TIB CHEMICALS

BASIC CHEMICALS | **INORGANIC SPECIALTY CHEMICALS** | COATING SYSTEMS

Copper Chemicals | for specific demands

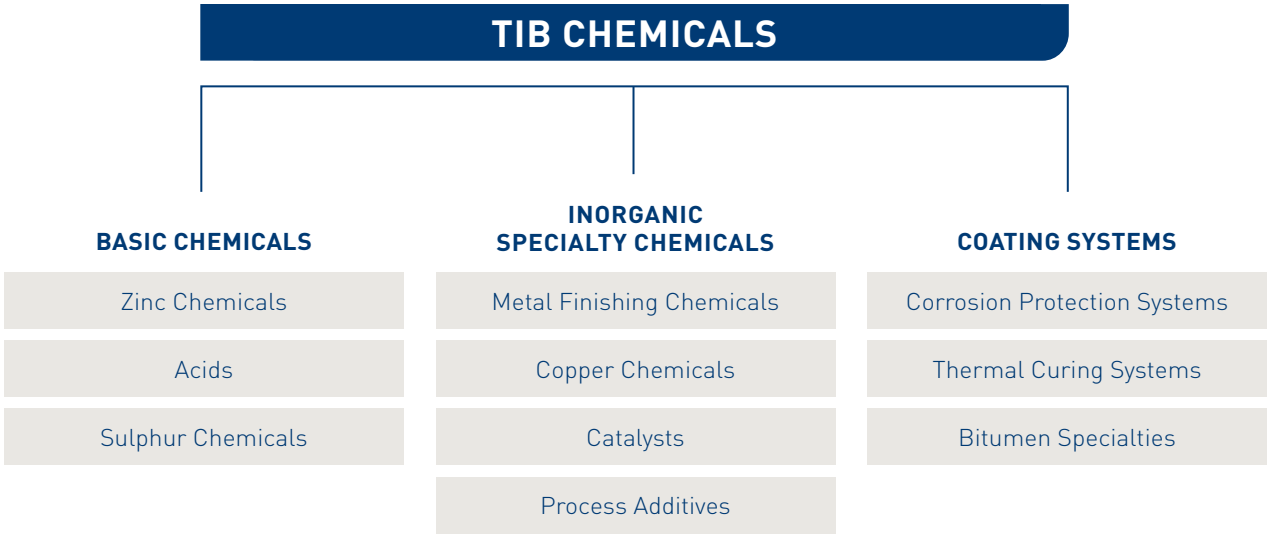
LEADERS IN QUALITY AND SERVICE

TIB Chemicals was born following the merger of Goldschmidt TIB of Germany and Goldschmidt Química de México. The nickel chemicals specialist Königswarter & Ebell joined the TIB Chemicals Group in 2010. The company is a leading international supplier of a wide range of basic chemicals, innovative inorganic specialty chemicals and high-performance coating systems.

The largest production facilities are located in Mannheim and Hagen, Germany and San Luis Potosí, México. Our sales and distribution organisation operates worldwide. TIB Chemicals has more than 350 highly qualified employees who draw on the company's over 130 years of experience and accumulated expertise. Currently they produce and process more than 400,000 tonnes of chemicals and generate revenues of about 150 million euros a year, with an accelerating trend.

For years, the growth of TIB Chemicals has outpaced the industry average. Our success is based on the highquality products and tailor-made solutions we develop for our customers, backed by a flexible logistics service. We are committed to supporting our customers and helping them to achieve business success.

The company is divided into three business units: Basic Chemicals, Inorganic Specialty Chemicals and Coating Systems. All three act flexibly and quickly to meet our customers' wishes and needs. Together they form a strong unit with a solid financial base and the logistical and organisational structure of a large corporation.



THE THREE BUSINESS UNITS OF TIB CHEMICALS

BASIC CHEMICALS

Such as zinc compounds, acids and sulphur compounds for chemicals companies, the metal industry, the hot dip galvanising industry and the plastics industry. Our basic chemicals are also used in the preparation of fertilisers and in the food processing and oil industries.

INORGANIC SPECIALTY CHEMICALS

Based on the elements tin, zinc, copper, nickel, bismuth and chrome. These special compounds are used for various purposes in today's high-tech industries. Target markets include electroplating chemicals, automotive, catalysts for coatings and process additives for chemistry, ceramics and building materials.

COATING SYSTEMS

Based on two-component liquid polyurethane and epoxy systems, serve as anticorrosion protection for the pipeline and valve manufacturing industry, as well as for water treatment and power plants. In the area of thermal curing systems, we produce dip coatings for the electroplating and tool industries, as well as stoving varnishes for the packaging industry. Bitumen specialties find their application in civil engineering and traffic areas.

Our **Copper Chemicals** are presented on the following pages.

SPECIAL PRODUCTS – FOR PARTICULAR DEMANDS

Our high-quality copper chemicals are used wherever certain specifications or particular requirements have to be met: e. g. in complex catalysis and synthesis processes or in formulations of sensitive products like propellant mixtures for airbags.

Manufacturers of copper-containing catalysts, automotive suppliers, vitamin manufacturers, producers of animal feeds and fertilisers, the ceramics industry or the pyrotechnics industry: Customers of many different branches appreciate the copper compounds manufactured by TIB Chemicals as important additives and base materials. Products of high purity that exactly fulfil the desired specifications.

We have accumulated decades of experience in the production of copper chemicals.

Our claim: always deliver best-quality products. Every day, our highly educated and experienced employees put this aim into practice, assisted by modern process engineering techniques and an effective quality management system.

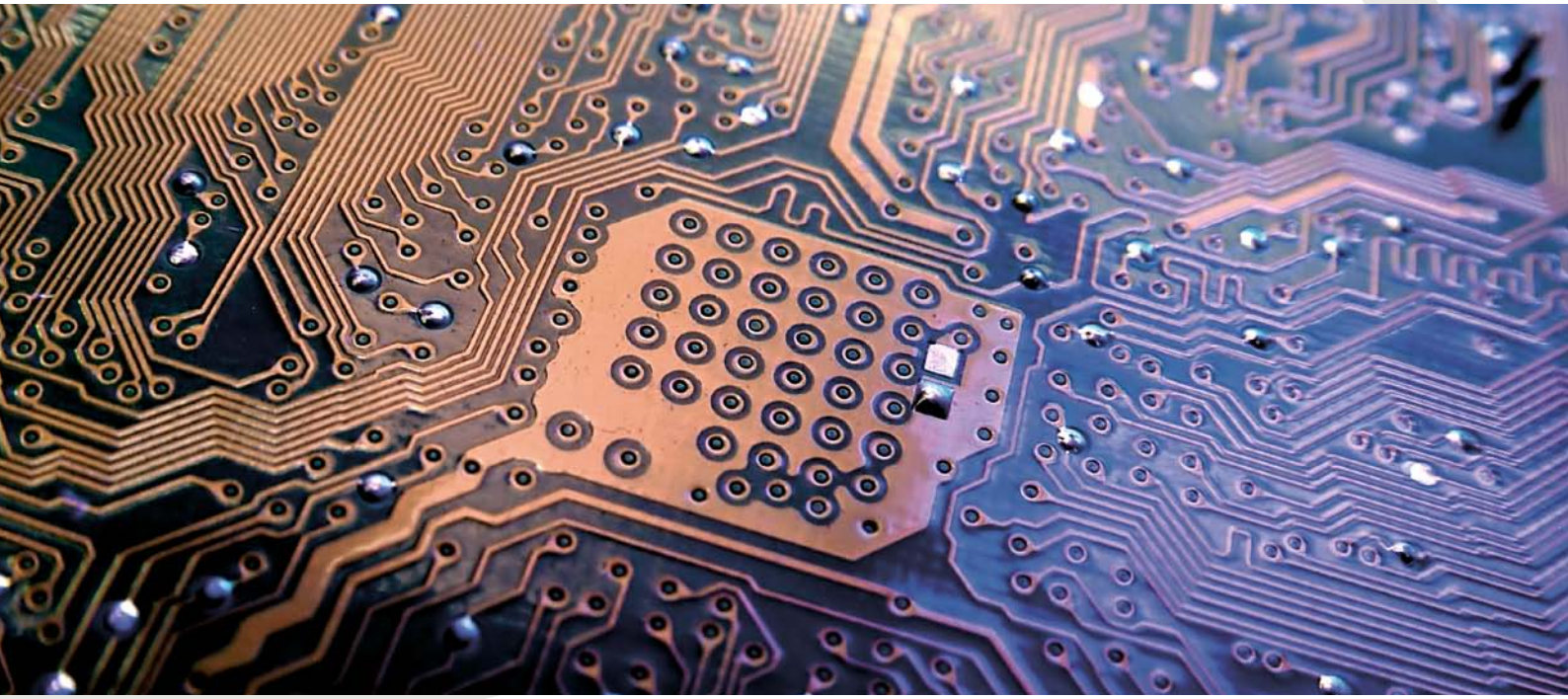
SPECIFIC SOLUTIONS – FOR SPECIFIC REQUIREMENTS

Our wide product range provides a suitable solution for nearly all users. And in case the required product with the desired characteristics is not included in the existing portfolio, we will set out to develop it. A rare specification is needed? Or an innovative, environmentally friendly alternative to an essential additive is required? Our highly qualified chemists and laboratory assistants, in close collaboration with our customers, will do everything in their power to develop individual solutions that enhance the performance of the envisaged products and that are easily integrated into the respective production processes.

HIGH-QUALITY TECHNIQUE – FOR PROTECTION OF THE ENVIRONMENT

TIB Chemicals partly discharges sewage directly into the river Rhine und runs an own purification plant. Here we ensure that the sewage pollution does not exceed mandatory limit values.

In the copper chemicals production at Mannheim headquarters, we purify the sewage by using a three-stage ion-selective cation exchanger in order to secure compliance with these limits. Applying this complex treatment, we achieve a sewage copper load of only 0.2-3 mg/l. Regular controls ensure that we remain in compliance with these values.



SOLID RAW MATERIAL BASIS – VERSATILE UTILISATION

A balanced and solid raw material mix provides the basis of our product range: We manufacture copper chemicals for various applications in state-of-the-art plants by using spent copper etching solutions from the electronics industry and pure copper metal in various forms like scrap, swarfs, clippings or granules. We are able to meet even the most unusual requirements of our customers and to manufacture products with very high and specific purity grades, by selective control of our raw materials.

THE PERFECT CIRCULATION – DISPOSAL OF ETCHING SOLUTIONS AND SUPPLY OF ACIDS

TIB Chemicals is a certified and reliable disposer of spent copper etching solutions. We are equipped with a big tank capacity for copper etchants. Our experienced forwarders collect the copper etchants on schedule and in return deliver hydrochloric acid, if requested. This efficient logistics concept saves time, reduces expenses and is environmentally friendly. Further we ensure the functionality of the waste management circulation.

LOGISTICS WITH HIGH STANDARDS

We adapt to today's logistics requirements and deliver on short notice. This is facilitated by our demand-orientated purchasing management as well as our warehousing. Just-in-time deliveries can be taken for granted. Our carefully selected forwarders will take care of this.

We guarantee high flexibility – also in the filling type and filling size of our final products. Bags, drums or big bags – our business partners receive the packing that can be integrated most effectively into their production processes.

PROPELLANT COMPONENTS

Safety is key in the automotive industry. Pyrotechnical gas generants, delivered to the car manufacturers (OEM's) by automotive suppliers, are a big part of this field. TIB Chemicals produces speciality chemicals for pyrotechnical inflators. These are customised for the automotive supplying industry and fulfil a wide range of customer specifications.

Securing a stable and good product quality is crucial for the success as supplier into this industrial sector. That's what our customers rely on. We guarantee this by having a substantial long-term process know-how and being in line with high quality management standards. Sources of errors are identified and preventive measures defined. Periodic quality audits of the automotive suppliers confirm the outstanding performance of our processes. Analytical control of the specification characteristics is carried out on high-quality laboratory equipment, such as the CILAS 1180L for the determination of particle size distribution as well as the Nova 2000e from Quantachrome for evaluation of the specific surface area.

BASIC COPPER NITRATE (BCN)

Basic Copper Nitrate (BCN) plays a major role in the development of propellant mixtures of inflators as well as for seat-belt pretentioners. Over the past years, numerous formulations have been developed in which BCN has a pivotal function as oxygen supplier. TIB Chemicals has been involved in this development since the beginning (1990's) and has obtained a broad know-how in process technology and chemical engineering for the control

of the essential product properties, especially with regard to physical characteristics as e. g. particle size, surface structure or bulk density. As these characteristics have a central function in the automotive industry, we developed two product types that vary mainly in their bulk density.

Types

Basic Copper Nitrate uncompacted
BCN with a bulk density of ‹ 0.5 g/cm³

Basic Copper Nitrate compacted
BCN with a bulk density of › 0.5 g/cm³

COPPER(II)-OXIDE SPECIAL ULTRAFINE

We developed Copper(II)-oxide Special ultrafine for pyrotechnical inflators in combination with BCN. Copper(II)-oxide Special ultrafine is responsible for the preferably entire burnout of the kindled mixture in the propellants of inflators. It also has special physical properties such as a higher specific surface (› 8 m²/g) for better catalytical reactions and a fine particle size (98 % ‹ 25 µm).

For this product partially exist diversified specification requirements as well and that's why we currently offer 2 different types:

Types

Copper(II)-oxide Special ultrafine BET › 8 m²/g
Copper(II)-oxide Special ultrafine 30 BET › 20 m²/g

PROCESS CHEMICALS

TIB Chemicals offers a wide range of copper products which, due to their high quality, are highly appreciated for use as additives and base materials in formulations for many different industrial sectors. Our copper compounds, also named inorganic copper salts, are used in a multitude of different catalysis and synthesis processes. In addition to our copper salts, we offer copper chloride, copper nitrate and copper sulphate solutions.

COPPER(II)-HYDROXYCARBONATE

Types & their characteristics

Copper(II)-hydroxycarbonate dry

This is a fine, light-green powder with a copper content of approx. 55 % and a relatively high bulk density (› 1.5 g/cm^3). It is extremely free flowing, does not form lumps and is insoluble in water.

Copper(II)-hydroxycarbonate wet

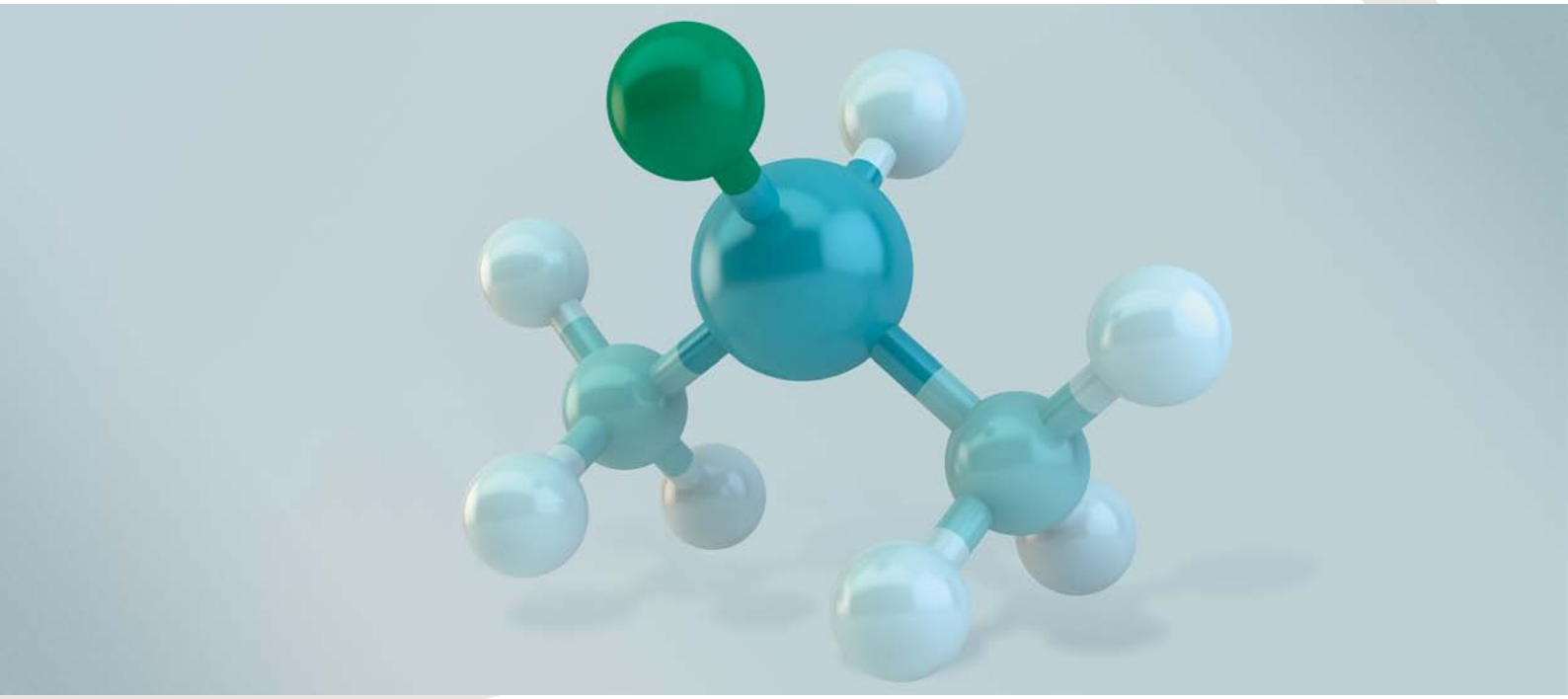
This alternative has a copper content of approx. 48 % and a moisture content of approx. 12 %. This product is dark green, low on dust and, despite the high water content, still free flowing.

Copper(II)-hydroxycarbonate ultrafine

This very light product with a bulk density of less than 0.50 g/ml has been developed for catalytical reactions mainly. It is especially characterized by its small primary particle size (d50 ‹ 5 µm) and is low on chlorides (‹ 0.01 %).

Applications

- as starting product for the manufacture of various catalysts in organic chemistry
- as starting product for the manufacture of other copper compounds, e. g. copper(II)-oxide (thermal processing), copper citrate, copper acetate
- for wood preservation (impregnation solutions)
- for dyeing of ceramics
- as pigment in paper production
- in pyrotechnics
- for respiratory protection techniques
- as algaecide in waters



COPPER(I)-CHLORIDE PEARLS

CuCl consists of fine grey-black pearls with an average particle size of approx. 100-200 µm. The copper content is around 64 %. Copper(I)-chloride is a highly hygroscopic product. In order to avoid agglomeration it can get blended with an additive.

Applications

- Methylchlorosilane synthesis (Mueller-Rochow)
- as raw material for the synthesis of copper-phthalocyanine pigments
- as catalyst for various reactions in organic chemistry
- for the Sandmeyer reaction
- in formulation of pharmaceutical active ingredients

COPPER(II)-CHLORIDE

Types & their characteristics

Copper(II)-chloride dehydrate

This product consists of blue-green crystals, is soluble in water and has a copper content of approx. 37 %.

Copper(II)-chloride anhydrous

The anhydrous copper chloride version is a brown crystal powder, good soluble in water and highly hygroscopic. The copper content is around 47 %.

Copper(II)-chloride solution

Here we can deliver various copper concentrations, according to the requirements of our customers. The actual availability varies from standard concentrations of approx. 15 % of copper to copper contents of more than 19 %.

Applications

- for the manufacture of various catalysts in organic chemistry
- as catalyst (in organic synthesis for chlorination and/or oxidisation, in catalytical processes)
- in the electronics industry
- in the pigment and dyeing industry
- for pyrotechnics to generate green flames
- for production of vitamins
- for the pickling of brass

COPPER(II)-CITRATE

Copper(II)-citrate is a light-blue powder. It is hardly soluble in water but better soluble in diluted acids and ammonium solutions. The copper content is around 37 %.

Applications

- as algicide (swimming pools)
- as antiseptic agent
- in metal treatment lubricants
- in wine agitation to avoid the so-called wine errors ("Böckser")

DISODIUM COPPER(II)-CITRATE SOLUTION

This solution is deep blue coloured and has a copper content of approx. 8 %.

Applications

- as Algaecide (swimming pools)
- in metal treatment lubricants

COPPER(II)-HYDROXIDE

Types & their characteristics

Copper(II)-hydroxide

This is a light-blue powder, insoluble in water. The copper content is approx. 64 %. At temperatures of 60-80 °C, dehydration and formation of copper(II)-oxide occur.

Copper(II)-hydroxide Special

Copper(II)-hydroxide Special was developed especially for processes aiming at a high catalytical impact. This is achieved by its high specific surface area of › 75 m^2/g. The copper content is at approx. 62 %.

Applications

- as starting product for the manufacture of other copper compounds, like copper naphthenate
- suitable as copper source for organic syntheses and formulations due to fast dissolving speed in acids
- as pesticides
- in heterogeneous catalysis
- for the manufacture of copper silk
- for the manufacture of mordants and ship bottom paints
- in wood preservative formulations

COPPER(II)-NITRATE

Types & their characteristics

Copper(II)-nitrate Trihydrate

Copper(II)-nitrate Trihydrate is a technical crystalline product ($Cu(NO_3)_2 \times 3H_2O$) with a copper content of around 27 %, consisting of big blue-green, deliquescent, orthorhombic crystals.

Copper(II)-nitrate solution

The standard solution is manufactured at a copper content of approx. 15 %; higher concentrations are available upon request. We have a huge production capacity for this product due to our own high demand for copper nitrate solution as starting product for other copper compounds.

Applications

- as starting product for the manufacture of other copper compounds
- as starting product for the manufacture of various catalysts in organic chemistry
- for dyeing of metals
- for dyeing of textiles
- for the formulation of fungicides and herbicides

COPPER(II)-OXIDE

Types & their characteristics

Copper(II)-oxide

Copper(II)-oxide is a fine black powder. It is insoluble in water and alcohol but soluble in diluted acids. Available are copper oxides with a copper content of approx. 78 % which can be mainly classified by their different production processes (thermal or precipitation process), or by their different bulk densities (heavy CuO with approx. 2.4 g/cm^3 or light material with approx. 1.8 g/cm^3).

Copper(II)-oxide HSSA (High Specific Surface Area)

This special product with a minimum copper content of 73 % and a specific surface area (BET) of minimum 60 m^2/g features a very high surface area for this chemical compound and is therefore especially suitable for heterogeneous catalysis.

Applications

- as starting product for the manufacture of other copper compounds
- as coloured pigment in glazes for glassware, ceramics and enamel
- in pyrotechnics
- as catalyst and for the manufacture of various catalysts in organic chemistry
- in the rubber industry

COPPER(II)-ACETATE MONOHYDRATE

Copper acetate is the copper salt of acetic acid and is also specified as verdigris. It contains approx. 32 % of copper, crystallises with 1 mol crystal water and is soluble in water and alcohol.

Applications

- as starting product for the manufacture of other copper compounds
- as catalyst for oxidisation, hydrogenation, esterification, polymerisation and other chemical reactions in inorganic chemistry
- as intermediate for the manufacture of colour pigments
- for the formulation of fungicides and bactericides
- for dyeing of textiles
- for the production of vitamins
- in the rubber industry

COPPER(II)-OXYCHLORIDE

Copper oxychloride is a fine, light-green powder with a copper content of approx. 57 %. It is insoluble in water, but soluble in various acids.

Applications

- as starting product for the manufacture of various other copper compounds
- for the formulation of fungicides, herbicides and insecticides
- for the manufacture of various catalysts in organic chemistry
- as catalyst (in organic synthesis for chlorination and/or oxidisation)

COPPER(II)-SULPHATE

Copper(II)-sulphate Pentahydrate is a blue crystalline product with a copper content of approx. 25 %. It is easily soluble in water, but insoluble in most organic solvents.

Applications

- as starting product for the manufacture of other copper compounds
- for the formulation of fungicides and algaecides
- as supplement in animal feeds
- as fertiliser
- for aftertreatment in dyeing works
- as catalyst and for the manufacture of various catalysts in organic chemistry

COPPER(II)-OXALATE

This copper compound is a blue powder with a copper content of around 41 %. It is insoluble in water and alcohol but soluble in liquid ammonia.

Applications

- as starting product for the manufacture of other copper compounds
- as catalyst for oxidation reactions, hydrations, esterifications, polymerisations and other chemical reactions in organic chemistry
- for the formulation of fungicides and bactericides
- in galvanizing treatment
- in the ceramics industry

COPPER SACCHARINATE APPROX. 15 % CU

Copper Saccharinate is a white powder with a copper content of approx. 15 %.

Applications

- in methacrylate adhesives

PRODUCT LIST COPPER CHEMICALS

PROPELLANT COMPONENTS

Basic Copper Nitrate (BCN), compacted	Dicopper(II)-trihydroxynitrate, bulk density › 0.5 g/cm³
Basic Copper Nitrate (BCN), uncompacted	Dicopper(II)-trihydroxynitrate, bulk density ‹ 0.5 g/cm³
Copper(II)-oxide Special ultrafine	BET › 8 m²/g , particle size 98 % ‹ 25 µm
Copper(II)-oxide Special ultrafine 30	BET › 20 m²/g

PROCESS CHEMICALS

Copper(II)-acetate Monohydrate	approx. 32 % Cu
Copper(II)-hydroxycarbonate	approx. 55 % Cu, bulk density › 1.5 g/cm³
Copper(II)-hydroxycarbonate wet	approx. 47 % Cu, moisture content approx. 12 %
Copper(II)-hydroxycarbonate ultrafine	ø particle size ‹ 5 µm, bulk density ‹ 0.5 g/cm³
Copper(I)-chloride pearls	approx. 64 % Cu, ø particle size 100-200 µm
Copper(II)-chloride dehydrate	approx. 37 % Cu, crystalline
Copper(II)-chloride anhydrous	approx. 47 % Cu, moisture content ‹ 1 %, crystalline
Copper(II)-chloride solution	concentrations upon request
Copper(II)-citrate	approx. 37 % Cu
Disodium Copper Citrate solution	approx. 8 % Cu
Copper(II)-hydroxide	approx. 64 % Cu
Copper(II)-hydroxide Special	BET › 75 m²/g
Copper(II)-nitrate Trihydrate	approx. 27 % Cu, technical grade, crystalline
Copper(II)-nitrate solution	concentrations upon request
Copper(II)-oxychloride	approx. 57 % Cu
Copper(II)-oxide	approx. 78 % Cu
Copper(II)-oxide HSSA	BET › 60 m²/g
Copper(II)-sulfate Pentahydrate	approx. 25 % Cu
Copper Saccharinate	approx. 15 % Cu
Copper(II)-oxalate	approx. 41 % Cu

GERMANY / EUROPE / INTERNATIONAL

TIB Chemicals AG
Mülheimer Strasse 16-22
68219 Mannheim
P.O. Box 81 02 20
68202 Mannheim
Tel. +49 621 8901 0
Fax +49 621 8901 900
info@tib-chemicals.com
www.tib-chemicals.com

Dr. Dieter Guhl
Director Business Unit
Inorganic Specialty Chemicals
Tel. +49 621 8901 404
Fax +49 621 8901 1404
Mobile +49 171 3717 769
dieter.guhl@tib-chemicals.com

Markus Bogdan
Senior Business Manager
Copper Chemicals
Tel. +49 621 8901 484
Fax +49 621 8901 1484
Mobile +49 151 2031 1804
markus.bogdan@tib-chemicals.com

Matthias Eisemann
Sales Manager Copper Chemicals
Tel. +49 621 8901 278
Fax +49 621 8901 1278
Mobile +49 151 2031 3689
matthias.eisemann@tib-chemicals.com

France
TIB Chemicals AG
Hervé Luneau
Tel. +33 130 620 007
Mobile +33 687 766 689
herve.luneau@tib-chemicals.com

Italy / Spain / Switzerland / Greece
TIB Chemicals AG
Fabrizio Scesa
Tel. +39 037 39 75 224
Fax +39 037 39 75 260
Mobil +39 348 254 18 50
fabrizio.scesa@tib-chemicals.com

Norway / Sweden / Denmark
Eidsvik Agentur Ltd
Rødtvedtveien 16
0955 Oslo
Norwegen

Arne Eidsvik
Tel. +47 944 983 46
Fax +47 220 656 99
e.agent@online.no

Mexico / South America
TIB Chemcorp Mexicana S.A. de C.V.
Eje 110 S/N
Zona Industrial
San Luis Potosi S.L.P. 78395
Tel. +52 444 824 7717
Fax +52 444 824 7720

Gabriela Valencia
Sales
Tel. +52 444 824 7876
Fax +52 444 824 7720
gabriela.valencia@tib-chemicals.com

Japan
Evonik Degussa Japan Co., Ltd.
Shinjuku Monolith 12F
2-3-1, Nishi-Shinjuku
Shinjuku-ku, Tokyo
163-0938 Tokyo

Masatoshi Murakami
Tel. +81 353 237655
Fax +81 353 238789
masatoshi.murakami@evonik.com

www.tib-chemicals.com

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