Depleted uranium

Origin, uses, releases, concerns

by Barry Smith

“ when used in military conflict or testing, depleted uranium can become widely dispersed, resulting in an increased potential risk to the environment and human health ”

Depleted uranium (DU), which is less radioactive than naturally occurring uranium, has been produced in large quantities as a by-product of nuclear fuel production. It has been stockpiled by the nuclear fuel industry who have, in conjunction with other industries, sought to find useful end products for this material.

How is DU used?

Initially it was felt that DU could be used in fast breeder reactors to produce other fissile elements such as plutonium. These could then be used to increase feedstocks for the continued production of nuclear power given a potential shortage of natural uranium ore and the envisaged worldwide proliferation of nuclear power. Despite the successful demonstration of such processes, the expected proliferation of nuclear energy has not happened and, at the same time, larger reserves of uranium ore have become available. The use of DU by the nuclear industry has therefore been restricted to its use as a shielding agent, which utilises its high mass density (approximately twice that of lead) and relatively low level of radioactivity, in fuel canisters, shipping containers for radioactive sources, and as collimators in certain types of equipment used in nuclear medicine. Outside the nuclear industry the high density and metallurgical properties of DU have encouraged its use as a counterweight in aircraft, and in both an offensive and defensive capacity in warfare.

It is in this latter use that DU, when alloyed with a small amount of titanium, has been most widely brought to the attention of the public. Such materials were developed during the 1970s (although armour-piercing uranium-based munitions were trialled by Germany during the Second World War) and their first reported major use under battlefield conditions was in the first Gulf War, Balkans conflict and, most recently, in the second Gulf War. It is now believed that more than twenty countries possess DU weapons systems and these include both small bore (typically around 30mm) and large bore (100 to 130mm) ammunition. The small bore systems are typically deployed in ground-attack aircraft while the latter are restricted to land-based tanks and artillery. DU can be used as a component in highly protective tank armour, but its wide-scale use in this capacity has yet to gain international acceptance because its weight affects performance. In the manufacturing processes and during deployment, controls are such that the risks from DU to the workforce or military personnel

Testing of the UK’s DU munitions has taken place for more than ten years at the Eskmeals and Dundrennan (Kirkcudbright) firing ranges. Understanding the corrosion and fate of DU ammunition used at these sites is a key factor in assessing risk at these sites.

are minimised. However, when used in military conflict or testing, DU can become more widely dispersed resulting in an increased potential risk to the environment and human health.

What are the risks associated with the use of depleted uranium?

Like many heavy metals, the toxicity of uranium to humans and, to a more limited extent, animals has been widely studied. However, unlike metals such as cadmium, exposure to uranium may also result in health effects due to the presence of its inherent radioactivity. In both cases exposure must occur to the receptor under study (for example, a human or an ecosystem) before any resultant risk may be quantified. Because of this, it is important to understand scenarios in which exposure to DU may occur and the form and magnitude of the exposure pathways likely to be involved.

For example, in the case of military conflicts, the most likely exposure routes are to those actually present in the immediate vicinity of a projectile strike. Obviously such people also face the immediate risks associated with the kinetic impact of the weapon and any resulting fires or explosions. Apart from such extreme situations, those likely to be exposed include rescue workers and field staff associated with the clean-up and decommissioning of vehicles and sites attacked by DU weapons, and any local members of the population re-entering the war zone. In all such cases the main potential exposure routes are related to the inhalation or ingestion of uranium-rich dusts produced by the projectiles' impact. On a longer timescale (tens to thousands of years) uranium from such dusts or fragments of projectiles may become locally dispersed into the environment and, as a result, contaminate foodstuffs, dusts through which children and adults may be exposed via deliberate or inadvertent ingestion, and drinking waters. The magnitude of any such contamination depends largely upon the intensity of the military action and the amount of dust produced from each impacted projectile, which is a function of the hardness of the impacted material and the energy of impact.

Consequently, both earth and environmental sciences have an important role to play in improving our understanding of the risks associated with DU through the development of appropriate validated mechanistic and empirical models describing its initial interactions, transport and fate.

Understanding the extent of environmental contamination associated with DU munitions is a key factor in assessing risks to human health and the local environment. We were able to assist in this by undertaking chemical, isotopic and microscopic analysis of samples collected from the vicinity of Iraqi tanks suspected of being disabled with DU munitions during the last Gulf War.

Current and future work

Over the past five years we have been involved in a wide range of practical and theoretically based studies investigating the fate and risks associated with DU. These have included: support for the production and publication of detailed reviews by the Royal Society and World Health Organisation; analytical support to the Ministry of Defence in assessing potential environmental exposures to DU in Kosovo, Bosnia and Iraq through the use of X-ray fluorescence spectroscopy; inductively coupled plasma mass spectrometry and electron microscopy; field and laboratory support in improving our understanding of corrosion and fate of DU munitions at the Kirkcudbright and Eskmeals firing ranges; and the high-resolution low-level measurement of DU in urine from potentially exposed individuals. Future work will continue to focus on these areas of geoscience with the aim of providing a firm basis for estimating environmental and human exposures to DU. ▮

> “ the magnitude of any contamination depends largely upon the intensity of the military action and the amount of dust produced from each impacted projectile ”

For further information, contact:

Barry Smith
Tel: +44(0)115 936 3423
e-mail: bsmi@bgs.ac.uk