FreePyroInfo.Com

Items Needed to Get Started In Pyrotechnics:

Pyrotechnic Chemical Incompatibilities

Some combinations of chemicals lead to especially sensitive or instable mixtures. There are many more of such incompatible chemicals/mixtures than listed here but these are some of the more commonly encountered types:

1. **Chlorates and sulfur**. Mixtures containing both are not only very sensitive to friction and shock but are also known to ignite spontaneously. The sulfur reacts with water and air to form trace amounts of sulfuric acid. This will react with chlorates to form chlorine dioxide, a yellow explosive gas that will ignite most flammable materials upon contact. Addition of small amounts of barium or strontium carbonate to chlorate based compositions is sometimes done to prevent buildup of acid, even in compositions without sulfur. Many older texts on pyrotechnics describe the use of chlorate/sulfur based compositions. Today, many alternative and much safer compositions are available and there is therefore no excuse for the use of chlorate/sulfur mixtures. This also means chlorate based compositions cannot be used in items that also contain sulfur based mixtures. For example: chlorate based stars cannot be primed with black powder. Nor can a H3 burst charge be used with black powder primed stars (or stars containing sulfur).
2. **Chlorates and ammonium compounds**. Mixing these will allow ammonium chlorate to form in a double decomposition reaction that takes place in solution (moisture speeds up the process). Ammonium chlorate is a highly instable explosive compound. It decomposes over time producing chlorine dioxide gas (see chlorates and sulfur). Mixtures are likely to spontaneously ignite upon storage or may explode for no apparent reason. An exception seems to be the use of ammonium chloride and potassium chlorate in some smoke compositions. According to Shimizu this combination is safe due to the lower solubility of potassium chlorate (compared to ammonium perchlorate). I personally would still use these mixtures with great caution (or avoid them) since it seems inevitable that small amounts of ammonium chlorate will still form. The lower solubility of potassium chlorate will make it the -main- product in a double decomposition reaction but not the -only- product.
3. **Chlorates with metals and nitrates**. These mixtures show the same problems as chlorate/ammonium compound mixtures. The reason is that nitrates can be reduced by most metals used in pyrotechnics to ammonium. The reaction rate of this reaction is increased by presence of water. Over time (for example when drying) these mixtures may spontaneously ignite or become extremely sensitive. The fact that ammonium forms in a relatively slow reaction is treacherous. These mixtures are referred to as 'death mixes' by some.
4. **Aluminum and nitrates**. Mixtures of these compounds sometimes spontaneously ignite, especially when moist. The mechanism is assumed to be as follows: the aluminum reduces some of the nitrate to ammonium, simultaneously forming hydroxyl ions. The aluminum then reacts with the alkaline products in a very exothermic reaction leading to spontaneous heating up of the mixture. This can eventually lead to ignition. The reactions take place in solution and therefore moisture speeds up the reaction. The process is usually accompanied by the smell of ammonia. Some types of aluminum are more problematic than others. Stearin coated aluminum is generally safer to use. The whole process can be prevented in many cases by the addition of 1 to 2 percent of boric acid. This will neutralize the alkaline products. It is best to bind such compositions with non-aquaous binder/solvent systems such as red gum/ethanol. Since aluminum/nitrate mixtures are extensively used it is important to be aware of this problem which is why the combination is listed here.

Shell Name	Description
Palm	Contains large comets, or charges in the shape of a solid cylinder, that travel outward, explode and then curve downward like the limbs of a palm tree
Round shell	Explodes in a spherical shape, usually of colored stars
Ring shell	Explodes to produce a symmetrical ring of stars
Willow	Contains stars (high charcoal composition makes them long-burning) that fall in the shape of willow branches and may even stay visible until they hit the ground
Roundel	Bursts into a circle of maroon shells that explode in sequence
Chrysanthemum	Bursts into a spherical pattern of stars that leave a visible trail, with an effect somewhat suggestive of the flower
Pistil	Like a chrysanthemum shell, but has a core that is a different color from the outer stars
Maroon shell	Makes a loud bang
Serpentine	Bursts to send small tubes of incendiaries skittering outward in random paths, which may culminate in exploding stars

General Solubility Information

The following is a listing of available materials that are (among other things) used as a binder in pyrotechnic type formulations. Those so marked with " ***** " preceding the item indicate that the material so used in solution, that is to say, it is dissolved in the appropriate solvent before mixing into the formulae. It should be noted that all of these materials may be used in solution but those so noted must be dissolved first because of their more difficult to solvise properties. Do not allow complete solvation before evaporation and drying the mixture resulting in adhesive bond failure. Some of these materials may take as long as 24 hours at room temperature to completely dissolve.

If maximum strength is required, binder solutions should be used instead of moistening the dry mixture containing the binder. A solution allows a more thorough, homogenous mixing with adequate wet-out and a cured strength many times greater than the same binder when used dry.

Those so indicated with "**+**" also have good moistureproofing properties (some better than others) because they are impervious to moisture themselves and seal the ingredients in the formula that are hygroscopic from the air and moisture they may otherwise absorb from it.

Resin and/or Binder	Dissolves in
Asphaltum (solution advised but may be used in dry form	Toluene, turpentine & other hydrocarbon solvents
*+ Calcium Resinate	Toluene, MEK
*+ Cellulose Acetate	Acetone
Cellulose Gum	Warm water
Dextrine	Water
Guar Gum	Water
Gum Arabic (acacia gum)	Water
Hydroxyehtyl (HEC)	Water
*+ Linseed Oil	Hydrocarbon solvents
*+ Nitrocellulose Lacquer (lacquer may be thinned)	Acetone
*+ Paraffin Oil	None required
*+ Parlon, chlorinated rubber	Acetone, Xylene
Phenolic Resin, Bakelite (TM) (solution advised, but may be used in dry form)	Acetone, Ethanol
*+ Polybutadiene (PBAN, R-45, etc)	plasticizer (curative required)
*+ Polyester Resin	Plasticizer (curative required
*+ Polystyrene	Toluene & other hydrocarbon solvents
*+ Polysulfide Resin	Plasticizer (curatives, etc.)
*+ Polyvinyl Alcohol	Boiling Water
*+ Polyvinyl Chloride	Methylene chloride, Methyl Ethyl Ketone, Cyclohexane
Red Gum	Alcohol

Rosin (sticky, much easier to use in solution)	Alcohol & hydrocarbon solvents
*+ Rubber	Benzene, Benzine
*+ Saran Resin (solution advised)(slowly in Acetone	Methyl Ethyl Ketone, Cyclohexanone
Shellac	Alcohol
Sodium Carboxymethylcellulose (CMC)	Water
*+ Sodium Silicate (solution may be thinned if necessary)	Water (heat resisting binder)
Starch	Warm Water
*+ Styrene Resin	Toluene, Methylene Chloride
* Vinsol Resin (solution advised but may be used in dry form)	Alcohol, Ketones, Hydrocarbon solvents
*+ Vinyl Resin	Toluene, Methyl Ethyl Ketone, Acetone

Compound	**% Chlorine by mass**
Ammonium chloride	66
Chlorowax	30-70
Dechlorane	78
HCB	75
HCE	90
Lead chloride	25
Lindane	73
Mercurous chloride	15
Parlon	64-68
PVC	57
PVDC (Saran)	73

Rocket name	**ID**	**OD**	**Length**	**Stick***	**Payload***
2 oz	3/8”		3-3/4”		
4 oz	1/2”		5”		
8 oz	5/8”	1”	6-1/4”	30”	120g
1 lb	3/4”	1-1/4”	7-1/2”	36”	180g
2 lb	7/8”		8-3/4”		
3 lb	1”	1-1/2”	10”	48”	500g
4 lb	1-1/4”		12-1/2”		

6 lb	1-1/2”		15”		

*Stick length and payload weight general suggestions
**All are for core burner black powder rockets
***Conventional drag stabilized core-burners usually have a case 10 IDs long, stingers must use shorter cases for stability, typically 4 IDs long. OD is 1.25 to 1.5 IDs.

	Virgin Kraft Paper Sheets and Rolls					Super Strips		Secret Weapon Strips	
	35# Blonde	50# Blonde	40# Brown	55# Brown	70# Brown	70#, 1"	70#, 2"	60#, 1"	60#, 2"
Pupadel Cans		•		•	•				
Siatine Cans					•				
3" - 4" Can, Inner	•	•	•	•	•				
5" - 6" Can, Inner		•		•	•				
7" - 8" Can, Inner					•				
10" - 12" Can, Inner					•				
Pupadel Pasting	•	•	•						
Siatine Pasting	•	•	•	•					
3" - 4" Can, Pasting	•	•	•	•	•				
5" - 6" Can, Pasting	•	•	•	•	•				
7" - 8" Can, Pasting	•	•		•	•				
10" - 12" Can, Pasting	•				•				
Small Crossettes	•	•	•						
Large Crossettes		•		•	•		•		•
Match Piping, Nosing	•	•	•						
Small Can, Outer Dry Wrap	•		•						
Large Can, Outer Dry Wrap		•	•	•					
3", 4", & 5" Ball	•	•	•	•		•		•	
6", 7", & 8" Ball		•	•	•	•	•		•	
10", & 12" Ball					•	•	•	•	•
16", & 24" Ball					•		•		•

U.S. Mesh	**Inches**	**Microns**	**Millimeters**
4	.1870	4760	4.760
6	.1320	3360	3.360
8	.0937	2380	2.380
10	.0787	2000	2.000
12	.0661	1680	1.680
16	.0469	1190	1.190
20	.0331	841	.841
25	.0280	707	.707
30	.0232	595	.595
40	.0165	400	.400
50	.0117	297	.297
80	.0070	177	.177
100	.0059	149	.149
200	.0029	74	.074
325	.0017	44	.044
400	.0015	37	.037
(1200)	.0005	12	.012
(2400)	.0002	6	.006
(4800)	.0001	2	.002

U.S. Sieve Mesh And Sieving Information					
Opening (Microns)	U.S. Sieve Mesh No.	Opening (Microns)	U.S. Sieve Mesh No	Opening (Microns)	U.S. Sieve Mesh No
4039	5	250	60	88	170
1905	10	210	70	74	200
841	20	177	80	63	230
595	30	149	100	53	270
420	40	125	120	44	325
297	50	105	140	37	400
Theoretical: 20 micron = 635 mesh					

Sieve Mesh No.	Inches	Microns**	Typical material
14	0.056	1400	
28	0.028	700	Beach sand
60	0.0098	250	Fine sand
100	0.0059	150	
200	0.0030	74	Portland cement
325	0.0017	44	Silt
400	0.0015	37	
(1200)	0.0005	12	Plant Pollen
(2400)	0.0002	6	Red Blood Cell
(4800)	0.0001	2	Cigarette smoke

* The mesh numbers in parentheses are too small to exist as actual screen sizes; they are estimated and included just for reference.
*figures in parentheses are too small to be for actual screens, just estimated as such

U.S.A.	Tyler	British	Sieve Opening	
Standard Sieve		Standard	Micron	Inch
10			2000	0.0787
	9		1981	0.0780
		10	1676	0.0660
	10		1651	0.0650
14			1410	0.0555
		12	1405	0.0553
	12		1397	0.0550
		14	1204	0.4740
16			1190	0.0469
	14		1168	0.0460
		16	1003	0.0395
18			1000	0.0394
	16		991	0.0390
		18	853	0.0336
20			840	0.0331
	20		833	0.3280
25			710	0.0280
	24		701	0.0276
		22	699	0.0275
		25	599	0.0236
30			590	0.0232
	28		589	0.0232
35		30	500	0.0197
	32		495	0.0195
		36	422	0.0166
40			420	0.0165
	35		417	0.0164
		44	353	0.0139
	42		351	0.0138
45			350	0.0138
50			297	0.0117
	48	52	295	0.0116
		60	251	0.0099
60			250	0.0098
	60		246	0.0097
		72	211	0.0083
70			210	0.0083
	65		208	0.0082
		85	178	0.0070
80			177	0.0070
	80		175	0.0069
		100	152	0.0060
100			149	0.0059
	100		147	0.0058
120			125	0.0049
	115	120	124	0.0049
140			105	0.0041
	150	150	104	0.0041
	170	170	89	0.0035
170			88	0.0035
		200	76	0.0300
200	200		74	0.0029
		240	66	0.0026
230			62	0.0024
	250		61	0.0024
270	270	300	53	0.0021
325			44	0.0017
	325		43	0.0017
400			37	0.0014

Grades

Grades of purity listed have been generally adapted to indicate the degree of quality and their primary uses.

Primary Standard - Reagents of special exceptional purity, for preparing standard solutions.

Reagent Grade - An analytical grade unexcelled for all general laboratory use.

ACS - Meets the requirements of the American Chemical Society Committee on Analytical Reagents.

CP - Chemically Pure grade, generally exceeding U.S. P. or N.F. requirements but of lower quality than Reagent Grade.

NF - A grade meeting the requirements of the National Formulary.

USP - Meets the requirements of the United States Pharmacopoeia.

Practical - Organic compounds of medium purity suitable for many laboratory applications.

Purified - A grade of higher quality than technical, often used where there are no official standards.

Technical - A grade suitable for general industrial use.

Table of Units

Unit (Full Name)	Value in SI Units
atm (Atmosphere)	101325 kg/m*s2 (N/m2)
bbl (Barrel)	0,158987294928 m3
c (Speed of light)	299792458 m/s
ct (Carat)	0,0002 kg
ft (International foot)	0,3048 m
g (Gram)	0,001 kg
gal (US gallon)	0,003785411784 m3
ha (Hectare)	10000 m2
hp (Horsepower)	745,699871582 kg*m2/s3 (W)
in (Inch)	0,0254 m
kip (Kilopound-force)	4448,22161526 kg*m/s2 (N)
knot (Nautical miles per hour)	0,54444444444 m/s
lb (Avoirdupois pound)	0,45359237 kg
mi (International mile)	1609,344 m
N (Newton)	1 kg*m/s2
oz (Ounce)	0,028349523125 kg
Pa (Pascal)	1 kg/m*s2 (N/m2)
psi (Pounds per square inch)	6894,75729317 kg/m*s2 (N/m2)
ToBeContiniued	What did I forgot?