carbon 100 D	9
	pilot scale different tests		bio-carbon 100 G		10
lab. scale different tests		bio-carbon 100 G		available on request	
1 Woody biomass 1.2 Used wood	shredded used untreated pine/spruce wood	A-wood			
	shredded used treated mixed wood	B-wood			
2 Herbaceous biomass	Bagasse, Banagrass, Miscanthus, Empty Fruit Bunches (EFB), HiCross, Palmoil Kernel Scales (PKS)				

Input partly (>50%) renewable		TorCoal Process		Output	
		process max. torrefaction temp.		torrefied product (*)	specification
blends of Solid Recovered Fuel (SRF: classification according NEN-EN 15359: 2011) and woody biomass (classification according ISO 17225-1: 2014)		340°C - 360°C		bio-carbon 50 G	II
		pilot scale different tests			

(\*) bio-carbon 100 D: >98% renewable, Densified (pellets), specification according ISO/TS 17225-8: 2016  
 bio-carbon 100 G: >98% renewable, Grinded (powder)  
 bio-carbon 50 D: partly renewable (>50%), Densified (pellets)  
 bio-carbon 50 G: partly renewable (>50%), Grinded (powder)

densified torrefied woody biomass only available for mild torrefaction process conditions.

## Output Product Specifications

Specification	1	2	3	4	5	6	7	8	9
Moisture % (a.r.)	4,40	0,90	2,20	0,90	1,10	1,30	0,60	0,80	4,20
Ash % (d.b.)	2,93	2,72	2,45	3,00	4,90	6,60	1,70	6,70	1,36
Volatiles % (daf)	69,90	71,30	48,30	28,40	24,80	27,20	62,50	59,60	70,00
GCV (daf) MJ/kg	23,80	23,60	28,40	31,50	35,20	34,00	25,40	26,10	23,70
NCV (a.r.) MJ/kg	20,90	21,60	26,00	29,40	33,80	32,60	23,70	23,00	21,10
Hydrogen % (daf)	5,90	5,70	5,20	4,10	3,70	3,40	5,50	5,40	6,00
Carbon % (daf)	60,80	59,20	71,80	81,00	84,80	86,30	62,80	65,10	60,70
Nitrogen % (daf)	0,68	0,47	0,30	0,56	0,60	0,71	0,27	1,03	0,62
Sulfur % (daf)	0,04	0,05	0,07	0,02	0,03	0,02	0,01	0,04	0,02
Oxygen % (daf)	32,60	34,60	22,60	14,30	10,90	9,60	31,50	28,40	32,60

### 10: Results torrefaction trials B-type waste wood in pilot scale indirect heated rotary drum reactor

torrefied product: bio-carbon 100 G									
GCV (daf) MJ/kg	NCV (daf) MJ/kg (cV)	Volatiles (daf)	C (daf) content	O (daf) content	H (daf) content	N (daf) content	S (daf) content	Cl-content on dry base	ash content on dry base
20,46	19,22	81,5%	52,3%	39,7%	6,02%	1,86%	0,06%	0,086%	3,30%

torrefied product specifications at various levels of mass loss on dry base										
mass loss on dry base	GCV (daf) MJ/kg	NCV (daf) MJ/kg (cV)	Volatiles (daf)	C (daf) content	O (daf) content	H (daf) content	N (daf) content	S (daf) content	Cl-content on dry base	ash content on dry base
33,0%	24,74	23,72	60,7%	63,9%	28,5%	5,01%	2,49%	0,13%	0,038%	6,55%
45,0%	26,64	25,73	52,0%	69,8%	22,9%	4,47%	2,69%	0,19%	0,047%	7,80%
52,9%	28,56	27,81	42,6%	73,8%	19,5%	3,77%	2,74%	0,21%	0,051%	10,78%
55,7%	29,02	28,28	39,8%	77,5%	15,5%	3,66%	3,14%	0,20%	0,043%	12,02%

### II: Torrefaction results with blends of Solid Recovered Fuel (SRF) and woody biomass (\*\*)

		30% / 70%	50% / 50%	SRF feedstock
		340°C	360°C	
Moisture % (a.r.)		0,10	0,10	5,90
Ash % (d.b.)		4,70	13,10	10,60
Volatiles % (daf)		38,00	60,90	
GCV (daf) MJ/kg		31,60	34,40	
NCV (a.r.) MJ/kg		29,10	28,50	26,20
Hydrogen % (daf)		5,10	7,60	
Carbon % (daf)		79,70	78,30	
Nitrogen % (daf)		0,74	0,88	
Sulfur % (daf)		0,18	0,31	
Oxygen % (daf)		14,30	12,80	
Al mg/kg (d.b.)				5,180,00
Fe mg/kg (d.b.)				2,150,00
Ar mg/kg (d.b.)				< 3,80
Cd mg/kg (d.b.)				0,70
Cr mg/kg (d.b.)				27,00
Cu mg/kg (d.b.)				37,00
Hg mg/kg (d.b.)				0,11
Pb mg/kg (d.b.)				200,00
Ni mg/kg (d.b.)				14,40
Zn mg/kg (d.b.)				182,00
Sb mg/kg (d.b.)				21,00
Co mg/kg (d.b.)				< 4,70
Mn mg/kg (d.b.)				51,00
Tl mg/kg (d.b.)				< 4,70
Sn mg/kg (d.b.)				< 5,70
V mg/kg (r.h.)				< 4,70
Ca g/kg (a.r.)		12,50	28,70	
Na g/kg (a.r.)		0,50	1,70	
K g/kg (a.r.)		3,90	2,50	
Mg g/kg (a.r.)		1,00	1,60	
Fe g/kg (a.r.)		0,70	8,10	
Si g/kg (a.r.)		7,00	21,50	
Cd mg/kg (a.r.)		1,60	2,60	
Pb mg/kg (a.r.)		40,10	398,80	
Hg mg/kg (a.r.)		< 0,02	< 0,02	
P mg/kg (a.r.)		815,00	811,00	
Cl % (a.r.)		0,03	0,34	

(\*\*) Due to inhomogeneity and composition variation over time of SRF feedstock, wide spread on analysis results can be expected. The results reported are based on limiting number of sample analysis and therefore values presented should be considered indicative.