

In search of a safer, greener firework

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Fireworks are often the centrepiece of major religious, cultural and sporting events, but they can be the cause of air pollution and the fireworks industry is one of the most hazardous to work in. However, research is underway to find a safer and greener firework.

In 2013, there were eight reported accidents in firework factories worldwide including China (3), India (2), Italy, Canada and Vietnam killing at least 48 people and injuring over a hundred. The worst incident in Northern Vietnam's Phú Thọ Province killed 26 people and damaged an estimated 1,300 households in a three kilometre blast radius.

Fireworks are also a significant cause of short-term, localised [air pollution](#) consisting of [sulfur dioxide](#) and fine particles of potentially toxic metallic elements such as potassium, magnesium, barium, copper and aluminium. The particles are small enough to be taken into the lungs and can cause breathing difficulties and aggravate lung disease.

Studies have shown that [fireworks](#) displays at festivals like Diwali can increase air pollutants by nearly six times and the Lantern Festival in China by a similar level. Another study in Eastern Spain (mascletàs) has recorded increases of firework generated fine particle pollutants in excess of 100 times normal levels.

However, researchers are beginning to find new ways to reduce the environmental impact of fireworks without affecting their performance, especially the sound they make.

The solution is to reduce the [particle size](#) of the chemicals in the firework. Researchers have found that fireworks made from the smaller nanoparticles require a reduced amount of chemicals to achieve the same performance. The result is less pollution.

Tests involving 'cake bombs' or 'repeaters' – one of most popular fireworks after 'sparklers' and 'firecrackers' – made from nanoparticles required just a quarter of the powder used in traditionally made fireworks. Other tests, involving firecrackers, have resulted in [sulfur dioxide emissions](#) being reduced by 61 per cent.

David Brown, chief executive of the Institution of Chemical Engineers (IChemE), said: "Fireworks are enjoyed all across the world, but it is easy to forget the hazardous nature of their production and the impact they can have on the environment, and on health and wellbeing.

"This new approach to the manufacture of fireworks using nanoparticles has some important advantages for the environment. But there are risks too for an industry which has a poor record for safety.

"Chemical engineers are well aware of the dangers of using chemicals with very small particle sizes. They are particularly explosive and fireworks made from [nanoparticles](#) carry an even greater risk.

"More research is needed to identify safer methods of production in the fireworks industry, as well as higher standards of process safety."

More information: "High-time resolution and size-segregated elemental composition in high-intensity pyrotechnic exposures." Javier Crespoa, Eduardo Yuberoa, Jose F. Nicolása, Franco Lucarelli, Silvia Navab, Massimo Chiarib, Giulia Calzolaib. *Journal of Hazardous Materials*.

"Impact of Nano Particles on Safety and Environment for Fireworks Chemicals." Azhagurajan, A., .Selvakumar, N. *Process Safety and Environment Protection* (2014). [dx.doi.org/10.1016/j.psep.2013.12.007](https://doi.org/10.1016/j.psep.2013.12.007)

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