Journal of Conventional Weapons Destruction

Volume 8
Issue 2 *The Journal of Mine Action*

Article 47

November 2004

Machines Can Get the Job Done Faster

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The Geneva International Centre for Humanitarian Demining (GICHD) published *A Study of Mechanical Application in Demining* in June 2004. The study looked at the most suitable roles for machines in demining, examined the potential for machines to be considered a primary clearance tool, explained factors involved in protecting operators and presented a software model to help programme managers understand the cost-effectiveness of their mechanical assets. In 2005, the GICHD plans to release six more sub-studies related to mechanical demining. The following article explains some aspects of the operational tasks where machines are currently employed.

Manual demining is the backbone of the mine clearance industry, but it is very slow and laborious. A significant amount of time, effort and money goes into the search for the ultimate solution to make demining faster. Ultimately, most of these solutions are aimed at supporting manual deminers by reducing suspect areas to areas where mines actually are, speeding up the process of detecting them or destroying mines individually once they have been located. Brilliant minds have been working on a multitude of possible solutions—training bees or utilizing bio-detection to indicate the presence of explosive molecules. New advances in ground-penetrating radar, ultra-sonic vibration, kinematic magnetic induction systems, and other high-tech, sub-surface detection systems are continually being made. The science of vapour sampling is also used widely, and much research is invested into the safe destruction of individual mines in situ using lasers or deflagration devices.

All of these methods are ingenious. But few of these prototype systems are ready to be immediately deployed to minefields. Of those that are ready, extensive knowledge and training is required to make them work. Others might be effective but are unable to withstand the rigours of life in the field. However, there are already demining systems that greatly enhance performance. Some can defeat all the major obstacles facing a manual deminer. Many of them have been on the scene for years and are continually improving. They are reasonably robust, and after comparatively little training, they can be used by personnel with even the most basic education. These are demining machines.

by A. Griffiths, *GICHD*

The Use of Demining Machines

Machines have been employed in mine clearance since the early 1990s. The "big idea" about using machines to clear mines was the hope that they could carry out full clearance independently. For a variety of reasons, this has not been achieved. Machines are mainly used in a supporting role—to prepare ground for subsequent manual, mine-detecting dog (MDD), or combined manual/MDD clearance. They are also effective for area reduction, as part of the technical survey process. Some programmes have used mechanical systems for post-clearance confirmation—a type of quality assurance (QA)/quality control (QC) role. Where information on suspected hazardous areas is scarce, machines can be used for reconnaissance; a few sweeps of a suspect area can reveal the presence of a hazardous ordnance. Even the specific type of threat posed can be revealed. These alternative uses have not diminished the aim of developing a machine and a methodology that could realise the initial goal: machines as a primary clearance tool supported by other assets.

The most common types of purpose-built mechanical demining systems are flails and tillers. Anti-mine rollers are also widely used. Commercially available earthmovers have also been adapted with the application of protective armour plating. Excavation is the only mechanical clearance method that can be said to perform primary clearance to International Mine Action Standards (IMAS) (at least down to the depth indicated by the operator). Suspected hazardous areas treated in this way are rendered clear of all ordnance—the soil and any mines/UXO within it are removed to a new location for inspection. The situation is not so clear-cut with tillers and flails. These operate by delivering a violent impact to the ground. Ordnance is detonated or smashed by the thrashing of chain links or the grinding of tiller bits. A successful result, however, is not guaranteed. Machines have been known to leave live ordnance unharmed. Results must be checked by at least one secondary method, which is normally considered the primary method when machines are not involved.

There are numerous models of flail and tiller. They encounter many different types of mines. There are almost infinite permutations and combinations of physical conditions—soil, topography, vegetation and climate—with which machines are expected to cope. Because of these factors, flails and tillers have achieved variable effectiveness as a demining tool. Flails and tillers often fail to completely destroy more robust UXO and AP fragmentation mines, although tripwires are usually ripped out and fuses are knocked off.

There are, however, numerous examples in which machines employed to prepare ground for manual clearance teams have, in effect, achieved full clearance. In areas proven by survey to contain mines, there are cases where no live mines have been found by post-machine clearance methods. This means that optimal conditions for mechanical clearance exist where a combination of the right machine against the right mine types and in the right soil can achieve a successful outcome—i.e., the complete destruction of AP blast mines. However, what these optimal conditions are needs to be understood well enough so that the result is predictable. For certain machine models, when working in a suitable environment, there is future scope to scale down post-machine clearance.

For example, this might take the form of a small team of manual deminers conducting a battle area clearance (BAC)-style movement across a machine-cleared area with metal detectors set to minimum sensitivity. Through empirical precedent acquired by their machine, such a team should have come to expect that only solid AP fragmentation mines or UXO (not including sub-munitions) might remain in a hazardous condition—the high metal content of which makes them easy to detect. Small, fragmented, but inert components of sub-surface AP mines will not be indicated, and might be left in situ. The overall pace of clearance could thus be much accelerated. Currently, this scenario is not practiced. Neither is it likely to be in the near future. Rightfully, the demining community has to be very careful about radical changes to established procedures. The level of detail in the recording of clearance data for mechanical operations does not presently support this. Further understanding of mechanical capabilities in varied conditions must first be acquired, but such a methodology should be a future goal.

Risk Assessments

Risk assessments are becoming standard conduct in industry. Risk assessments are implemented in order to better understand the possible risks of an undertaking so that action can be taken to prevent accidents or poor performance. Formal risk assessments are becoming more common within the demining industry. General Survey, and especially Technical Survey, could rightly be described as risk assessments. A Technical Survey requires a physical effort to confirm information about a suspected hazardous area—with the information having been acquired by General Survey. Most commonly, this would mean clearing manual survey lanes in a suspect area or using MDD teams to establish the presence of mines. The former method is very slow, and is very likely to miss mines, particularly when they are non-patterned, sporadically laid and widely disbursed. The use of MDDs for Technical Survey can expose the handler to unnecessary risk. Machines can gather or confirm information more quickly, with less risk to personnel. Typically, a medium (6–20 tonnes) or heavy (20 tonnes plus) flail can be expected to process 3,000–4,000 sq m per day (single sweep). As an information-gathering tool, machines are not required to guarantee destruction of mines or UXO. They can confirm general survey and therefore establish the presence of ordnance by detonation or fragmentation.

Obstacles to Demining Efficiency

One of the greatest obstacles to efficiency in demining is that most clearance activity is conducted in areas that are subsequently shown not to contain mines. In part, this is because the application of machines in Technical Survey is not common practice. The exact parameters of suspect hazardous areas are difficult to establish, particularly in non-patterned minefields. In order to avoid the risk of leaving ordnance in situ, larger areas than necessary are given over to full manual clearance. A key component of Technical Survey is area reduction. Area reduction can be performed by any demining method. However, machines can conduct area reduction operations faster than any other tool. Reducing the area of land receiving full manual clearance will dramatically increase the speed of overall operations. For manual teams to conduct area reduction, they must employ normal manual clearance drills on the area to be reduced. Often, the area of non-mined land cleared can be many times the area actually containing them. This practice is therefore inefficient. Where terrain allows, area reduction by machine, as part of Technical Survey, should become standard practice. Manual deminers are too valuable an asset to waste clearing large areas where mines are not present.

Deminers face an array of obstacles within their clearance lane. Each of these will cause the deminer's work to be slowed. Removing these leads to an increase in the deminer's efficiency. Usually, obstacles are overcome by the deminer himself: tripwires are disconnected, vegetation cut by hand, hardened soil excavated, and metal fragments detected and removed. The main job of mechanical systems in demining is area preparation. Area preparation is the removal of common obstacles in order to make the task of manual demining easier and faster. With little risk to personnel, and at greatly increased speed, machines prepare areas effectively by ripping out tripwires, cutting vegetation and turning over soil to make the job of investigating detector signals easier.

Where present, the most significant obstacle reducing a deminer's efficiency is the presence of metal fragments. From the time that a deminer first detects metal to the excavation of soil around the source of a detector signal and removal of the metal piece (or exposure of a mine), a significant amount of time has elapsed. In areas heavy with metal contamination, a deminer must investigate detector signals multiple times for each square metre cleared. Most machines penetrate soil, making it easier for deminers to excavate metal. Currently, only two mechanical systems remove metal fragments with an earth magnet as part of their operational methodology: the Pearson Engineering Survivable Demining Tractor and Tools (SDTT) and the Redbus Land Mine Disposal System (LMDS).

Tests were conducted using the SDTT in Cambodia. The object was to investigate how magnets could increase manual demining efficiency. The SDTT magnet was passed over lanes before soil was overturned, picking up surface metal. The lanes were then raked and the magnet passed over once more, in order to collect metal lying beneath the soil surface. The lanes were then manually cleared, and residual metal fragments collected and counted. Fragments collected by the magnet were also counted. Results of the tests showed that the magnet collected up to 89 percent of the metal fragments in the ground. The remaining pieces were collected by follow-on manual deminers. The SDTT magnet function increased manual demining efficiency by approximately 200 percent. The Thailand Mine Action Centre (TMAC) has experienced similar results. Where metal contamination in lanes is significant, the removal of metal fragments represents the biggest contribution to manual demining efficiency—it is superior to the removal of other common obstacles. The manufacturers of mechanical demining systems should investigate the addition of magnets to their machines.

Conclusion

Mechanical demining has many detractors. In some cases, particularly in the early phases of mine action, reservations about the effectiveness and reliability of mechanical systems were not unjustified. Early machines were often little more than derivatives of heavy military armoured vehicles. However, after 10 years of development and field experience, many of the initial problems have either been solved or their severity lessened. The search for technological solutions to help make demining less dangerous, more efficient and faster will continue. Machines are already making a significant contribution to this aim. Machines are reducing huge areas of suspect land so that manual deminers and MDD teams do not become mired in clearance tasks that prove unnecessary. They prepare ground by reducing the common obstacles facing deminers—one example increased the productivity of manual demining operations by over 2,000 percent. They convert technical survey operations that take months into an effort of a couple of weeks. Demining should be about reducing the extent of the world's mined areas in as short a term as possible. Machines are here to do just that. Deminers should seize the opportunity they afford.

References

1. "A Study of Mechanical Application in Demining," GICHD, 2004, p. 43.

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