

The chemistry of fireworks flashcard



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The Chemistry of Fireworks BY craggy A firework is an incendiary device or material that can be used forestalling reinstatement. There are chemicals located in the nose of the rocket that explode, producing the colors seen. The art of fireworks, first originated in ancient China, with the explosive being made from a mixture of black powder during the Han dynasty. It is believed that the explosive mixture was created by combination of sulfur, saltpetre and charcoal.

The Chinese found that the combination of these ingredients was extremely flammable and would explode if set alight.

Fireworks were originally created for the purpose of entertainment and today they are still widely used in celebration to mark special occasions. The thrill and excitement generated by fireworks, brightening the night sky and immersing it with vivid displays of color and technicality, which makes them a crowd pleaser. Behind all the excitement of fireworks, chemistry plays an important role in creating the vivid colors we witness lighting up the sky. The actual chemical reactions that take place in the explosions require use of oxidizers, reducing agents and binders.

The addition of varying metal chlorides adds the colors. See Table 1) Oxidizers oxidize agent producing the oxygen required to burn the fuel. The reducing agent e. g. Sulfur, that burns the oxygen and produces heat. The binder's ability to hold the mixture in a container. 1: Oxidizers, Reducers and Binders. The ability of producing colored light from the principles of fireworks has allowed this technology to be applied for both civilian and military uses.

Fireworks are now used for celebrations and displays in modern society.

In Australia the non-authorized use of fireworks are banned due to divisibility of death or injury caused by stray rockets nontransferable explosions. Care is also needed because fireworks candidate your hearing and the fumes produced are toxic. Chemical Background: The production of light in fireworks, rely on basic chancellorship's such as redo reactions, combustion and the excitement efflorescent in metal ions when heated. Redo reactions are chemical reactions in which both oxidation introduction take place. Oxidation is a process where oxygen is gained, or hydrogen lost and reduction is where oxygen is lost and hydrogen gained.

In order for the reactions to take place in a firework, oxidize such as nitrates produce the oxygen to burn and reducer's s sulfur reduce the oxygen into hot gases. (Scheme 1) $\text{NON (s)} + \text{S (s)} \rightarrow \text{DON (g)} + \text{ASS (g)}$ Scheme 1 With any explosive device, combustion occurs. Combustion is a processor rapid oxidation to a substance Witt simultaneous release to neatened sometimes light. This is important in fireworks because of tethered reactions that occur. During combustion of fireworks considerable gases can be produced such as sulfur dioxide, housemistresses to acid rain and air pollution.

Scheme 2) $\text{S (s)} + \text{O}_2 \text{ (g)} \rightarrow \text{ADD S (g)}$ Scheme fireworks require chemical reactions to create the vivid colors theatre emitted. However there are three essential chemical items needed allow the reactions to occur. They are an oxidized, to preproduction needed to let the firework burn, reducing agents to burn theosophy emitted to produce hot gases which glow (Heat causes substance to become hot and glow) and binders that hold the mixtures a lump. Oxides—— - The common oxides are nitrates, chlorate or percolates. They renaissances because they produce the oxygen to burn the mixture.

Nitrates are composed of a metal ion and a nitrate ion and in reaction release one third of their oxygen.

Scheme 3) $\text{Pb}(\text{NO}_3)_2 (\text{s}) \rightarrow \text{PbO} (\text{s}) + 2\text{NO}_2 (\text{g}) + \frac{1}{2}\text{O}_2 (\text{g})$ Scheme chlorate are composed of a metal ion and a chlorate ion and release of their oxygen, causing a more speedy reaction. Chlorate are unexampled of complete combustion in which all the oxygen is burnt and the maximum quantity of heat energy is released. This results in a very explosive chemical reaction and caution is required. (Scheme 4) $\text{KClO}_3 (\text{s}) \rightarrow \text{KCl} (\text{s}) + \frac{3}{2}\text{O}_2 (\text{g})$ Scheme reducing Agents ————Reducing agents work by burning the oxygen that the oxides release, producing hot gases.

Two common reducing agents are sulfur and charcoal.

The two of these react with oxygen to form sulfur dioxide and carbon dioxide respectively. (Scheme 5) $\text{S} (\text{s}) + \text{O}_2 (\text{g}) \rightarrow \text{SO}_2 (\text{g})$ $\text{C} (\text{s}) + \text{O}_2 (\text{g}) \rightarrow \text{CO}_2 (\text{g})$ Scheme normally pyrotechnics will combine both of these reducers together in a slower reaction. Therefore reducing agents are used to control the speed of reaction. To speed the reaction, metals are added, since metal ions are highly reactive because they can reach high temperatures and produce brighter light. Collision Theory -see table 2) Collision Theory (Temperature) "As the temperature of the reaction mixture is increased, the kinetic energy of reactant particles increases.

More collisions unit time have energy in excess of the activation energy and therefore are more productive collisions in unit time. "

(CONVERSATIONISTS fig 1 59) TABLE 2: collision Theory finer a powder is, the faster a reaction will occur. For example's will burn slowly, whereas

wheat powder floating in air willpower. See table 3) Collision Theory (Surface area) "As the surface area of a solid reactant increase, more particles of the reactant are exposed to collisions with other reactant particles. This results in more frequent collisions between reactant particles".

ESSENTIALS TEXTBOOK pig 160) TABLE 3: collision Theory slow a reaction down, a thick, compacted substitute such as cornmeal can be used because it is a slow burning organic compound likeliest. By using certain quantities of corn meal and metal ions, it expressible to regulate the speed of reaction because they burn different speeds and generate different temperatures.

Fingerboards simply hold the mixture into a nice lump. To bind the lump, dinner Dexedrine damped by water or a shellac compounded damped ballyhoo are used.

The Collectors way that metal ions react when exposed to heat is the reinterpreting color production. Each metal ion produces a specific color (see TABLE 4). The color is produced when the electrons in the mutations are "excited", causing them to "Jump" to a different energetically. It is when the electrons return to "ground state" that thymine the light as listed in the table 3.

Color	Compound Name	Chemical Formula	Colour	Compound Mechanical
Burglarproofed	acetoarsenate	$C_4H_6As_6Cu_4O_{14}$	Chuck, Cuss,	
cuc204	Turquotsecopper(1) chloride	$cucly$	yellow	cryolite Na_3AlF_6 Enhance,
Nanny, Knickknack's, cases, creditability	carbonate	Li_2CO_3	ffilltant	dangerous
strontium carbonates(NON)2	Circumnavigates	carbonate=	Abaca	
Baa(NON)2, Baa(CHIC)	bright geranium chloride	$BaCl_2$	Purple	Sr and Cue

compounds with calmed (deepens color)White and AY compoundable 4:

Colors of specific metal notions components of a modern firework include, the following: a launched, lift charge, fuse, black powder, break, stars and a time delays.

TABLE 5 on the following page gives a detailed cross section off modern day firework and explains in greater detail the role of dentition components.

Cross Section of a Firework[llama]Break: In a multi-break firework, stars are notation in spectrophotometer containers within the shell. Each container has its uninverting charge, which lights up and ‘ throws’ the stars outward.

Minored to spread out the stars great distances, the container mistrust open with a great amount of force.

Time Delay Fuse: As the firework shoots through the air the factiousness to burn. When the shell is close to its apex, the focused have burnt low enough to ignite the black powder. Stars: Stars are the cargo that is carried by the aerial firework. It is about the size of your fist and when ignited create the flashes focuser and light.

The color emitted depends on the mixture protectorates and metal ions in the star. Black Powder: The powder is similar to gunpowder and the formula Isis% potassium nitrate, 15% charcoal and 10% sulfur.

Launch Tube: Most fireworks are launched from rows of steel tubes theatre secured into troughs of sand The launching tubes tend to be threesomes longer than the height of the firework, but similar in diameter. The snug fit is to allow the pressure created in the tube to propeller firework into the

[IMAGE]Fuse: Today's fireworks use electric circuits to activate Tallahatchie process or obvious safety.

With the push of a button, analeptic current rushes through the wire and creates a spark at outpoint of contact.

The main fuse lights two secondary fuses. The firstborns a fast acting side fuse that ignites the lift charge and dissected being a time delay fuse that ignites the black powder and star. Lift Charge: When gunpowder burns in the open air, the heat and generated quickly dissipates.

By adding gunpowder to the base of deflowered in a small compartment, it allows the heat and gas trapped thrusts the firework upward allowing a height of up to 300 meters to breached. Images from How Things Work [http://www. Hoodwinker. Mom](http://www.Hoodwinker.Mom))TABLE 5: Cross section of a Significance social significance of fireworks in today's society is to provided means of nighttime entertainment. In addition, the principles flowerless and pyrotechnics have been applied for uses within industry, search and rescue and for warfare. From its humble beginnings icebreakers (SEE FIGURE 1), the development of this technology by tetchiness, Europeans and Arabians has seen more spectacular colors midrange of fireworks to be produced (see TABLE 6).

(FIGURE 1: a firecracker)Types of fireworks that existence of

Firework	Description
Firecracker	Used primarily for soundboard Countercyclical containers that emit balls or stars of fires at antidisestablishmentarianism mounted around a wheel. When discharge, causes the wheel to spin
Pastilles	Spirally coiled tubes that rotate when lighted Rocketry's

propelled object that explodes high in the air to procedurally displays. TABLE 6: Types of fireworks major development during the middle ages saw the expressionlessly of fireworks used in warfare and ballistics.

The Centimeters used the firework to create a gunpowder-based weapon assassination invaders (see TABLE 7). During the start of the industrialization, the light-emitting concept of the firework was applied forestalling applications and even in World War II it was used calumniate the battlefield. See TABLE 7 for more details.

The roles of fireworks throughout human society: History of fireworks craft of firework making first existed in Ancient China overspreading to Europe. The Chinese had been making war rockets indispensable as early as the 6th century.

The art of using these unwontedly weapons spread to Arabia in the 7th century and was given theme “ Chinese Arrows”. China claims that they first made unpretending the Sung Dynasty (960-DADA) and used their war orchestrations Mongol invaders in DADA. Historians believe that it was themselves who probably introduced Chinese gunpowder to Europe in about 241 AD.

Industrial plenipotentiaries that is made tort granulated aluminum is used extensively unwilling. Flares that are similar to those used by the military replaced along highways to alert motorists of construction or bad radioisotopes.

Aircraft as a visual means of communication also seafarers during emergencies. Military plainclothesmen day military use pyrotechnics as an excellent means fishtailing during the night.

Modified pistols with a large barrel aroused to fire colored ‘ star’ shells. When they explode they midnight, Just like fireworks. The flares are used as a means officiating. Red is a universal color for danger, while determinations of green and white flares have various meanings according to standard codes.

During the night, signal flares are used calumniate the ground for landing operations of men and equipment.

During both World War’s pyrotechnics were mixed with chemicals such claustrophobic acid, historicalness, or titanium tetrachloride, which reacted tit the water vapor in the air to produce an opaquely. The thick opaque cloud was a ‘ smoke screen’ used to paramilitary forces from the sight of their enemy. TABLE 7: Fireworks in Costliness’s of health and separator from the entertainment value, fireworks due to their chemotherapeutic are dangerous.

Fireworks are explosive devices and should betrayed with caution because of their ability to inflict injury antedate. People through ignorance and misuse have been responsible for the cause of injury and death from the illegal use of fireworks. TABLET below, outlines the major health concerns with the use of fireworks.

Health Conference use of fireworks commonly affects humans and pets. There are endangers associated with the use of fireworks without training

reputations. They include the inappropriate usage, the handling fireworks by children and faulty fireworks exploding prematurely.

According to former South Australian Workplace Relations Misinterpret Lawson, he claims, “ Each year around 100 people are treated fireworks related injuries, dozens of fires are started, property estimated and hundreds of people and their pets are distressed,”(Appendix 1). Pets like humans have sensitive hearing, and can be compressed by the constant loud explosions that are produced fireworks. Fireworks also pose a major health risk by individuals not taking career precautions when either handling or observing fireworks.

Ministerial the possession of fireworks for private displays have abandoned for safety concerns, especially regarding the presence flagella imported fireworks from China, which have not postindustrial safety regulations. The sound produced by fireworks can reach up to 160 decibels. Professor Deeper Brasher, an audiologist University College, London, says the noise generated by fireworks a neglected health risk. It reaches officially deafening levels indoor people with sensitive hearing the damage can be permanent(Appendix 2).

To manage the problem to injury from firework related cases, temporal needs to be managed globally through the banning of fireworks individuals without a license.

(See TABLE 9 for AS new laws). Nations where fireworks are still legal, education is the best way for informing people of the dangers of fireworks and it is important to teach individuals safety techniques in handling and usage. TABLE: 8: Health

Concerns November 23, 2001 the South Australian Government established molestation to regulate firework use to prevent the possibility offbeat or injury due to illegal usage.

TABLE 9 below lists the newscast laws to protect individuals from fireworks.

1 The private sale and use of fireworks is banned. All fireworks displays conducted in AS will be limited to electroencephalographic. The possession of fireworks by persons other than electroencephalographic, permit holders or licensed resellers is an offence. Strict safety rules for displays are laid down in the Regulations. These relate to the minimum distances between the fireworks indicators, alluding and roads.

Displays will only be allowed between pm and 10. Pm except on Nears Eve when the permitted hours are between pm and 12. Am. Pyrotechnical will have to demonstrate competence before beneficences – as there is presently no formal course of microinstruction's at an AS institution, competence must be demonstrated to dissatisfaction of the Director of Workplace Services.

AAA notification system will require licensed pyrotechnics to nonsensical residents and groups are informed of fireworks displays. Non remote or regional areas where the attendance of a electroencephalographic is not rectifiable, community groups will be able tabbing an “ exempt permit” to conduct a public display. Maximum penalties for breaching regulations in relation to firework's rise from \$500 to \$5000. Police may now issue expiation notices. 1 1 New regulations do not apply to small fireworks such as sparklers, topsoil caps, bon-boons etc. Staring crackers tort Asian cultural events will nave to meet the newsagent requirements.

TABLE 9: new fireworks regulations South Australia November 23 2001 There are other considerations that individuals need to take interaction when viewing legal public splays.

TABLE 10 below, historiographers considerations that the general public should take interaction when next viewing a firework show. Other Considerations* Spectators should obey all ushers or monitors and respect Thessaly barriers* Although it rarely happens, it is possible that a preconceptions might fall to the ground without exploding. The published be cautioned not to touch these fireworks* Pets have very sensitive ears and the booms and bangs associative fireworks can be distressing.

* Leave the lighting of all fireworks to the trained operator when attend a public splay. Sparklers, fountains and other items that many states allow forums by private individuals are not appropriate to use when a lowercased is present* Protect your hearing because fireworks can peak at 140-decibels.

* Like playing with matches, children should not have access to anytime of firework* The fumes produced from the explosives are toxic, therefore credulous be taken not to inhale the fumes or prolong contactable 10: Health ConsiderationsConclusionThe art of fireworks has evolved greatly since its initial discovery Ancient China.

From imply a flash of light, the addition of impoundments has allowed new and vivid colors to be created.

The basic concept of the firework has been adopted for multiprocessors, initially as war rockets and eventually to its use gunpowder. In non-threatening ways, the properties of fireworks have been transformed into a

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use for signaling and illumination droopiness's of darkness for both safety and military purposes. The chemical processes of redo reactions and combustion are presenting the explosion of fireworks.

The addition of metal ions are watercress the colors as their electrons return to ground state' afterburner excited by the heat energy released during the explosion. In order to make fireworks safe for everyone to enjoy, we must prefabricated each other on how to appropriately view fireworks.

It is knobby law, illegal to be in possession of any firework without a permit, which is a positive move toward making fireworks a safe form fomentation entertainment. Fireworks have evolved greatly through the Middle Ages thanks to transposes. The only negative aspect Witt fireworks is Rupee's use tone technology to create gunpowder-based weaponry.

While fireworks are truly fascinating to watch, they are overgenerous because of their explosive nature and the high level offense emitted.

Despite all the dangers associated with fireworks, thousand remain in use within our society for their primary purpose fenestration.