CARBON AND GRAPHITE PRODUCTS

FOR CHEMICAL RESISTANT LINING

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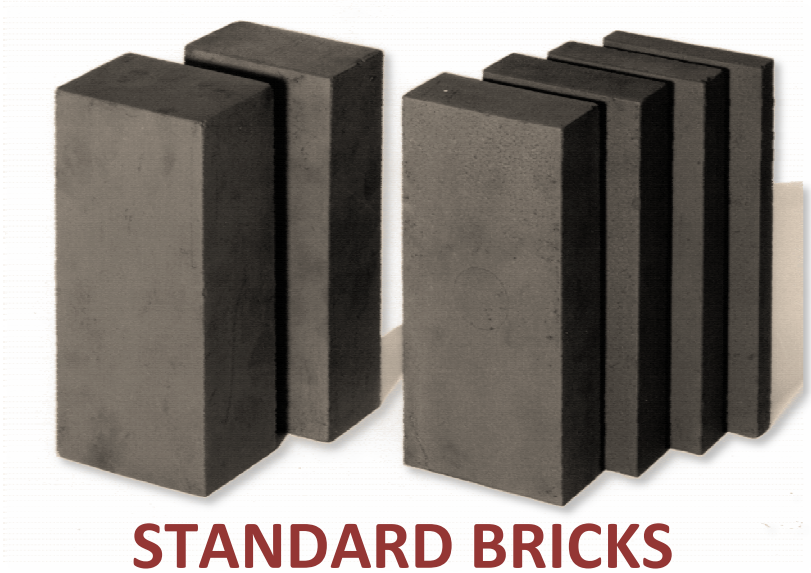
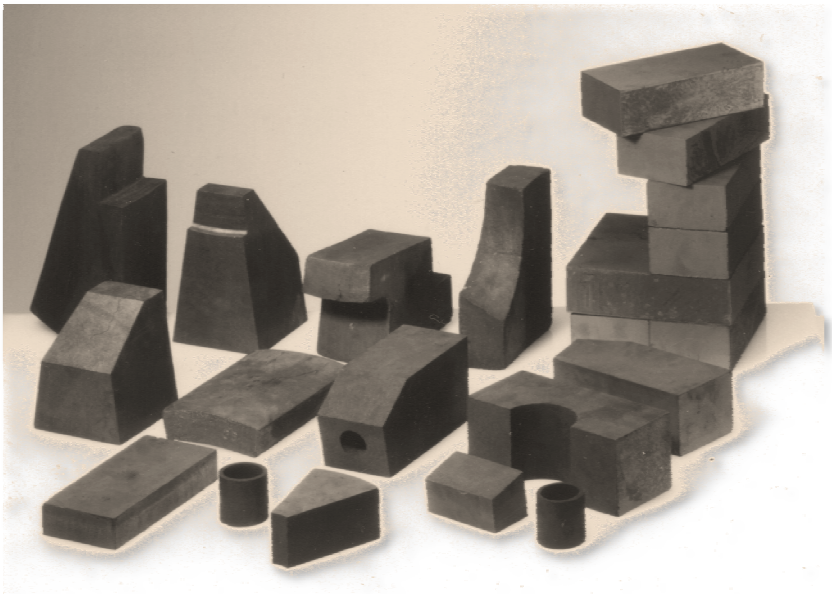


STANDARD BRICKS



SHAPES

CARBON PRODUCTS FOR APPARATUS AND REACTION VESSEL LININGS IN THE CHEMICAL INDUSTRY

INTRODUCTION

In many chemical processes, the 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 very 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 CECOLIT bricks has been extremely successful.

GRADE TYPES OF CARBON LININGS (TYPES OF CECOLIT)

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

CECOLIT A: Standard grade

CECOLIT AX: Standard grade, pitch impregnated

CECOLIT AF: Standard grade, impregnated with phenol formaldehyde resin

PROPERTIES

CECOLIT bricks are characterised by their high cold and hot compressive strength and hardness. CECOLIT 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 CECOLIT 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 CECOLIT 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 CECOLIT A 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 CECOLIT bricks in apparatus and construction units used for processes involving heat, attention should be given to the maximum withstandable temperatures given below:

450 °C	for non-impregnated bricks in the presence of air/oxygen (A, AX)
>450 °C	for non-impregnated bricks in oxygen-free atmospheres (A, AX)
180 °C	for material impregnated with phenolformaldehyde resin (AF).

TECHNICAL DATA FOR CECOLIT GRADES OF CARBON BRICKS

	PROPERTY	CECOLIT A	CECOLIT AX	CECOLIT AF	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	400	400	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			

The above values are average values.

DIMENSIONS

Standard dimensions for grades A/AX/AF:

240 x 114 x 20, 30, 40, 50, 65, 80, 100 mm (stock sizes)

250 x 124 x 20, 30, 40, 50, 65, 80, 100 mm (on request)

Other thicknesses to 100 mm max. on request.

All other dimensions can be made and supplied under contract. These include bends, wedges, small plates, hand moulded bricks, support beams and tubes up to an external diameter of 600 mm.

TOLERANCES *(UNLESS OTHERWISE SPECIALLY AGREED)*

a. Machined pieces e.g. tubes are manufactured in accordance with: DIN 7168 rough.

b. For special dimensions, e.g. hand moulded bricks no tolerances can be quoted and have to be agreed upon.

Besides the CECOLIT A, AX and AF grades, other grades of carbon and graphite in the form of beams or tubes etc., for special chemical construction applications can be supplied. The technical data of these other grades are available on request. On principle, any size and shape can be produced. Moulding methods can be block pressing, extrusion pressing, vibrating and ramming. Hand moulded bricks, both complicated and simple in form are made in the CECOLIT A, AX, and AF grades. It is recommended to contact us when projects in this field are being planned.

Special sizes and bricks with convex radii can also be made in suitable quantities. To allow us to check the feasibility of manufacture, both quantity requirements and dimensioned drawings should be supplied.

CHEMICAL STABILITY

CECOLIT A carbon bricks are extremely insensitive to all acids, provided they have no strongly oxidising properties. CECOLIT materials also show the same excellent resistance to attack by highest concentrations of alkaline solutions. Alternating acid and alkali conditions are withstood by this carbon material and they are also unaffected by corrosive salt solutions. CECOLIT A carbon brick linings are thus particularly suitable for chemical processes which involve various temperature and concentration cycles.

The stability of CECOLIT A, AX and AF to various chemicals is given in the following table. It is pointed out that there is no difference in stability between CECOLIT A and AX. Because of its higher density and lower porosity CECOLIT AX is recommended in surroundings where erosion and oxidation occur. CECOLIT AF is impregnated with phenolic resin, and is resistant to oxidising acids up to 170° C. CECOLIT AF is unsuitable for strongly alkaline media.

THE USE OF ACID RESISTANT CEMENTS

In acid protection and apparatus construction the use of suitable cement is of the utmost importance. This is also important when using our CECOLIT bricks. In many cases the stability of our carbon and graphite material is greater than that of the cement used. Thus, when checking the stability and suitability of the possible carbon or graphite materials, the stability of the cement to be used in the particular application should also be checked so that full advantage can be obtained from the properties of our products.

In the choice of suitable cement, e.g. phenolic or furan resin based, we will gladly give our experience and advise on suppliers of cements, which we do not produce ourselves.

GRAPHITE COVA GRADES

	Resistant	N	Non-Resistant
C	Conditionally Resistant	?	Use must be checked from case to case

MEDIUM CECOLIT	A	AX	AF
Acetaldehyde			
Acetic acid			
Acetic acid anhydride			
Acetic acid butyl ester			
Acetic acid ethyl ester			
Acetic acid methyl ester			
Acetone			
Alum – S			
Aluminium acetate – S			
Aluminium Chloride – S			
Aluminium sulphate – S			
Ammonia in aqueous solution			
Ammonia liquid			N
Ammonium Chloride – S			
Ammonium diphosphate – S			?
Ammonium fluoride - S			
Ammonium nitrate - S			
Ammonium phosphate - S			?
Ammonium sulphate - S			
Ammonium sulphite - S			
Ammonium thiocyanate - S			
Amylalcohol = pentanol			
Aniline			
Arsenic acid - S			
Arsenic trichloride			
Asphalt			
Barium Chloride - S			
Benzene			
Bleaching lye	C	C	C
Bleaching powder	C	C	C
Borax - S			C
Boric acid - S			
Boron oil			
Bromine, bromine water	C	C	C
Butadiene			?
Butane			
Butanol			
Butylacetate = Acetic acid butyl ester			
Butylalcohol = Butanol			
Butylcellulose			
Butyric acid			
Caiciumchloride - S			
Caiciumchlorite - S	C	C	C
Caiciumhydrogen sulphite - S (upto 50%)			
Caiciumhydroxide - S			C
Caiciumhypochlorite - S	C	C	C
Carbolic acid = Phenol			
Carbon disulphide	C	C	C
Carbon tetrachloride			
Chestnut extract			
Chloric acid	?	?	N
Chlorine (gaseous, dry)			C
Chlorine (liquid)	C	C	N
Chlorine (wet), chlorine water	N	N	N
Chlorobenzene			
Chloroform			
Chromate (Na, K) -S	?	?	?
Chromic acid - S	N	N	N
Chromium sulphate - S			
Citric acid			
Coal tar oil			
Copper(II) Chloride - S			
Copper (11) sulphate - S			
Cresol			
Developer - S (photographic)			
Dichlorobenzene, P-			
Dichloroethylene			

MEDIUM CECOLIT	A	AX	AF
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			
Methyl acetate = acetic acid methyl ester			
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	A	AX	AF
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)		?	
Potassium hydroxide - 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			