



NDRF Summer Conference 2005
24th – 26th August, 2005
in Stockholm



Magnets: A Tool for Manual Demining



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To support the manual deminers in the field different machines are used to cut vegetation, remove trip wires and loosen up hard soil. The metal debris that in different degree contaminates almost all areas and with the metal detector as the main tool it forms a huge obstacle for the deminers,. This is reflected in the study - A Study of Mechanical Application in Demining – published by GICHD in May 20004. Magnets have been used in minor scale and it is showing that a reduction of metal debris will severely reduce the man hour needed to clear an area. Under some conditions up to 200 % increase in the manual-demining rate. GICHD believed that the full potential of the magnet system is not yet in place. They decided to investigate the possibilities to make improvements of the magnetic tools and the working methodologies. The magnet will not be a single tool, it will be another tool in the toolbox.

The findings so far indicate that no magnet will by it own strength pull metal fragment out from the soil. The surface of the soil has to be “ripped up” to free the metal from its grip and the magnet requires a contouring system that will make the magnet to follow the uneven ground as close as possible.

Which magnetic strength of the magnet that is required do not have a simple answer. It has to be seen together with the machine that will carry the magnet. Magnetic strength cost weight and money and it is probably more important to have effective system to open up the soil and to keep the magnet as close as possible, than to have a huge magnet. Still, to be effective a magnetic strength of at least 500 Gauss at a 100 mm distance is required.

How effective a magnet system will be together with a flail or a tiller that cultivates the soil has to be further investigated.



Magnets:
A Tool for Manual Demining

A Study of Mechanical Applications in Demining
Published by GICHD May 2004

Manual Demining is, on top of the mines, fighting against four main obstacles

- Vegetation
- Trip wires
- Hard soil
- **Metal debris**

A large variety of Mechanical devices are used for ground preparation before the deminers start their work.

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Why !













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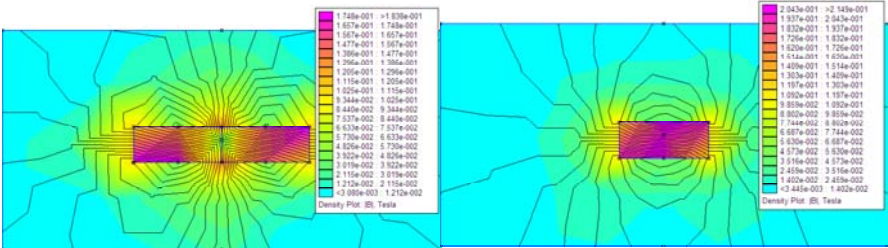


Magnetism and Magnetic Strength





– Magnetic strength or flux density is measured in Tesla or Gauss

- 1 Tesla = 10 000 Gauss
- 1 Gauss = Earth magnetic field at sea level



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Magnets

- **Permanent magnets**
 - **Composites**
 - Ceramic or **Ferrite magnets**
 - Alnico (Aluminium, Nickel and Cobalt)
 - **Rare earth magnets,**
 - Neodymium Iron Boron (NeFeB)
 - Samarium Cobalt (SaCo)


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Magnets

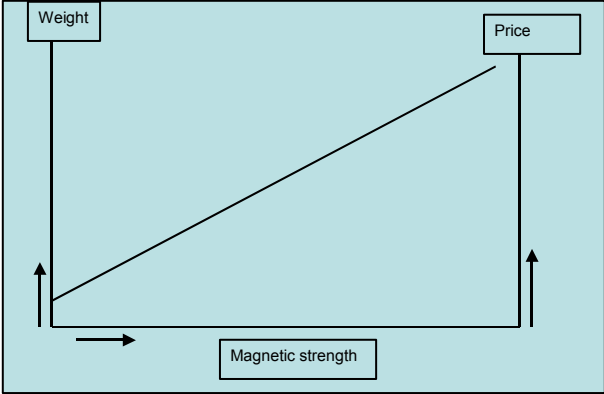
- **Electro magnets**
 - Weight and size is similar to permanent magnets
 - Power supply **Ac/Dc,**
 - Fuel consumption
 - Duty cycle 100% (overheating)
 - Could be switched off
 - Prize * 2 compared with permanent magnets

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Magnets

Weight Price




Magnetic strength

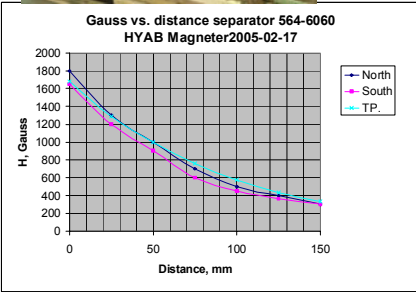
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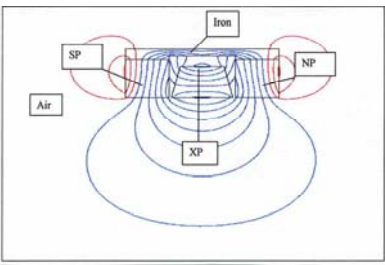

Test at SWEDEC



**Gauss vs. distance separator 564-6060
HYAB Magneter2005-02-17**



Distance (mm)	North (Gauss)	South (Gauss)	TP (Gauss)
0	1800	1800	1800
50	1000	1000	1000
100	500	500	500
150	300	300	300



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Test at SWEDEC



- The aim is to determine the optimal strength of a magnet
- Test target Steel balls, Metal washers and splinters from detonated shells all of them in three sizes
- Three depth, on top of the surface, flush to surface and buried with 20 mm of soil on top of the targets
- The targets were put in the same pattern every time

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Test at SWEDEC

Result

100% pick up of uncovered targets

Steel ball 5, 10, 20 mm 8 – 10 cm
(on top and flush to surface)

Metal washers, horizontal 18-20 cm

Metal washers, vertical 16-20 cm

Splinters 14 cm

All types in three sizes and with the same weight as the steel balls

10 cm 580 Gauss, 15 cm 320 Gauss

100% pick up of covered targets

(targets covered of 2 cm of gravel measured from top of the targets)

F= failed

Steel ball 5, 10, 20 mm F, F, 2 cm

Metal washers horizontal F, 6, 12 cm

Metal washers vertical F, 4, 6 cm

Splinters F, 4, 6 cm

The smallest targets are almost impossible to pull up. If the magnet is raised 2 cm 70 – 90 % of the targets is collected.

2 cm 1370 Gauss, 5 cm 1000 Gauss

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Test at SWEDEC



Conclusions

- Even if a magnet has a very high strength (?1000 Gauss at 100 mm distance) it will only have a marginal effect of the result on buried objects. The weight and price for the magnet will be high.
- An effective contouring system that allow the magnet to follow the ground as close as possible is required
- There is not one optimal strength of a magnet it has to be seen together with the machine that should carry it. As a guideline, the minimum magnet strength at 100 mm for small system is 500 Gauss for heavy systems ?800 Gauss.
- Even if it not was tested it was obvious that no object will be pulled out from a hard untouched soil

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Today



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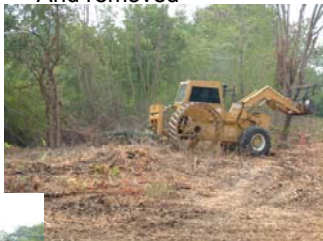
Today




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Operational requirements

Vegetation has to be cut  And removed 

Before the magnet could be used  If the soil is loose the magnet is more effective

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Conclusions



- This is a tool for ground preparation that not will solve the problem but it will **reduce** it.
- It is cost effective already today
- It is not a single tool, it is one more tool in the toolbox
- A ground (soil) preparation that open up the soil and expose the metal is required.
- Operational procedures has to be developed
- Possible advantages with a magnet attached to a tiller or flail that is cultivating the soil has to be further investigated

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