Graphite, Carbon, Bearing and Sealing Product Information

Graphite Grades:

In many chemical processes, apparatus and reaction vessels must be protected against the acidic and caustic materials used in the processes. Apparatus linings made from ceramic or synthetic plastic type materials are often unsuitable, since they may not withstand chemical attack, high temperatures or sudden temperature changes. Alkaline solutions and hydrofluoric acid are of great importance in chemical technology, but they rapidly destroy equipment linings not made of carbon containing materials.

The carbon and graphite products which have been developed in cooperation with the chemical and acid protection industries, have special characteristics which over many years have proved outstanding in numerous areas of chemical application for the lining of e. G. Baths, reaction vessels, boilers etc. , and as corrosion resistant floor coverings.

Carbon and graphite linings have a high mechanical strength, good heat resistance and excellent stability to temperature changes. Of special importance is the universal chemical resistance. In the food processing industries, tasteless and odourless carbon materials are valuable. Particularly under difficult chemical and technical conditions in which other materials have been lacking, the special combination of suitable physical and chemical properties of tygraf bricks have been extremely successful.

Grade types of carbon linings (types of tygraf):

A standard grade is available which for special applications can be modified by impregnation.

Tygraf-t: standard grade

Tygraf-tx: pitch impregnated

Tygraf-txh: impregnated with phenol formaldehyde resin properties

Tygraf is characterised by their high cold and hot compressive strength and hardness. Tygraf brickwork is thus exceptionally resistant to the mechanical demands made e. G. In numerous chemical processes due to the presence of erosive solid materials.

An important characteristic of tygraf is its excellent stability to temperature changes which results from the good heat conductivity, high elasticity and very low, reversible thermal expansion behaviour. Thus, for example, high temperature sulphite boilers lined with tygraf carbon bricks can be readily sprayed out with cold water without danger of cracking or splitting as occurs with other ceramic linings.

The density of non-impregnated tygraf-t is approximately 1,50 to 1,60 g/cm3. The total weight of a carbon lining is thus significantly lighter than one made of other brick materials, this is often most advantageous with respect to the construction and the statics of industrial plants. When using tygraf bricks in apparatus and construction units used for processes involving heat, attention should be given to the maximum withstandable temperatures given below:

- 350 °c for non-impregnated bricks in the presence of air/oxygen (t, tx)
- >350 °c for non-impregnated bricks in oxygen-free atmospheres (t, tx)
- 180 °c for material impregnated with phenolformaldehyde resin (txh).

Technical data (averages) for cecolit grades of carbon bricks:

	PROPERTY	TYGRAF-T	TYGRAF-TX	TYGRAF-TXH	UNIT
1.	Density	1.50-1.60	1.60-1.65	1.65-1.70	g/cm^3
2.	Porosity (open)	18-25	10-15	5-10	%
3.	Compressive strength	approx. 40	approx. 65	approx. 75	N/mm^2
4.	Bending strength	approx. 12	approx. 20	approx. 25	N/mm^2
5.	Modulus of elasticity	approx. 1.2×10^4	approx. 1.8×10^4	approx. 2×10^4	N/mm^2
6.	Tensile strength	approx. 6	approx. 8	approx. 10	N/mm^2
7.	Linear coefficient of thermal expansion	approx. 3.5×10^{-6} (293-573 K)	approx. 4×10^{-6} (293-573 K)	approx. 5×10^{-6} (293-423 K)	K^{-1}
8.	Heat conductivity	4-6	6-8	4-6	W/mK
9.	Temperature stability in air	350	350	170	°C
10.	Ash content	<1	<1	<1	%
11.	Specific electrical resistance	50-80	50-70	50-80	$\Omega mm^2/m$
12.	Stability to temp changes	very good	very good	good	
13.	Chemical stability	See stability table for more detail			

Graphite Grades:

☐ Resistant	N Not Resistant
C Conditionally Resistant	? Use Must Be Checked from Case to Case

MEDIUM CECOLIT	T	TX	TXH
Pentanol			
Pentyl Chloride			?
Petrol			
Petroleum			
Phenol, carbolic acid			
Phosphoric acid (all concentrations)			
Phosphorus trichloride			
Potassium bromide - S			
Potassium carbonate - S			C
Potassium Chloride - S			
Potassium hexacyanoferrate (11 and 111)		?	
Potassiumhydroxide - S			N
Potassium nitrate - S			
Potassium sulphate - S			
Potassium sulphide - S	?	?	N
Potassium sulphite - S			
Propane			
Pyridine			?
Rapeseed oil			
Saccharin - S			
Salicylic acid (alcoholic solution)			
Sea water			
Silicic acid/anhydride, silica - S			
Soda = sodium carbonate			C
Sodium acetate - S			
Sodium carbonate - S			C
Sodium Chloride - S			
Sodium hydrogen sulphate - S			
Sodium hydrogen sulphite - S			
Sodium hydroxide - S (upto 60 %)			N
Sodium hypochlorite - S	C	C	C
Sodium nitrate - S			
Sodium nitrite - S			
Sodium perborate - S	C	C	C
Sodium phosphate - S (tri)			
Sodium silicate - S			C
Sodium sulphate - S			
Sodium sulphide-S, polysulphide-S	?	?	N
Sodium sulphite - S			
Sodium thiosulphate - S			
Soya bean oil			
Stearic acid			
Sugar - S			
Sulphur dioxide (gas, dry and damp)			
Sulphuric acid (upto 20 %)			
Sulphuric acid (20 % - 50 %)			
Sulphuric acid (above 50 %)	C	C	N
Sulphurous acid			
Tannic acid - S (Tannin)			?
Tartaric acid			
Tin (11) Chloride-S			
Toluene			
Trichloroethylene			
Turpentine			
Varnish			?
Vegetable oil			
Vinyl acetate			
Water glass			C
Water, steam			
Wine			
Xylene			
Zinc Chloride - S			
Zinc sulphate - S			

MEDIUM CECOLIT	T	TX	TXH
Diesel oil			
Dioxane			C
Diphenyl (molten)			
Diphenyloxide (molten)			
Dowthern			
Ether (diethyl-)			
Ethyl alcohol = Ethanol			
Ethylchloride			
Ethylene dichloride			
Fatty acids			
Fatty alcohols			
Fixing salt = S (sodium thiosulphate)			
Formaldehyde (Formalin - S)			
Formic acid			
Freon 11 and 12			C
Frigen			C
Fruit acids			
Fruit Juices			
Furfurole			C
Furfuryl alcohol			C
Gelantine			
Glycerine			
Glycol			
Grape sugar – S			
Grease, fat (molten)			
Heating oil			
Heavy gasoline			
Hexane			
HToils			
Hydrazine hydrate - S			N
Hydrobromic acid			
Hydrochloric acid			
Hydrofluoric acid			C
Hydrogen sulphide (gas and solution)			
Iodine (alcoholic solution)	?	?	N
Iron (II, III) Chloride - S			
Iron (II) sulphate - S			
Isopropylacetic acid ester			
Isopropylalcohol, Isopropanol			
Isopropylether			
Kerosene			
Lead Acetate – S			
Linseed oil			
Magnesium Chloride - S			
Magnesium sulphate - S			
Malic acid			
Manganese sulphate - S			
Methane (gas)			
Methanol			
Metyl ethyl ketone			
Methyl isobutyl ketone			
Milk, lactic acid, whey			
Mineral oils			
Monochloro-acetic acid			
Monochlorobenzene			
Nickel Chloride - S			
Nickel sulphate - S			
Nitric acid (upto 20 %)	C	C	C
Nitric acid (above 20 %)	N	N	N
Nitrobenzene			
Nitrogenous gases (damp)	N	N	N
Oleic acid			
Oleum	?	?	N
Oxalic acid			
Paraffin			
Pentane			

MEDIUM CECOLIT	T	TX	TXH
Diesel oil			
Dioxane			C
Diphenyl (molten)			
Diphenyloxide (molten)			
Dowthern			
Ether (diethyl-)			
Ethyl alcohol = Ethanol			
Ethylchloride			
Ethylene dichloride			
Fatty acids			
Fatty alcohols			
Fixing salt = S (sodium thiosulphate)			
Formaldehyde (Formalin - S)			
Formic acid			
Freon 11 and 12			C
Frigen			C
Fruit acids			
Fruit Juices			
Furfurole			C
Furfuryl alcohol			C
Gelantine			
Glycerine			
Glycol			
Grape sugar – S			
Grease, fat (molten)			
Heating oil			
Heavy gasoline			
Hexane			
HToils			
Hydrazine hydrate - S			N
Hydrobromic acid			
Hydrochloric acid			
Hydrofluoric acid			C
Hydrogen sulphide (gas and solution)			
Iodine (alcoholic solution)	?	?	N
Iron (II, III) Chloride - S			
Iron (II) sulphate - S			
Isopropylacetic acid ester			
Isopropylalcohol, Isopropanol			
Isopropylether			
Kerosene			
Lead Acetate – S			
Linseed oil			
Magnesium Chloride - S			
Magnesium sulphate - S			
Malic acid			
Manganese sulphate - S			
Methane (gas)			
Methanol			
Metyl ethyl ketone			
Methyl isobutyl ketone			
Milk, lactic acid, whey			
Mineral oils			
Monochloro-acetic acid			
Monochlorobenzene			
Nickel Chloride - S			
Nickel sulphate - S			
Nitric acid (upto 20 %)	C	C	C
Nitric acid (above 20 %)	N	N	N
Nitrobenzene			
Nitrogenous gases (damp)	N	N	N
Oleic acid			
Oleum	?	?	N
Oxalic acid			
Paraffin			
Pentane			

Cutting Rates:

Sawing:

- High-speed steel and bimetal-cutting band sawblades 3 teeth per inch
- Cutting speed: 100 m/min

Grinding

- Silicon carbide wheels, grain 36…60 µm
- Cutting speed: : 20…30 m/s
- Diamand cutting wheels, grain 100…200µm,
- Galvanic and bronze bonding
- Cutting speed: 30…50 m/s

Turning:		Tools K 10 Hard Metal	Cutting Speed m/min	Forward Feed mm/r	Cutting Depth mm
Carbon		Roughing	100...150	0,10...0,20	up to 15
		Smoothing	150...200	0,05...0,15	0,10...0,30
Graphite		Roughing	100...200	0,20...0,50	bis 25
		Smooting	200...400	0,05...0,20	0,10...0,50

Drilling	Tools K 10 Hard Metal	Cutting Speed m/min	Forward Feed mm/r
Carbon		80	0,10...0,30
Graphite		150...300	0,10...0,50

Milling	Tools K 10 Hard Metal	Cutting Speed m/min	Forward Feed mm/min	Cutting Depth mm
Carbon	Roughing	50...100	100...200	3
	Smoothing	100	100...200	0,2...1
Graphite	Roughing	50...150	150...1000	15...30
	Smoothing	100...200	150...600	0,2...2

Grinding	Tools	Cutting Speed m/s	Forward Feed mm/min	Cutting Depth mm
Carbon	SiC Plates Grain: 24 - 60	20...30	200...400	0,05...5
Graphite	Hardness: F – J Texture: 6 - 9	20...35	500...2000	0,05...10

Carbon and graphite can easily be lapped and honed allowing fine tolerances.

GUIDELINES FOR THE INSTALLATION AND DESIGN OF BEARINGS

The design of radial bearings and collar bearings of carbon and graphite is determined by DIN 1850, Section 4, „Bushes for slide bearings made of artificial carbon". Instructions for the location of lubrication grooves are contained in DIN 1850, Section 2 and DIN 1591.

It Is recommended that bores are smooth for dry-running radial and axial bearings. Wet running carbon radial bearings can be provided with longitudinal grooves specific to each case. Grooves are recommended for wet running axial bearings.

Normally the bearings are shrunk or pressed directly into the housing or into metal bushings. The low thermal expansion coefficient of carbon and graphite (3 … 5 x 10-6/K) must be taken into account when shrinking or pressing in the bearings.

GENERAL GUIDELINES FOR TREATMENT OF CARBON AND GRAPHITE

Carbon and graphite can be machined to fine tolerances on most machines and machine tools. The work piece remains both structurally and dimensionally stable.

Extraction: Care must be taken that all dust is extracted during machining (e.g. by an industrial vacuum cleaner with a rating of at least 30 mbar and 20 m/s air speed). Lubricated machine driving elements must be covered, moving parts or platens must be kept grease and oil free.

Cooling: The use of cutting lubricants and cooling agents is not recommended. Water may be used as a coolant for honing, lapping and occasionally for cutting and separating.

Clamping: The parts must be carefully and lightly clamped, the clamping pressure should be distributed over as large an area as possible. Parts with a low wall thickness (<0.1 d or <10 mm) must be pre-pared internally with collet chucks or expanding rings. For external treatment it is advisable to place the part on a mandrel.

Tools: The following values generally apply to all turning, drilling and milling tools: clearance angle α: 15° ... 25°; wedge angle ß: 65° ... 75°; tool orthogonal plane γ: ± 2°, large cutting radii prevent chipping of the work piece. The use of K 05 and K 10 types of hard metal and diamond tools are recommended.