Prototype technology for unearthing minefields with fire developed by team

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Only 5,000 landmines out of the original 20,000 anti-personnel and 5,000 anti-tank landmines have been cleared in the Falkland Islands. Credit: Imperial College London

Engineers have developed prototype technology that uses controlled burning to partially reveal landmines buried in peat soil.

The researchers from Imperial College London have developed

technology called O-Revealer that ignites peat, causing a smouldering fire that strips the upper layer of soil to reveal the landmines – making it easier to dispose of them.

The O-Revealer technology consists of an electric power source and a heating coil that is inserted into the top layer of peat. When switched on it slowly heats the peat to 500 degrees Celsius, which ignites it causing a smouldering fire, which is a flameless combustion process, with smoke as the only visible sign that the fire is occurring.

The researchers have so far successfully tested the device in the lab with dummy landmines that were buried in peat soil. They used a fan to simulate wind conditions, which affect the intensity and direction of a smouldering fire, and showed how they could partially unearth the buried landmines.

The engineers who wrote the study, published in the journal *Experimental Thermal and Fluid Science*, have also shown the areas in the world where O-Revealer may be of most benefit. They did this by cross-referencing world maps of minefields with maps of peat lands. Areas most likely to benefit from O-Revealer technology include the Falkland Islands, Vietnam, Burma, Laos, Uganda, Zimbabwe and former Yugoslavia.

Dr Guillermo Rein, the lead author from the Department of Mechanical Engineering at Imperial, said: "The insidious threat of landmines and their impact on people is well documented around the world. However, the technical and safety challenges in removing these minefields are huge. Even a rich and technologically advanced country such as the UK faces challenges.

"The British Government, for example, had a legal responsibility to remove landmines from the Falkland Islands by 2009, but due to the

slow rate and high costs of conventional mine removal techniques they've had to request a ten-year extension to their programme."

The landmine problem worldwide is rising. It is estimated that two to five million landmines are laid every year. Globally, blast injuries caused by landmines currently exceed 26,000 people per year.

However, the clearance of these minefields is ten times slower than the rate at which they are laid, for example, more than 30 years since the 1982 war between Argentina and the United Kingdom only 5,000 landmines out of the original 20,000 anti-personnel and 5,000 anti-tank landmines have been cleared in the Falkland Islands.

"That is why a study like ours is important as we need to find quicker and safer methods for revealing landmines so that they can be removed," added Dr Rein.

The O-Revealer is based on the controlled use of smouldering combustion. This is the low-temperature, flameless burning of porous fuels. Peat is combustible and prone to smouldering fires. There is a body of scientific literature on the ignition and spread of smouldering fires in peat lands, but this knowledge has not been used before in mine clearance.

In the lab, the Imperial team replicated two of the most common types of landmines – the Italian SB-33 (widely used in the Falklands) and the Serbian PROM-1 (used widely worldwide) – and buried them in peat as part of the tests.

Minimal environmental impact

In terms of the potential environmental impact of burning peat, the team say that they method would be carefully controlled if used in the field.

The smouldering fires would be very small. The researchers also say the impact would be minimised by choosing at what time of the year they burn peat.

The next steps will see the team trialling the technology in the field. They will first work at a military test site and then the team would like to trial the technology in the Falkland Islands, working with bomb disposal de-mining teams. They predict that the O-Revealer is around five years from being used in the field.

More information: Guillermo Rein et al. Detection of landmines in peat soils by controlled smouldering combustion: Experimental proof of concept of O-Revealer, *Experimental Thermal and Fluid Science* (2017). DOI: 10.1016/j.expthermflusci.2017.07.016

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