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The MineWolf Toolbox System: Ground Preparation to Mine Clearance

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encourage the pig by saying "good boy, good job." "The pig wants to find the mine more than you do because he wants food," says Giva. "This was very difficult for me because I like to speak to the animal during training. But when I speak to Chavisa, she looks at me as if to say, 'What off? Don't speak. Let me do what I need to do.'"

In the first stage of training, every time the pig detects the scent of the explosive, she is rewarded with food. In the second phase of training, the pig must find the explosive with her nose—without seeing the explosive in grass. In the third stage, Giva buries the defined mine 10 cm under the ground and the pig is rewarded when she finds the mine, indicated by normal rooting behavior. Giva teaches the pig that when she finds the mine she must sit. This is difficult because it is not a natural response for pigs to sit. Sitting leaves the pig's belly exposed and finds the mine, indicated by normal rooting behavior. Giva is constantly learning something new about pigs.

One of the challenges that Giva has dealt with is the loss of three pigs. At this point, he is uncertain of the reason for the deaths. Present conditions are very good and clean. Each pig has a cage and they run in a large area that was used for horses in the past. Giva mentions that the pigs were not born in Israel—be it that perhaps the problems they have had are related to the location and difficulty acclimating. It is difficult to get pigs that are born and raised in Israel. Lahav and Kibbutz Mitzra, in the Yizrael Valley, are two of the few kibbutzim that have pigs.

The Future of Pigs as a Demining Tool

"Pigs are for the demining field," says Giva. "Pigs cannot take the job from the dogs in the airports because they are unannuric. Dogs are beautiful and clean. Also, dogs are good for detecting explosives that are above the ground." Pigs, like dogs, could be used for quality assurance in areas where there are industrial pipes and metal detectors cannot be used. Another option for their use is to detect mines with plastic and wood components. At present, machines and dogs are used for quality assurance; in the future pigs and machines may also be used. The value of pigs, like dogs, is that they do not need to search for landmines as do humans. Pigs have a lot of endurance because searching for mines is so closely parallel to their instinctual habits.

Giva is in the process of looking for foundations that are interested in his research. A lot of people who are interested in the business side of his research have contacted him and want to be involved in the project. With the publicity that his research is receiving, he is confident that people will help him. Giva, "In one day, TV stations in 60 countries publicized my research project." Presently, the Institute for Animal Studies at Kibbutz Lahav funds Giva's research. The kibbutz supplies the facility, the money and the advice needed to complete the research. "We don't need to get rich as a result of this project. This is a humanitarian project," says Giva. He mentions that the others who are working on the project, such as the vet, help with the research because they believe in it too. "They want to give something to the world. People like to help humanitarian causes."

The Future of Pigs in Israel

"This project is not for Israel," says Giva. "It is for places like Angola. Giva spoke with two officers in the Israeli army who are experts in the field of animal training. While they agreed that there is a future in Giva's research, they told him that his findings are "good for the world, not for Israel." Also, at this point, companies in Israel are looking for research that will help them improve suicide bombers."

"Also," says Giva, "fews don't like pigs. Even Jews who are not religious have a strong aversion to pigs." Many in Israel are nonreligious to Giva's research. He has even been told that he is stupid for working with pigs. Giva realizes that it is a natural human response to doubt and that it is difficult to convince others to give something so new a chance. He is confident that those who sell him that his project is doomed will eventually support his research. Giva cites his father as an example. "He doubted my research at the beginning. He felt that nothing would happen," says Giva. "But, as the months pass, he is becoming more and more interested in what I am doing. When I began my research, he would ask me questions about my research at the end of the conversation. Now the questions come at the beginning."

Giva remains true to the idea of pigs being used for explosive detection in Israel. He can see where pigs could be useful, for example, with the search for mines on the border with Lebanon. He mentions that the Jewish religion is not against touching pigs or looking at pigs—only against eating pigs. "I believe that even God likes my idea," says Giva, "because I am using the pig for a good reason. Maybe in the future, after pigs have been used successfully in other regions, or after research confirms that pigs can be used for demining, Israelis will accept them for use on their own land."

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The MineWolf Toolbox System: Ground Preparation to Mine Clearance

The MineWolf Toolbox System, which operates in minefields near Sarajevo, is a mine clearance device that has been used to improve efficiency and effectiveness in demining operations. This article discusses the benefits of the MineWolf Toolbox System and compares it to other demining machines and technology currently used to clear minefields.

by Heinz Rath, Project Manager, STS

Introduction

MineWolf is a joint German-Swiss mine clearance concept developed through the collaboration of an industrial machinery manufacturer based in Herborn, Germany (the AHFW), RUAG Land Systems, based in Thun, Switzerland, and the Safety Technology Systems (STS) in Germany. In our detailed discussions with the Mine Action Centre (MAC) in Bosnia and Herzegovina (BiH) as well as in Croatia, we learned that the emphasis of future demining activities is on the large areas of minefields and suspected fields. Croatia has 1,630 sq km with approximately 700,000 mines and items of UXO, and BiH has 2,080 sq km of suspected areas. The ratio of suspected fields to mined fields is about 10:1. Obviously, demining these areas is a challenge that can only be met with the use of improved mechanical demining machines (in terms of cost and time). We asked the users, the MACs and the non-governmental organizations (NGOs) whether today's technology met their requirements, and have come to the conclusion that today's tiller or tiller machines need to be improved.

Performance Comparison of Today's Mechanical Demining Systems

The present tiller systems are too heavy (up to 55 tons), too large in size (100 cm) and too expensive, with high operational costs and limited mobility. The high operational costs are the result of AT mine blasts that occur next to the tiller, which lead to damage to both the tiller and the machine. The tiller systems avoids the disadvantages of high weight and cost. AT mines explode far in front of the machine, and the blast can expand through the chassis, resulting in a reduced impact on the machine. In addition, the ground-bearing equipment is easy to replace if damaged. However, the tiller machine suffers from limited demining depths, problems with vegetation and the need for intensive quality assurance (QA) with manual-dog demining.

The MineWolf System

Clearance Methodology

Clearance of mined API/AT minefields is divided into two phases. First, the tiller system detonates or breaks up the AP and AT mines. Then, with a ground penetration depth of 30 cm, the tiller system breaks up the remaining intact mines and reduces the size of components left by the tiller.

Description of MineWolf Technology

MineWolf Technology combines the strengths of the tiller and tiller systems to create a more efficient and effective demining system. The following list describes some of the important characteristics of the MineWolf System.
The MineWolf is a multi-purpose part of the demining toolbox.

• A medium-sized Standard Caterpillar Tractor can be used with a Drutex-Diesel engine, 500 kW with a pendulum track.
• The power transmission is mechanically by a heavy duty PTO shaft via a noux clutch to provide protection of the driveline.
• The use of quick couplings facilitates rapid replacement of the demining tools (within 15 minutes).
• The open Buckets-Type Tiller design allows expansion of the mine blast through the tiller to avoid or reduce damage.
• The MineWolf is equipped with a Leica GPS System 500 for directional control.
• Depth control is provided for fill and tiller operations.
• The total weight does not exceed 20 tons (excluding tools).
• The system is designed for container transport by road, rail, sea, or air.
• The MineWolf is a multi-purpose toolbox machine. With standard commercial attachment, it can also be used for construction, agriculture and forestry.
• The MineWolf can be operated by local personnel.

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http://commons.lib.psu.edu/ci-survey/veda/173/1/3

FOCUS

The MineWolf is a multi-purpose part of the demining toolbox.

Specifications for the Use of Mechanical Demining Machines in BiH for Survey Areas

The Bosnia and Herzegovina Mine Action Center (BHMAC) has released the standard operating procedure book, SOP-14. In chapter 4, on page 3/16, the specification reads as follows:

“The basic Bosnia and Herzegovina Standard layout for a machine is as follows: machine with technical and other characteristics proved through testing, which is capable of removing vegetation and disturbing the soil to the minimum of 10 cm into the depth, breaking it to pieces not larger than five cm in diameter, prevents the adequate quality that is achieved by using the prodder (minimum 10 cm in depth), or the detector, which is supposed to locate the minimum metal content mine to 10 cm into the depth (PMA-S). Provided these characteristics might be used at suspect areas for which there is no reliable data on mining, the BH Standard in Chapter XIV - Mechanical Preparation of the Ground proposes these areas (entire or partially) be declared as areas without obvious risk, provided there were no explosions or visible mines thrown out on the surface or their pans. Such areas would not be further threatened, while the demining resources might be deployed at other mined areas.”

Full machines, as used today, do not meet these requirements and are therefore only to be used as ground preparation machines. The MineWolf, with its rough (tiller) and fine (tiller) operation, has the potential to meet the specifications and may be considered for survey operation as a mine-clearing machine. The MineWolf can be used as a mechanical detection system to mark the edges of the minefield and thus achieve area reduction.

Experience has proven that during demining mines can be destroyed without exploding. AP and AT mines with plastic cases can be turned into pieces but not explode. Fuses and pieces of TNT may still be left. PRDMs with metal bodies also might not be completely destroyed. The partially destroyed mines remain as a residual risk. In the discussion about the danger of these residues, the following proposals should be considered:

• No further treatment providing SOP-14 (area without obvious risk) will be met.
• The driving system requirement of 99.6% must be fulfilled.
• Repeated tiller operation to break up remaining mine pans into smaller pieces should take place.
• Visual control should occur by explosive ordnance disposal (EOD): if mine pans are found, 100 percent man/robot survey is necessary in the surrounding five-meter area.
• Survey with EOD and mine dog should be conducted. The burnt mine should be found due to the intensive smell of TNT.
• Survey with an array metal detector mounted directly behind the MineWolf, with colour marking or global positioning system (GPS) identification. With this method, pieces of UXO can be found.

All these methods would drastically reduce time and cost compared with today’s practice of 100 percent survey with man/dog on survey fields.

The MineWolf is a multi-purpose part of the demining toolbox.

Specifications for the Use of Mechanical Demining Machines on Mined Areas in BiH

Areas declared as minefields based on survey Level 1 to Level 3 require a 100 percent quality control with man/dog teams after the mechanical demining process, as machines today are ground preparation machines only. It is basic knowledge in the car and aircraft industry that quality cannot be inspected—quality has to be guaranteed by the process. MineWolf improve the quality of the demining process compared to full machines in the following ways:

• Two demining operations (thall – rough/tiller – fine)
• Ground penetration depth of 30 cm
• Multiple operations with the tiller (if required)
• Breakup of partially exploded or remaining mines and explosive components not completely destroyed by the full PTO

GPS navigation for directional control

• Depth control for fill and tiller
• Improved vision with optimal position of the driver cabin
• Drive-control system for operator
• Control of all relevant technical data, such as penetration depth, speed of fill and tiller, vehicle speed, etc.
• Quality control with array metal detection system mounted on the back of the vehicle.
• Failure Mode and Effect Analysis (FMEA) for machine and process

The MineWolf clearing a minefield.

The MineWolf operates in minefields near Sarajevo from July until September, managed by the German humanitarian organisation HELP. The demining is sponsored by the Department of Foreign Affairs of the Federal Republic of Germany.

*All photos courtesy of the author.

References


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Functional Testing by BWB (German Army), RUAG (Tunnel Test) and IITEP (Flail System)

A functional prototype vehicle was tested by the German army at their test fields in Koblenz and Meppen. Ninety-five inert test mines, AP and AT mines of different types, were buried up to 30 cm deep at different ground conditions. The aim of the test was to measure clearance effectiveness. The German army came to the following conclusion: “All mines and mine parts detonated by the MineWolf have been destroyed leading to a minefield without danger.”

Based on RUAG’s broad expertise in testing armoured vehicles, we decided to test the protective features with a functional full-scale mock-up in the test tunnel of the Swiss army. The test demonstrated that the MineWolf is protected against AP mines with up to 2 kg of TNT and against AT mines with up to 7.5 kg of TNT. The health risk of the driver was investigated by means of a dummy. The test proved that the tiller system and the mechanical power drive are very robust. The driver is safe under all conditions.

The International Test and Evaluation Program (ITEP) tested the full system on a British army test field in Shoeburyness against AP and AT mines with up to 7.5 kg of TNT. (Based on an Armtrac I 100 Traction Armcart, Avinci is the supplier of the flail system). The two AT-size mines provided useful information. The most significant conclusion is that the flail unit is well-designed for waving large explosive blasts.

Summary

Based on the positive test results, the MineWolf Toolbox System will lead to improvements over today’s mechanical technology in the following areas:

• Demining effectiveness and quality of demining process
  • Weight
  • Transport and mobility dimension
  • Operational costs
  • Production time (the machine can be manufactured within four months)
• Ability to be used for multiple purposes in land preparation

Tests on the MineWolf helped determine that the fill unit is designed for waving large explosive blasts.