

Substance Scheme

Thermolysis Carbon

Product name: Thermolysis Carbon

Precursor: Tyre rubber

Production process: Pyrum-Thermolysis

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Revision index	Date	Description	
Version 1	17/07/2017	First draft of substance scheme	
Version 2	23/08/2017	Addition inner surface	
Version 3	25/09/2017	H+P statements	
Version 4	16/10/2017	Safety parameters	
Version 5	01/08/2018	Addition minimum ignition energy and ignition temperature	
Version 6	16/05/2019	Addition ash content	
Version 7	17/07/2019	Update	
Version 8	05/08/2019	Update chemical composition,	
Version 9	12/02/2020	Update	
Version 10	27/02/2020	Update PAH	

Substance Scheme

Thermolysis Carbon



Table of contents

1	Safety information.....	3
2	Physical Properties.....	4
3	Chemical Properties.....	4
4	Physiological Properties.....	4
5	Composition.....	4
5.1	Single substances and molecules.....	4
5.2	Nuclear Composition.....	5
5.3	Composition of ash.....	5
5.4	Polycyclic aromatic hydrocarbons.....	6
5.5	Impurity.....	6
6	Safety parameters of grinding thermolysis carbon.....	7
7	Structure.....	8
8	Examples of application (to be completed).....	8
9	Hazard and precautionary statements.....	8
9.1	Relevant hazard warnings.....	8
9.2	Relevant precautionary information.....	8

Substance Scheme

Thermolysis Carbon



1 Safety information

No relevant hazard notes for packaging and safety data sheet according to GHS

Hazard warning: H315

Precautionary Statements: P280; P302+P352, P332+P313

Table 1: Recommended personal protection equipment






			
PPE - long clothing	Safety shoes	Breathing protection	Resistant gloves
			
Safety goggles			

Table 2: Relevant warning signals and prohibitions for technical applications

			
No open flames	Danger of explosive atmosphere		

All safety information is based on experience and is merely intended to assist and sensitize the user. It does not replace the user's risk and danger assessment in any way.

Substance Scheme

Thermolysis Carbon



2 Physical Properties

state of aggregation:	solid	
colour:	black, grey	
calorific value:	23000-30000 kJ/kg (dry)	DIN 51900-3
particle density:	900-1100 kg/m ³	ASTM D 1513-05
bulk density:	300-500 kg/m ³	
iodine number:	114,5 +-1 g/kg	ASTM D 1510-13
solubility:	non soluble	
wettability:	low	
dust accumulation:	Dust accumulation with air can result in explosive mixtures.	
BET:	48 – 72 m ² /g	DIN ISO 9277:2014-01
BET after activation:	480 – 525 m ² /g	

3 Chemical Properties

Sulfuric components can be dissolved by abundant humidity. To be regarded concerning the choice of materials in contact with thermolysis carbon. Slow proceeding corrosion is possible.

4 Physiological Properties

smell:	characteristic, slightly sulfuric
toxicity:	see safety data sheet

5 Composition

The values represent a measured maximum, if not specified differently.

5.1 Single substances and molecules

Volatiles	< 2,00	wt. -%	DIN 51720
Water content:	0,4 – 0,7	wt.-%	DIN ISO 11465

Substance Scheme

Thermolysis Carbon



5.2 Nuclear Composition

C:	72 – 78	wt.-%	DIN EN ISO 16948
H:	< 0,1 – 0,5	wt.-%	DIN EN ISO 16948
N:	0,1 – 0,35	wt.-%	DIN EN ISO 16948
O:	n.b.		
S:	17000 – 22000	mg/kg TR	DIN EN ISO 10304
Zn	26000 – 44000	mg/kg TR	DIN EN ISO 11885

Based on the Zinc and Sulphur content is the resulting Zincsulfide (ZnS) content:

ZnS	3,9 – 6,6	wt.-%	(XRD-Analysis)
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5.3 Composition of ash

By ash we refer to the mixture of all non-volatile substances contained within the solid product, which is not actually carbon. The ash content varies between 15 - 27 wt.-% (DIN 51719).

Table 3: Composition of ash (X-ray fluorescence)

	Content in TC in wt.-%	Content in Ash in wt.-%
SiO₂	11 to 19	61 to 83
ZnO	2,6 to 4,4	8 to 22
CaO	0,22 to 1,1	1 to 5
SO₃	0,22 to 2,2	1 to 10
Al₂O₃	0,22 to 1,1	1 to 5
MgO	0,11 to 1,1	0,5 to 5
K₂O	0,11 to 1,1	0,5 to 5
Fe₂O₃	0,11 to 1,1	0,5 to 5
P₂O₅	0,022 to 0,22	0,1 to 1
Co₂O₃	0,022 to 0,11	<0,1 to 0,5
TiO₂	0,022 to 0,11	0,1 to 0,5

Substance Scheme

Thermolysis Carbon



5.4 Polycyclic aromatic hydrocarbons

The polycyclic aromatic hydrocarbons (PAH) are analysed according the list of the Environmental Protection Agency (EPA, DIN EN 15527) and AfPS GS 2014-01

Table 4: Concentration of polycyclic aromatic hydrocarbons (PAH)

PAH	Concentration [mg/kg]	Norm
Naphthalene	< 0,1 – 5,1	DIN EN 15527
Acenaphthylene	< 0,1 – 0,1	DIN EN 15527
Acenaphthene	< 0,1 – 0,9	DIN EN 15527
Fluorene	< 0,1 – 1,3	DIN EN 15527
Phenanthrene	< 0,1 – 2,2	DIN EN 15527
Anthracene	< 0,1 – 0,8	DIN EN 15527
Fluoranthene	< 0,1 – 0,7	DIN EN 15527
Pyrene	< 0,1 – 1,2	DIN EN 15527
Benz(a)anthracene	< 0,1 – 0,4	DIN EN 15527
Chrysene	< 0,1 – 0,9	DIN EN 15527
Benzo(b)fluoranthene	< 0,1 – 0,6	DIN EN 15527
Benzo(k)fluoranthene	< 0,1 – 0,1	DIN EN 15527
Benzo(a)pyrene	< 0,1 – 0,5	DIN EN 15527
Dibenzo(a,h)-anthracene	< 0,1 – 0,1	DIN EN 15527
Benzo(g, h, i)perylene	< 0,1 – 0,7	DIN EN 15527
Indeno(1, 2, 3-c, d)pyrene	< 0,1 – 0,3	DIN EN 15527
Benzo(j)fluoranthene	< 0,1 – 0,2	AfPS GS 2014-01
Benzo(e)pyrene	< 0,1 – 0,9	AfPS GS 2014-01

5.5 Impurity

Water: low hygroscopicity, humidity can vary

Ash: Ash content varies between 15 - 25 wt.-%, can be recovered as valuable product.

Substance Scheme

Thermolysis Carbon



6 Safety parameters of grinding thermolysis carbon

Table 5: Characteristics of ginded carbon

Method	Norm	Test result				
Humidity	-	1.54 mass % at 70°C				
Smoldering temperature	EN 50281-2-1/ VDI 2263, sheet 1	380 °C				
Calorific factor	VDI 2263, sheet 1	BZ3				
Explosion characteristics	DIN EN 14034/ 1+2	Max. explosion pressure (Pmax)			6.5 bar	
		Max. rate of pressure rise (dP/dt)			144 bar/s	
		Product specific constant (K _{St})			39 bar*m/s	
Lower explosion limit	DIN EN 14034-3 and 14034/ A1, sheet 1	90 g/m ³				
Volume resistance	IEC 60079/32 1+2 and TRGS 727	5*10 ⁴ Ωm The specific resistance of the sample is low (<10 ⁶ Ωm).				
Sieve analysis*	DIN 66 165/ 1+2	Average value		49 μm		
		Mean particle diameter		57 μm		
		0 - 63 μm	63 - 125 μm	125 - 250 μm	250 - 500 μm	> 500 μm
		73.4 %	22.2 %	4.4%	0.0 %	0.0 %
Minimum ignition energy	DIN EN 13821	1000 mJ				
Ignition temperature	DIN EN 50 281-1-2 and VDI 2263, sheet 1	> 600 °C				

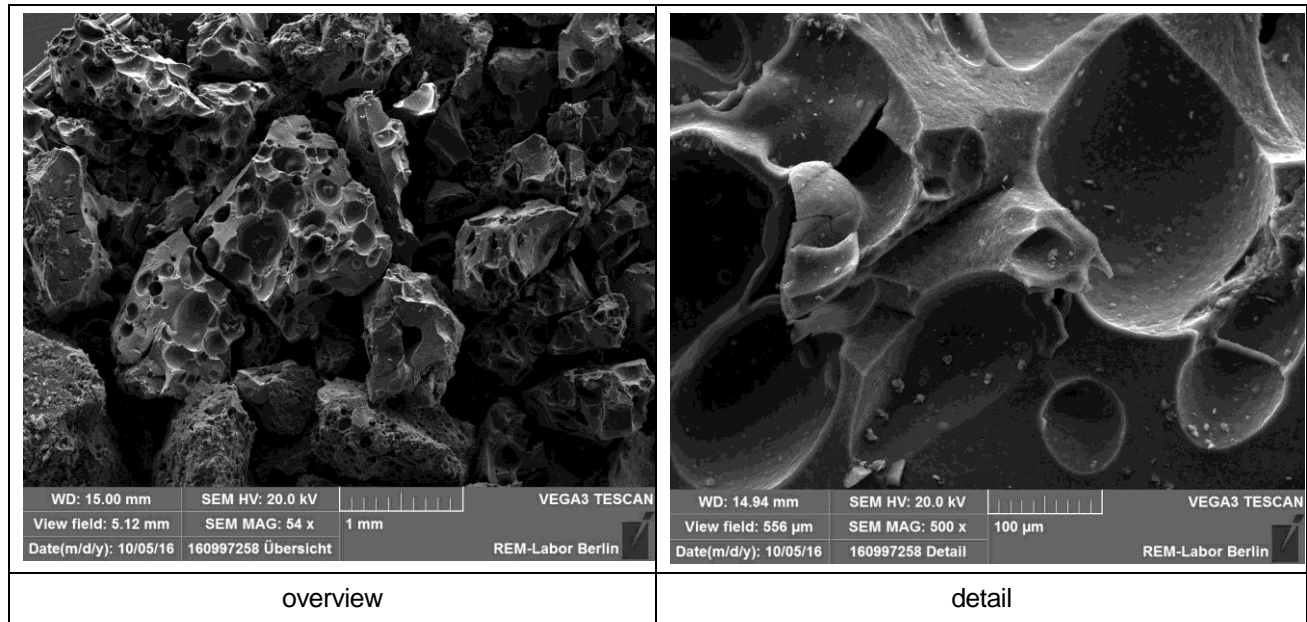
* refers to milled thermolysis carbon

Substance Scheme

Thermolysis Carbon

7 Structure

Table 6: REM-shots of thermolysis carbon



8 Examples of application (to be completed)

Filler for production of rubber

Carbon black substitute

Fuel for power generation

9 Hazard and precautionary statements

9.1 Relevant hazard warnings

H315 Causes skin irritation.

9.2 Relevant precautionary information

P280 Wear protective gloves/protective clothing/eye protection/face protection.

P302+352 IF ON SKIN: Wash with plenty of soap and water

P332+P313 If skin irritation occurs: Get medical advice/attention.