

[The Explosives and Weapons Forum](#) > [Energetic Materials](#) > [High Explosives](#) > TACC, TACN, and tetramine copper perchlorate

[Log in](#)

View Full Version : [TACC, TACN, and tetramine copper perchlorate](#)

Pages : [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [[7](#)] [8](#)

Rosco Bodine

November 28th, 2003, 01:34 PM

TACP is easily made by mixing a warm concentrated solution of copper nitrate with a warm concentrated ammonium hydroxide solution of ammonium perchlorate .TACP is a moderately sensitive secondary explosive which has good power and good stability so long as the material is kept from contact with liquid water . TACP is not at all hygroscopic and will remain stable exposed to the air outdoors even during rainy weather so long as it is not directly wetted by condensation or liquid water . On contact with liquid water TACP is decomposed immediately and uneventfully by hydrolysis . TACP crystallizes directly from synthesis in a desirable crystal form and purity . The crystals are very beautiful in color , an intense deep sapphire blue quite similar to granulated "cobalt glass" , very reflective and prismatic crystals . The synthesis of TACP is actually worth doing just to see these sparkling little beauties which are distinctly unforgettable . Many years ago I made a batch of TACP and I still remember the jewel-like beauty of TACP crystals , blue-violet cubes having a granulation size similar to table sugar . Upon ignition in the open the TACP deflagrates and produces a bright "electric blue" blue-white colored light . The TACP crystals can be compressed in a detonator capsule and initiated by a primary . TACP is slightly more sensitive to initiation by lead azide than is picric acid , and is nearly as powerful . Warming the dried TACP crystals in a beaker heated by a hot water bath , sufficient to melt paraffin chips , the warm TACP crystals can be stirred with a dowel and glazed with molten paraffin to form a composition which is optimum at 2.75 per cent paraffin . The warm mixture is dumped onto a paper plate for cooling , and the cooling paraffin glazed crystals will separate easily . This percentage of paraffin was found by experiment to improve the sensitivity to initiation of TACP and to improve its compression loading characteristics , as well as to provide an improved resistance to moisture .

Synthesis of Tetraammine Copper (II) Perchlorate

EXPERIMENTAL :

120 grams of ammonium perchlorate and 280ml of ammonium hydroxide 26 degrees Baume ,(28-29 per cent of solution weight is NH₃) are combined in a glass jar of 800ml capacity ,having a threaded lid , and the container is lightly sealed , but not so tightly as to prevent a slight leakage of any excess pressure of ammonia as the ammonia solution is heated . The solution of the ammonium perchlorate will require placing the jar into a pan of hot water , and warming and stirring will dissolve all of the ammonium perchlorate . This can most easily be accomplished using a magnetic stirrer , avoiding the fumes of ammonia which will be evolved if the container must be opened for manual stirring . Periodically swirling the sealed container is another option . While the mixture is warming and dissolving , prepare a solution of copper nitrate according to the following method .

Place 56 grams of basic copper carbonate into a 500 ml beaker and add 25 ml water , stir into a paste . Add dropwise , with stirring , cautiously and slowly due to effervescence , 68 ml of concentrated nitric acid 68 per cent . A dark blue transparent , hot solution of copper nitrate will result when all of the acid has been added , and the evolution of carbon dioxide has ceased . By the time this copper nitrate solution has been prepared , the other solution of ammonium perchlorate should be fully dissolved .

Remove the ammoniacal ammonium perchlorate solution from the warm water bath , and place it in a cool water bath . When the temperature of the ammonium solution has lowered somewhat , loosen and remove the lid and while stirring quickly pour into the stirred solution the warm copper nitrate solution . A strong evolution of ammonia will accompany the immediate exotherm as the complexation reaction occurs . The temperature of the dark purple colored reaction mixture will suddenly rise to nearly the boiling point while offgassing a lot of excess ammonia . Allow a minute or two for the excess ammonia to fume away and the temperature to begin its fall , then cap the container snugly to prevent further loss of ammonia . The reaction is rapid and within a few minutes a substantial precipitation of TACP crystals will begin to appear in the gradually cooling mixture . The hot reaction mixture should be allowed to stand without stirring for no longer than ten minutes , or very large crystals will appear , 4 to 5 mm cubes will grow at an astonishing rate in the mixture unless it is stirred up very well at least every three or four minutes while cooling . Ice should be added to the cooling bath to increase the rate of precipitation . With regular stirring of the cooling mixture nearly all of the precipitated crystals will be produced in a surprisingly uniform crystal size , which is easily filtered from the mixture when the precipitation is complete . It is imperative that the crystals not be rinsed with water . Alcohol may work okay but has not been tried . The TACP crystals are not themselves hygroscopic , however the reaction liquid which wets the freshly filtered TACP crystals IS very hygroscopic and must be blotted away from the crystals as much as possible , or else the atmospheric moisture attracted to the residual "mother liquor" will begin to decompose the TACP . It is essential to get the freshly filtered TACP crystals free from the residual moisture within a few minutes , and this is easily done by simply placing the coffee filter on a fresh stack of dry paper towels until the filtered crystals are substantially free of liquid and only slightly moist , no longer like a wet "mud" but more like a freely crumbling "damp sand" of loose crystals . The crystals should then be spread out in a thin layer upon paper to air dry . Yield of dried crystals is 115 grams , about 72 per cent of theory .

There is a color shift about the crystals which will be observed occurring from the time the crystals are first filtered from the reaction , and when the crystals are completely dry .The freshly filtered crystals are a darker violet blue sapphire color , and the finished drying crystals are a distinctly lighter and brighter blue very much like "cobalt blue" . The color change is accompanied by loss of ammonia , which suggests that the initial product is partly or fully the hexammine complex , which reverts to the tetraammine complex on exposure to the air by loss of ammonia .

The above procedure is not optimized , so the yield may be improved by refining the proportions or method . This synthesis is

simply reported as being one approach which does produce usable yields of crystalline TACP suitable for use as an explosive . The potential usefulness of TACP has not been the source of extensive experiments by me , but it may have usefulness with nitromethane or other energetic fuels , due to its positive oxygen balance . The ease of synthesis of TACP makes it interesting . The effectiveness of TACP as a detonator base charge has not been tested by me on actual charges . The comparison to picric acid relates to witness plate observations for two gram charges initiated by lead azide . A better real world test of detonator effectiveness would be to see how efficient two to three grams are at initiating lightly confined urea nitrate . In my experience , only a "persuasive" detonator impulse gets that job done well .

Marvin

November 28th, 2003, 10:43 PM

Nows thats a post for sore eyes.

I would think what youve made is specifically tetraaminocupric perchlorate dihydrate. This should be dark blue, low solubility. I would speculate that the lightening of colour is due to hydrolysis at the surface of the crystals, or maybe just to loss of ammonia.

How sensitive is this to shock, crushing, grinding etc? Do you have problems if the crystal sizes get too big or are you basing this on properties of other primaries?

Rosco Bodine

November 28th, 2003, 11:02 PM

Could you please cite the specific reference for the existence of this hydrolysis sensitive material as a dihydrate when speculating ?

The product shows no loss of moisture on heating , BTW .

The material is relatively insensitive to crushing or cautious grinding . It is sensitive to impact and initiation , somewhat more than picric acid .

PATR rates its power somewhat lower than is in accordance with my personal observation . The figures I would have to check , but IIRC the figure given by PATR was about 80 per cent of TNT in power , I would put it somewhere between TNT and picric acid in brisance based upon the size of the hole blown through steel by two grams in a cap base charge .

There will be a few megacrystals formed from the supersaturated hot reaction mixture just before an avalanche precipitation of much smaller crystals of uniform size . This is no significant problem . I simply made the observation that the more desirable mesh of crystals for use as an explosive are easily obtained by stirring of the cooling reaction mixture . If you want a great many larger crystals for some reason , then let the mixture sit undisturbed while cooling and bigger crystals you will see there .

Solubility is an irrelevant term for TACP , because on contact with liquid water TACP decomposes completely to copper oxide and other things . So there is no real "solubility" for TACP in water , as it is decomposed on contact with water .

TACP is definitely not a primary explosive , but is a good secondary high explosive .

Marvin

November 30th, 2003, 09:33 PM

The brief description in Mellor matches the compound youve described well, though there is a typo in the name. The one reference given for the compound is, coincidentally enough,

H. E. Roscoe, Liebigs Ann., 121. 355, 1862.

It is sparingly soluble, or it wouldnt ppt under the conditions youve described, the fact that pure water decomposes it isnt surprising. From other examples we know that anhydrous tetraamino copper(II) compounds do not form from Aq solution and that the usually dihydrated salts that do form, as this is I'm sure, always lose either ammonia or ammonia+water on attempted dehydration. The only way to make the anhydrous compounds involves anhydrous salts and dry ammonia gas, or presumably liquid ammonia.

We know the tetraamine copper(II) complex cannot be the light blue compound, because tetrahedral copper (II) has to be darkly coloured for symmetry reasons. This is the 'real' reason behind why adding excess ammonia to copper sulphate solution turns the mixture dark blue/purple. The octahedral water complex has a symmetry forbidden transition in the visible region, which is why it only absorbs very weakly. Add ammonia and although the ligand changes it shouldnt affect the absorption bands that much, but because it forms a tetrahedral complex instead, the same transition is now fully allowed by tetrahedral symmetry and the solution becomes very strongly absorbing.

From your description of deflagration in the open I assumed it would go high order when ignited strongly confined and thus make a useful primary explosive, does it not do this?

Rosco Bodine

December 1st, 2003, 12:11 AM

Marvin ,

Regarding the DDT capabilities when strongly confined , actually I did not test for that . In the open even several grams ignited merely burn , although the burning is quite rapid and makes a crackling snapping growl of a noise , as if the potential for transitioning could be there . I think I did test it with light confinement in an open tube and it merely flashed like rocket propellant . It appeared to be a rapid enough burn that no nozzle would be required , just an end burning grain in an open tube would probably do the trick . I think it would probably DDT but the size of the charge would probably be large , but that is just my guess and it might go DDT beautifully with strong confinement . When I was stepping up the initiating weights of lead azide to quantify the sensitivity , there were incomplete detonations with a couple of the tenth gram initiating charges . That would seem to be plenty of azide to get a DDT capable material to go high order in a cap casing if it just needed a bit of confinement to go . Since that didn't happen , I would say that the DDT capabilities are not present for a detonator sized charge . Bigger charges could cook off nicely , just like regular ammonium perchlorate can do .

It is good to keep in mind that when syntheses are done for publication , samples of proposed materials are often made by awkward methods merely for the purpose of justifying a particular identification by using methods which exclude other possibilities . These methods are used for producing what are most certain to be "authenticated samples" as standards for comparison . But the anhydrous methods used on those references never can be taken to mean that the same material can't also be synthesized under much less restrictive conditions . I believe that to be the case here with my proposed synthesis . The product is soluble in the ammonium hydroxide solution of precursors from which it forms and the byproducts of the reaction , and indeed there is water in that solution . But that reality cannot be taken to indicate that the TACP is therefore "soluble in plain water" nor can it be speculated that because a substance crystallizes from a water containing solution of precursors that it must be a hydrated salt . Directly observe the absolutely instantaneous decomposition of TACP crystals upon contact with plain water and you will see why it is unlikely that the compound actually contains that same water which is its own destruction if one more bit of it tips the stability balance .

A more modern reference is B.B. Wayland and W.L. Rice
Inorganic Chemistry vol 6 , No. 12 (Dec 1967)
pg 2270-2272

If it isn't really TACP , how about we just call it
"pretty purple 'splosiv stuff" :D
or , we could split the difference and call it
copper pentaammine perchlorate maybemonohydrate .

Zeitgeist

February 15th, 2004, 08:38 PM

Interesting.....

So, let me get this straight, using CuSO4 solution in EtOH, we dissolve in a nitrate or permanganate at a 1:2 mol ratio and bubble in NH3 ?

Or do i need to start from Copper Nitrate ?

So do you need NH3 gas? Could you use, say, (NH4)2SO4 and NaOH in the solution?
How about crappy household ammonia solution?

I'm really only interested in the Nitrates and Permanganates, chlorate is a bitch to get here.

Mumble

February 15th, 2004, 10:23 PM

Actually refluxing has to be done. Just heating and replacement of boiled EtOH is acceptable. The copper salt formed will dissolve into the alcohol. Filter to remove excess Copper sulfate or x Sulfate. I don't know about the other salts, but the Chlorate turns the alcohol solution neon green. Quite a neat color.

For the best product Ammonia gas has to be used. Also all reagents should be quite dry. Water kills any use the compounds may have. One may want to keep them under solvent until they are to be used. Ammonia solution can be used, but like it says, water kills the usefulness. If you just want to make them for bragging rights use Ammonia solution by all means for ease and lower risk.

If you do want to use the compound actually, might I recommend decomposition of Urea. It is quite dry just by itself. No wash bottles needed.

Zeitgeist

February 18th, 2004, 01:41 AM

OK , I've got some solid copper nitrate now, which is good,

Does having water present just make it less able to detonate because it is so hard to dry, or does it stop the complexation by complexing itself to the copper?

I added 5% aq. ammonia to Cu nitrate, got Cu(OH) which then dissolved to the rich blue colour tetramine complex - but when I started boiling it I just ended up with brown Copper Oxide precipitate.

Also, I tried mixing KMnO4 and CuSO4 to make Cu(MnO4)2, 2:1 mol ratio in aqueous solution, but black-brown Copper Oxide and/or Mn(IV) oxide precipitated out, any ideas how I can make this ?

Marvin

February 18th, 2004, 06:00 AM

Mixing ethanol and permanganate would not be a good idea.

Water forms a complex, which is all hydrates salts really are.

If you make copper nitrate in aq solution this will be hydrated, it is not possible to dehydrate this to make the anhydrous salt. If you use dry ammonia though you can make the anhydrous ammoniated salt.

Copper sulphate doesn't dissolve in alcohol.

I have doubts about the feasibility of making ammoniated permanganate compounds, do you have a reference or is this speculative?

Hubert

May 4th, 2004, 11:33 AM

This is movie- 200g [Cu(NH3)4](NO3)2 tetraamino copper nitrate TACN

[http://www.pirotechnika.one.pl/Proby/\[Cu\(NH3\)4\]\(NO3\)2.mpg](http://www.pirotechnika.one.pl/Proby/[Cu(NH3)4](NO3)2.mpg)

I don't smell NH3 in TACN.

This is very persistent and looks good.

We can see more in this video.

Rosco Bodine

May 4th, 2004, 08:58 PM

I have doubts about the feasibility of making ammoniated permanganate compounds, do you have a reference or is this speculative?

<http://mihailru.freesevers.com/>

The page will only display correctly with your browser using UTF-8 decoding , and the language plugin for cyrillic characters , as the page is in Russian .

kryss

June 5th, 2004, 11:00 AM

I've found Copper Nitrate difficult to prepare pure - easy enough to make a conc solution but it's so soluble you end up with a thick syrup when you try to evaporate off the water. Heating it more just gives off nitric acid - producing a basic nitrate. I probably need to add a solvent to reduce its solubility - but I suspect it's reasonably soluble in methanol and isopropanol as they didn't seem to do much. Plus I've read that Copper can form adducts with alcohols - in Mellor. Took a sample amount of the solution and added excess ammonia and precipitated with isopropanol - lots of purple solid. I think this is one of the copperamine nitrates, but probably not fully ammoniated or nitrated. Air dries easily enough - doesn't smell strongly of ammonia but melts/burns then goes up in a puff of smoke - more smoke than anything else. Interesting though.

I'm trying the Copper Chlorate - 4g CuSO4.5H2O and 3g KClO3 refluxed in a milk! bottle with Methanol. Solid loses the blue colour, liquid goes apple green colour. This might be due to the water in the copper sulphate being extracted into the methanol, and excess methanol complexing with the Copper. Should be easy enough to tell.

Macgyver

September 2nd, 2004, 11:41 PM

Has anyone here successfully used TACN to initiate something else, for example ANNM?

I have made some TACN, but it seems that I need something else to initiate the TACN, because on its own it is not particularly flame sensitive.

Maybe mixing part of it with black powder would work?

KemiRockarFett

September 3rd, 2004, 03:09 PM

According to the subject Tetraamminecoppernitrate, than you add ammonia to the water solution of coppernitrate the ammonia will become a stronger induced dipole, due to copper's electronegativity, than water is dipole and therefore the ammonia complex bonds to copper and as you have noticed the colour will be dark blue and that Marwin tried to explain with MO theory. Then you have your Tetraamminecoppernitrate you suspect it to have two crystal waters left and if it is in that way its no problem at all. In Federoff you can read that the substance was used with aluminum and KNO_3 and sulfur and I think carbon in blasting caps. The eventually crystalline water will react nicely with the aluminium and give a lot of energy.
Summary: don't try to use the complex salt as it is, use it in a mix and the result is a perfect cheap safe and easy blasting cap.

meselfs

September 3rd, 2004, 06:00 PM

I've found Copper Nitrate difficult to prepare pure - easy enough to make a conc solution but its so soluble you end up with a thick syrup when you try to evaporate off the water. Heating it more just gives off nitric acid - producing a basic nitrate. I probably need to add a solvent to reduce its solubility - but I suspect its reasonably soluble in methanol and isopropanol as they didn't seem to do much. Plus I've read that Copper can form adducts with alcohols - in Mellor. Took a sample amount of the solution and added excess ammonia and precipitated with isopropanol - lots of purple solid. I think this is one of the copperamine nitrates, but probably not fully ammoniated or nitrated. Air dries easily enough - doesn't smell strongly of ammonia but melts/burns then goes up in a puff of smoke - more smoke than anything else. Interesting though.

I'm trying the Copper Chlorate - 4g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and 3g KClO_3 refluxed in a milk! bottle with Methanol. Solid loses the blue colour, liquid goes apple green colour. This might be due to the water in the copper sulphate being extracted into the methanol, and excess methanol complexing with the Copper. Should be easy enough to tell.
It has a surprisingly low melting point, around 150 C (can't remember exactly but definitely around there). Around 220 C it decomposes.
So, try putting a thermometer in and keeping the temp around 180, hold it there for a bit and it should be totally anhydrous.

hereno

October 15th, 2004, 03:52 AM

Has anyone ignited TACC out in the open? how does 1g burn unconfined?

TACC is said to be the only common complex that will function as an initiating explosive, so it would be nice to give other complexes something to scale them by. How much is required for unconfined detonation?

TheArsenist

October 25th, 2004, 04:37 PM

Ha, I've just boiled some Cu powder in a HNO_3 solution for a couple of hours to make $\text{Cu}(\text{NO}_3)_2$. I thought about making it by boiling Cu powder in a NH_4NO_3 solution, and that was before I knew that $\text{Cu}(\text{NO}_3)_2$ combined with NH_4 formed an explosive :) Good thing I went with the HNO_3 solution.

I just want to make $\text{Cu}(\text{NO}_3)_2$, and I saw that somebody said that its possible to make by mixing CuSO_4 (aq) with $\text{Ca}(\text{NO}_3)_2$ (aq). Are you sure about that? What color is the solid that forms in the mixture? I believe that you need something like AgNO_3 in order to make CuSO_4 into $\text{Cu}(\text{NO}_3)_2$.

Are you sure its possible to make a $\text{Cu}(\text{NO}_3)_2$ solution just by mixing $\text{Ca}(\text{NO}_3)_2$ (aq) and CuSO_4 (aq) and filtering out the white and solid CaSO_4 ?

I don't have any $\text{Ca}(\text{NO}_3)_2$ at the moment but I have plenty of $\text{Mg}(\text{NO}_3)_2$ so would that work as well? Probably not since MgSO_4 has a high solubility in water. Which other procedures of making $\text{Cu}(\text{NO}_3)_2$ do you know?

The_Rsert

October 27th, 2004, 09:46 AM

Has anyone information about tetraminecopper persulphate?
(Solubility in water and alcohol, information about synthesis?)

I have just seen the video on <http://www.geocities.com/roguemovies7/>
It looks powerful...

Marvin

November 7th, 2004, 06:48 AM

Did it take 2 weeks for someone to authorise TheArsenists post?! I'm a little confused.

I don't follow why you needed to boil the copper in the acid. The last time I tried dilute nitric and copper it merrily dissolved producing NO.

Mixing solutions of copper sulphate and calcium nitrate will work, but beware that garden fertiliser grade calcium nitrate often also contains some ammonium nitrate. One wonders if that's what its made from. The precipitate should be white calcium sulphate, leaving copper nitrate in solution.

You cant make anhydrous $\text{Cu}(\text{NO}_3)_2$ by any process using water. The hydrate will be made which decomposes if you try to make it anhydrous. TACN can be made anhydrous using dry enough ammonia from the hydrate as stated allready.

If you are stuck for calcium nitrate, mixing sodium or potassium nitrate with calcium chloride as hot concentrated solutions and filtering still hot should dump out NaCl or KCl. By working out the math, how much sodium nitrate to calcium chloride, and what volume of liquid you need to keep most of the calcium nitrate produced this should work. You can then use calcium nitrate to produce the copper nitrate in the cold. Filtering will be a pain, use more water than you need and resign yourself to a longer concentration step at the end. My copper nitrate was a blue solution when cold and dilute, and green when hot/concentrated.

I dont know if magnesium nitrate will work, it depends on if copper sulphate (low solubility) or magnesium sulphate (fairly low solubility) will crystallise first.

The_Rsert

November 29th, 2004, 12:35 PM

Tetraminecopper(II)persulphate is quite powerful, not hygroscopic, sensitiv flame to shock an friction.

Preparation of tetraminecopper(II)persulphate:

- 1.)Dissolve 20g copper sulphate in 100ml of warm (not cooking) distilled water.
- 2.)Add 45-50g strong (25%) ammonia and wait a few hours.
- 3.)Make an other solution, with 20g potassium- or sodium persulphate in about 400ml (maybe less water is better) warm water.
- 4.)Mix the two solutions and wait some hours.
- 5.)Cool the solution to 0°C - 2°C .
- 6.)Filter out the little purple needles.
- 7.)Dry them in an desicator until it's 100% dry.

vBulletin® v3.8.2, Copyright ©2000-2009, Jelsoft Enterprises Ltd.