



The Chemistry of Explosions

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When we hear the word "explosion", we think of fireballs, destruction, loud noises, etc. but that just scratches the surface of what an explosion really is. According to J. Reed, "An explosion is a sudden, violent conversion of potential energy into work, which transfers to its surroundings in the form of a rapid rise in pressure called a blast wave or shockwave. The shockwave can cause substantial damage".

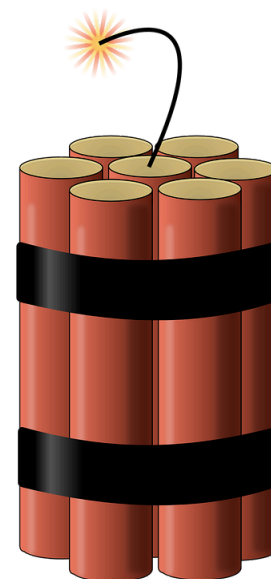


To understand a bit more about explosions we must establish two main features of explosions:

1. They are exothermic and self-sustaining meaning they release a lot of heat and will keep going until all the fuel has been used.
2. They release a considerable amount of gas very rapidly, which applies pressure on its surrounds leading to a shockwave.

Brief history

Human beings have been using explosives for a very long time. The earliest use of explosives can be traced back to China and the invention of gunpowder, which is a mixture of potassium nitrate, charcoal, and sulfur. However, this explosive produces copious amounts of smoke in the process, making it an inherently messy explosive. By the 1840s, two promising smokeless chemicals were discovered: nitroglycerin and nitrocellulose. Henry Broconnot, in 1833, used cotton treated with nitric acid to produce what is known as "guncotton". However, it was not until 1846 that two chemists, Christian Friedrich Schonbein and F. J. Otto, independently optimized the creation of nitrocellulose by placing the cotton into a mixture of nitric acid and sulfuric acid. Nitrocellulose was highly unstable making it impractical for use. So, it was not until 1867 when Alfred Nobel (the man who created the Nobel Prize) discovered dynamite while he was looking for a way to make nitroglycerin more stable and less prone to spontaneously exploding. By combining nitroglycerin with diatomaceous earth (ground-up shells of microscopic diatoms) and sodium carbonate, he was able to synthesize dynamite, which was considerably less dangerous.



How explosions works

As we have seen, an explosion is the release of an incredible amount of energy in a short time; but, where does this energy come from? This energy is called "potential energy" as it's the energy stored before an explosion occurs; it could be: nuclear, chemical, or physical.

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- **Physical Explosion:** A physical explosion is one where no chemical or nuclear reaction occurs. The most frequent example is the rupture of a vessel or container whose contents, either gas or liquid, are under high pressure. If the containing vessel bursts, its contents are free to expand and a shockwave is formed.



Current Applications

Humans have taken advantage of explosions in both positive and negative ways. They can be used positively such as in construction purposes (i.e. building roads, tunnels and mining), entertainment (i.e. fireworks) and even cars create a little explosion to move the pistons of their motor in order to create the power that moves the vehicle. Humans have also used explosives



as a means of war through military weapons. These weapons are so powerful that if used together, they could potentially destroy much of humanity.

The environmental impact

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The future

The evolution of the explosive responds to the needs of humans. As we have seen, explosives are made from a wide variety of compounds and there's a lot more to discover. Nowadays, there are millions of companies working and studying different reaction mechanisms to create better, stronger and more effective explosions to meet the needs of the market. To give you an idea of how far we've come, the nuclear bomb that was dropped on Hiroshima in 1945 and effectively ended World War 2, was the equivalent to 15 kilotons of TNT. Compare that to the bombs of today which have the destructive power of 50,000,000 tons of TNT!



Reading Comprehension Questions:

1. What
2. Who
3. Why is gunpowder not an effective explosive?
4. Why was nitrocellulose not a practice explosive?
5. Who
6. What is potential energy?
7. What is a
8. What is the difference between a chemical and physical reaction?
9. How
10. What are the immediate effects of nuclear explosions?
11. How much more powerful
12. Do you think the positive aspects of explosives outweigh their potentially devastating effects?
Explain.

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