An AP beginner's manual

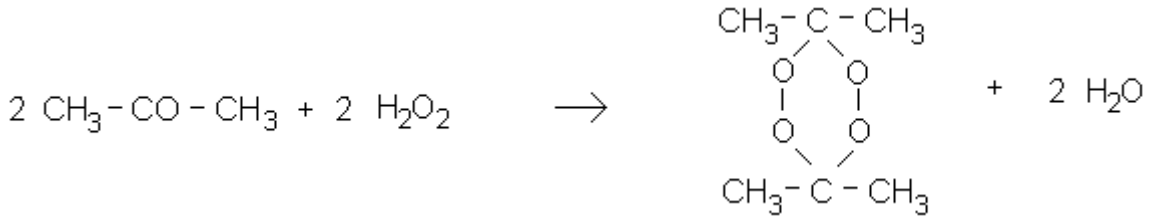
By Arthis

Introduction

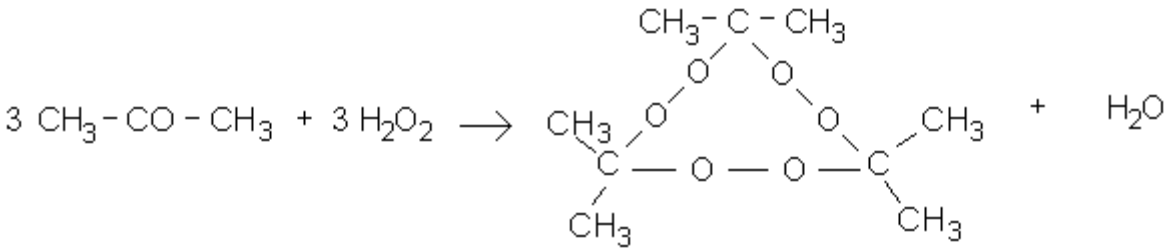
AP, or TCAP, stands for acetone tricycloperoxyde. It's a common very sensitive explosive for beginners, as it's easy to make, does not require any chemistry skills, nor hard to find chemicals.
It has some obvious advantages, some even more obvious problems, but as it's often made by beginners, it may be useful to compile most common information and research about it, made by members of the Forum. Of course further research and experiences are welcomed.

AP comes in 2 different forms, dicyclo and tricycloperoxyde:

Dimer reaction:



Trimer reaction:

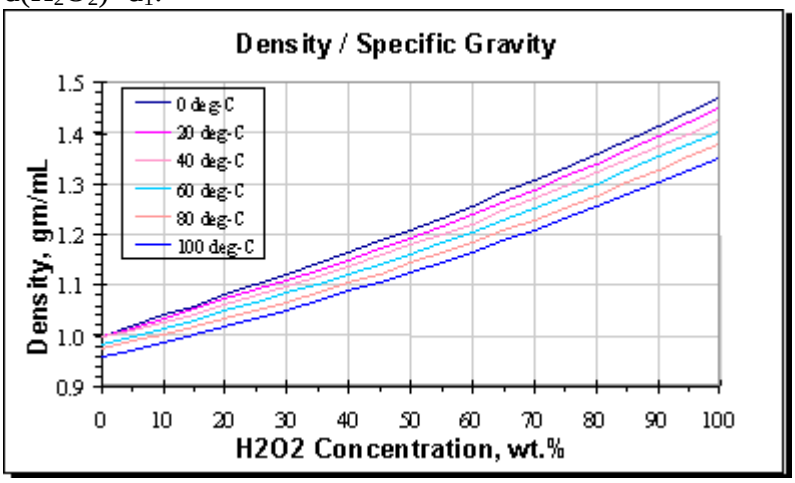


The dimer form is more unstable, and tends to self-decompose easily while the trimer form is more (relatively) stable.

You should try to get the trimer form, as it's also more powerful, and for that you need to keep the reaction the coolest possible.
You may have noticed that the acid is not present in the equation: it only acts as a catalyst.

Proportions
To get the proportions in your mix, you need to make a few calculations.

Densities:
$d(H_2O_2)=d_1$:



Acetone: d_2 = 789.9 $kg.m^{-3}$

You need one mole of acetone for every mole of hydrogen peroxyde.
With 30% h.p, a volume V, you have $(V*d_1*30\%)/M(H_2O_2)$ moles of H_2O_2
$M(H_2O_2)=2*16+2=34$ g
So $n=V*9.794$ moles

Number of acetone moles in 1 dm^3 (1 L): $n=d_2/M(acetone)=13.6$
Volume of acetone needed: $(V*9.794)/13.6=0.72$ V

So here's a table with the quantity of acetone you should add, function of the h.p you put:

	3 %	6 %	20 %	30 %
50 mL	3.6 mL	7.2 mL	24 mL	36 mL
100 mL	7.2 mL	14.4 mL	48 mL	72 mL
200 mL	14.4 mL	28.8 mL	96 mL	144 mL

Since acetone is cheap, and h.p less, you should add a little more acetone. That's why most methods propose slightly different ratios (and because they may not have done the calculation).

You should get 1/3 mole TCAP for every mole of acetone or H_2O_2 you put. Considering you put more h.p we'll do the calculation function of it.
For a volume V of 30% h.p, you have $(V*d_1*30\%)/M(H_2O_2)$ moles of H_2O_2, thus you should get $[(V*d_1*30\%)/M(H_2O_2)]/3$ of moles of acetone peroxyde. $M*n=m$
$M(TCAP)=M(C_9H_{18}O_6)=9*12+18+16*6=222$g

You should get $m=(V*d_1*30\%)/(3*M(H_2O_2))*0.222=0.724*V$ of TCAP

All calculations made in liters and kg.
A small table about what you should get:

	3 %	6 %	20 %	30 %
50 mL	3.62 g	7.24 g	24.13 g	36.2 g
100 mL	7.24 g	14.48 g	48.26 g	72.4 g
200 mL	12.48 g	28.96 g	96.52 g	124.8 g

Method to synthetise AP

200 ml 30% hydrogen peroxyde
150 ml acetone
50 ml 30% hydrochloric acid

Procedure:
Mix your acetone with the acid, and cool the mix to 0-5 °C. The lowest the temperature is, the best it is as the addition of h.p will release heat. Once that is done, slowly add the hydrogen peroxyde, 20 mL at a time. The temperature should not be allowed to rise. You can for example put some ice cubes in your mix, it dilutes it a bit, but it's easy. Some ice cubes for whisky come into glass tubes, for the whisky not to be diluted when the ice melts. That's even better. As there's a lot of h.p to add, it's easier to control the reaction than when you add the acid to the acetone/h.p mix (but you can do it if you want). When addition is done, let your mix sit for a few hours. There's no real limit. I used to let it sit overnight, but it's not necessary, unless you use diluted chemicals: then you need to let the reaction happen for a longer time.
White crystals should rapidly form and stay in suspension into the mix. At the end you should get a full beaker of crystal soaked in a water/acid mix.

Filter out the crystals that should be TCAP. Coffee filters are ok, using a t-shirt is good too if you have higher quantities of AP, since it will absord more. Wash the AP in a large beaker of distilled water.You need to neutralize the acid that is left in AP, for that put it a beaker with a bit of sodium bicarbonate. You need to stir well, for the acid blocked in the molecules that have stuck together whil precipitating to be removed. Wash your AP again, and allow it to dry. You should have pure AP.

You have made here normally 165g of pure AP. With the filtering, dissolutions in water, you should have way less. This depends on the number of time you washed it, the quantity of water you used, the method of filtering. Care with your freshly made AP !

Precursors: there's not many things to say about them.

Acetone is a common solvent you can buy in any drugstore, homestore… If you can't, you may find it in some nail polish remover, but be careful as it's expensive, and some nail polish remover contain no acetone (subtitutes are used, better for your nails), and there are many other stuffs that may parasite the reaction.

Hydrogen peroxyde is oxygenated water that you can buy in pharmacy, as antiseptic or as hair bleacher. It should then be 3-6 %, just add some more to have the good number of moles in the reaction. It is normally sold to everyone in drugstores, as a bleacher, to the concentration of 30-35 %, and it will be far cheaper. Just ask if you can order some. Taxidermists and hair shops should have some, you can ask there too.

Hydrochloric acid can be found in any store, it is pH relevant for swimming pools. It's very common. You may want to use another acid instead of this, see in the Research/FAQ section for that.

Research and FAQ

(mostly a FAQ for the moment though)

Concentration of the hydrogen peroxyde

Using more concentrated H_2O_2 should not change the yield, as long as you put the same number of moles in the mix: if you use 6% instead of 30%, just put 5 times more hydrogen peroxyde. But note that AP dissolve (not much) in water so you may lose some. Some members have noticed that usually, they get better yields with concentrated H_2O_2. See also the acid section for more information.

Acid used

The acid acts as a catalyst and about any acid can be used in AP synthesis. Citric acid and sulfuric acid are also commonly used but some differences can be noted, and must be taken into account.

Sulfuric acid: adding it will cause immediately a local overheating and ebullition. You must add it drop-by-drop. A good solution to avoid a temperature elevation is to dilute your acid and let it cool (e.g. from 95+ % to 30%).

Hydrochloric acid: easy to get, it may be the best suited acid in this synthesis, regarding to its low cost. It is safer too, as pouring the whole acid at once in the mix will not cause (even local) ebullition or overheating; however, the global temp of the mix will rise thus favoring the formationof the dimer, or even producing tear gas. Don't forget that it's easier to keep the reaction cool than cooling it down once the temperature has raised.

Citric acid: this is not a strong acid, but it works well too. The main interest, excepted the ease in keeping the reaction cool, it that it's way easier to wash the AP and make it neutral, compared with the use of strong acids.

Keep in mind that the more water in the mix, the more AP lost because dissolved. If you use dilute hydrogen peroxyde, then sulfuric acid won't cause overheating thanks to all the water in the mix, and using concentrated H_2SO_4 will be more advisable than using HCl which is way more diluted. BTW you'll need to add less for it to be effective in the reaction.

Toxicity

Pure AP is not toxic, doesn't go trough the skin. The problem may only come from (unwanted explosions ;)) the acid kept in, if not well neutralized.

Color

Normally AP is pure white. However colors may appear with impurities, for example rust if you used an iron spoon to stir the mix. Impurities may also be due to impure reactants like acetone from nail polisher.

Storing - Volatility

AP tends to sublimate very easily at normal temperature. It is therefore difficult to store. As a personnal experience, I let 200 g AP on a plate for several monthes (about 4-5), and I lost about half of the product. AP will also recrystalize on supports, make bigger crystals that are more sensitive.
Storing AP is therefore dangerous. In an open container, you will lose some, and you can imagine there are risks, due to impurities coming in, for example.
People tend to store it in air-sealed containers. Pure AP in an air-sealed container tends to sublimate and recrystalize on the cap, so when you open it, the risk is that broken AP crystals detonate and the whole pot too. This happened to a member.
An explanation is that with recrystalization the molecules of AP forms ionic bonds with each other, and breaking these bonds release energy, sometimes enough to make the crystal deflagrate.
Storing AP in a liquid limits the risks, even if still present. You can store it either in acetone or water. You just need to make it dry then to recover your product. A small quantity is lost, dissolved, but not much.
Storing AP is definitely risky. If you think it's worth the risks, do it. But be aware that things can go right 1000 times then 1001^{st} they go wrong, and once is enough for you to go back to the land of shadows… As one said, it's not like the country is going to be taken over by aliens and you need your AP right that instant to save the world.

Pressing AP

Pressing AP can be useful to make blasting caps, way more powerful than if not pressed. I won't speak about the precautions you need to take. Some press it with pencil. Note that depending on your AP, you can press it only slightly, or dead press it. Make a few experiments with some AP of the same batch before any attempt to press it. The more it's pressed the less air is in the cap, so the shockwave spreads easily, detonation is more powerful. When pressed, AP is even more powerful than HTMD.