

# Petro-BAAB, Inc.

## Innovations & Technologies

### Demining Technology Anti-Personnel Landmines

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## **Table of Contents:**

<b>1. Introduction.....</b>	<b>page 3</b>
<b>2. Anti-Personal Landmines .....</b>	<b>page 6</b>
<b>3. Warfare .....</b>	<b>page 7</b>
<b>4. Guerrilla Warfare .....</b>	<b>page 7</b>
<b>5. Laying Mines .....</b>	<b>page 8</b>
<b>6. Demining .....</b>	<b>page 9</b>
<b>7. Anti-Personnel Mine Ban .....</b>	<b>page 9</b>
<b>8. Clearing Landmines .....</b>	<b>page 10</b>
<b>9. Solution .....</b>	<b>page 11</b>
<b>10. Advantages of Petro-BAAB’s demining technology.....</b>	<b>page 12</b>
<b>11. Cost and application method.....</b>	<b>page 12</b>
<b>Inventor’s Certificate .....</b>	<b>final page</b>

## 1. Introduction:

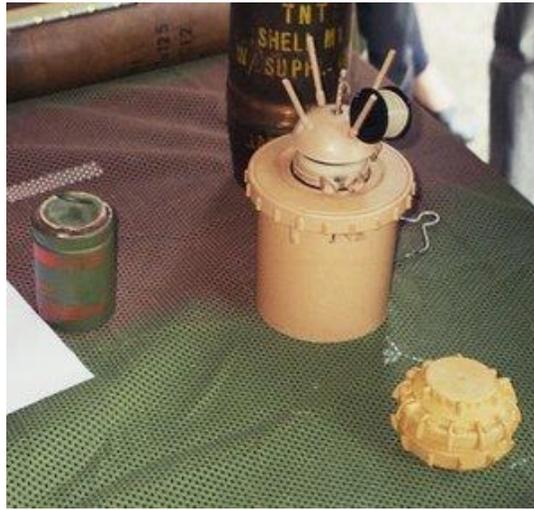
One of the most effective and cost-efficient inventions in history, the anti-personnel or landmine, came into its own in the 20th century. Though its first recorded use was by the Chinese against the invading Mongols of Ghenghis Khan eight hundred years ago, the landmine's ability to extend and multiply the casualties of war for many subsequent decades has seen it become the most feared of all military weapons. The advent of the tank during WW1 precipitated the development of the anti-tank mine, a clumsy, cumbersome device which was easily dug up and re-deployed by opposing forces.



To prevent this redeployment, the anti-personnel mine was developed and used extensively, targeting military personnel. Today, there are more than 100 million landmines buried and active. Another 100 million are stockpiled and ten million are produced annually. Landmines from WW2 still today claim large tracts of land in France and Holland, though the world-wide proliferation of land-mines and their indiscriminate use against civilian populations did not begin until the Vietnam War.

Prior to the recent war in Afghanistan, and the subsequent military build-up between India and Pakistan, more than a million people had been killed or maimed by landmines since 1975.

Half of all adults who stand on a mine die before they reach hospital. Children, being smaller, are more likely to die from their injuries, though there are still more than 300,000 children alive who have been severely disabled by landmines. Clearing mines is a dangerous and very costly job. Mines can cost as little as \$3 to produce yet the necessary care involved in clearing a landmine costs more than US\$2,000 a mine.



Examples of anti-personnel mines. From left to right: an M14, Valmara 69 (a bounding mine), and VS-50

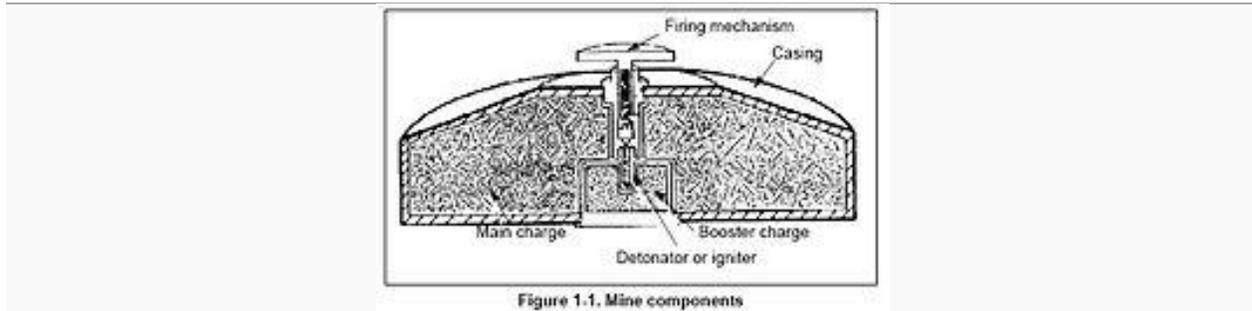
Even then, one accident occurs for every 1,800-2,000 mines cleared. For every one hour spent in sowing mines, over 100 hours are spent de-mining to achieve the same figure. If we stopped laying mines NOW and continued clearing at current rates, the world would be free of mines in the year 3100. One estimate of the cost of clearing the world's landmines is US\$33 Billion.

Unfortunately, mines are being laid 25 times faster than they are being cleared. One of the web's best military authorities, FAS.ORG, states on landmines, "Approximately 50 countries have produced and exported anti-personnel mines. Some 350 different models are currently available, and innovations in mine warfare demonstrate a truly perverse application of technology. Bounding fragmentation mines pop up before exploding, in order to disperse shrapnel over the widest possible area. Mines with little or no metal content have been designed to evade detection.

Further impeding demining, some are equipped with "anti-handling" devices, exploding when an effort is made to disable the mine. Most fiendishly, mines masquerading as toys have been developed particularly to appeal to children.

In addition to the enormous human toll, the social and economic costs of mine fields are enormous. Farming, commerce, development, travel and play are hindered where landmines are present, as is the return of refugees.

## Characteristics and functioning



A typical land mine includes the following components:

- firing mechanism or other device (including anti-handling devices)
- detonator or igniter (sets off the booster charge)
- booster charge (may be attached to the fuse, or the igniter, or be part of the main charge)
- main charge (in a container, usually forms the body of the mine)
- casing (contains all of the above parts)

### Firing mechanisms and initiating actions

A land mine can be triggered by a number of things including pressure, movement, sound, magnetism and vibration. Anti-personnel mines commonly use the pressure of a person's foot as a trigger, but tripwires are also frequently employed. Most modern anti-vehicle mines use a magnetic trigger to enable it to detonate even if the tires or tracks did not touch it. Advanced mines are able to sense the difference between friendly and enemy types of vehicles by way of a built-in signature catalog. This will theoretically enable friendly forces to use the mined area while denying the enemy access.

Many mines combine the main trigger with a touch or tilt trigger to prevent enemy engineers from defusing it. Land mine designs tend to use as little metal as possible to make searching with a metal detector more difficult; land mines made mostly of plastic have the added advantage of being very inexpensive.

Some types of modern mines are designed to self-destruct, or chemically render themselves inert after a period of weeks or months to reduce the likelihood of civilian casualties at the conflict's end. However, these self-destruct mechanisms are not absolutely reliable, and most land mines laid historically are not equipped in this manner.

## 2. Anti-Personal Landmines

Anti-personnel landmines are designed to kill or injure enemy combatants as opposed to destroying vehicles. They are often designed to injure rather than kill in order to increase the logistical support (evacuation, medical) burden on the opposing force. Some types of anti-personnel mines can also damage the tracks or wheels of armored vehicles.

Under the Ottawa Treaty, signatory countries undertake not to manufacture, stockpile or use anti-personnel mines. As of 2009, it has been signed/accessioned by 156 countries. Thirty-eight countries, including the People's Republic of China, Russian Federation and the United States, are not party to the Convention.

A landmine is usually a weight-triggered explosive device which is intended to damage a target—either human or inanimate—by means of a blast and/or fragment impact.

The name originates from the ancient practice of military mining, where tunnels were dug under enemy fortifications or troop formations by sappers. These tunnels ("mines") were at first collapsed to destroy targets located above, but they were later filled with explosives and detonated in order to cause greater devastation.

Nowadays, in common parlance, land mines generally refer to devices specifically manufactured as anti-personnel or anti-vehicle weapons and should be distinguished from improvised explosive devices ("IEDs").

The use of land mines is controversial because they are indiscriminate weapons, harming soldier and civilian alike.



They can remain dangerous many years after a conflict have ended, harming the economy of many developing nations. With pressure from a number of campaign groups organized through the International Campaign to Ban Landmines, a global movement to prohibit their use led to the 1997 Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-

Personnel Mines and on their Destruction, known informally as the Ottawa Treaty. As of 2011, a total of 158 nations have agreed to the treaty.

### **3. Warfare**

In military science, minefields are considered a defensive or harassing weapon, used to slow the enemy down, to help deny certain terrain to the enemy, to focus enemy movement into kill zones, or to reduce morale by randomly attacking material and personnel. In some engagements during World War II, anti-tank mines accounted for half of all vehicles disabled.

Since combat engineers with mine-clearing equipment can clear a path through a minefield relatively quickly, mines are usually considered effective only if covered by fire.

The extents of minefields are often marked with warning signs and cloth tape, to prevent friendly troops and non-combatants from entering them. Of course, sometimes terrain can be denied using dummy minefields. Most forces carefully record the location and disposition of their own minefields, because warning signs can be destroyed or removed, and minefields should eventually be cleared. Minefields may also have marked or unmarked safe routes to allow friendly movement through them.

Placing minefields without marking and recording them for later removal is considered a war crime under Protocol II of the Convention on Certain Conventional Weapons, which is itself an annex to the Geneva Conventions.

Artillery and aircraft scatter mines allow minefields to be placed in front of moving formations of enemy units, including the reinforcement of minefields or other obstacles that have been breached by enemy engineers. They can also be used to cover the retreat of forces disengaging from the enemy, or for interdiction of supporting units to isolate front line units from resupply. In most cases these minefields consist of a combination of anti-tank and anti-personnel mines, with the anti-personnel mines making removal of the anti-tank mines more difficult. Mines of this type used by the United States are designed to self destruct after a preset period of time, reducing the requirement for mine clearing to only those mines whose self destruct system did not function. Some designs of these scatter mines require an electrical charge (capacitor or battery) to detonate. After a certain period of time, either the charge dissipates; leaving them effectively inert or the circuitry is designed such that upon reaching a low level, the device is triggered, thus destroying the mine.

### **4. Guerrilla Warfare**

None of the conventional tactics and norms of mine warfare applies when they are employed in a guerrilla role:

- The mines are not used in a defensive role (for specific position or area).
- Mined areas are not marked.
- Mines are usually placed singly and not in groups covering an area.
- Mines are often left unattended (not covered by fire).

One of the aims of terrorism – and to a certain extent of guerrilla warfare – is to spread fear and panic. This can be achieved by a single mine left on a civilian road to be detonated by a civilian target which is clearly quite different from the normal military application.

One example where such tactics were in employed is in the various Southern African conflicts during the 1970s and 1980s, specifically Angola, Mozambique, Namibia, South Africa and Zimbabwe.

## **5. Laying Mines**

Minefields may be laid by several means. The preferred, but most labour-intensive, way is to have engineers bury the mines, since this will make the mines practically invisible and reduce the number of mines needed to deny the enemy an area. Mines can be laid by specialized mine-laying vehicles. Mine-scattering shells may be fired by artillery from a distance of several tens of kilometers.

Mines may be dropped from helicopters or airplanes, or ejected from cluster bombs or cruise missiles.

Anti-tank minefields can be scattered with anti-personnel mines to make clearing them manually more time-consuming; and anti-personnel minefields are scattered with anti-tank mines to prevent the use of armored vehicles to clear them quickly. Some anti-tank mine types are also able to be triggered by infantry, giving them a dual purpose even though their main and official intention is to work as anti-tank weapons.

Some minefields are specifically booby-trapped to make clearing them more dangerous. Mixed anti-personnel and anti-tank minefields, anti-personnel mines *under* anti-tank mines, and fuses separated from mines have all been used for this purpose. Often, single mines are backed by a secondary device, designed to kill or maim personnel tasked with clearing the mine.

Multiple anti-tank mines have been buried in stacks of two or three with the bottom mine fuzed, in order to multiply the penetrating power. Since the mines are buried, the ground directs the energy of the blast in a single direction — through the bottom of the target vehicle or on the track.

Another specific use is to mine an aircraft runway immediately after it has been bombed in order to delay or discourage repair. Some cluster bombs combine these functions. One example

is the British JP233 cluster bomb which includes munitions to damage (crater) the runway as well as anti-personnel mines in the same cluster bomb.

## **6. Demining**

Metal detectors were first used for demining, after their invention by the Polish officer Józef Kosacki. His invention, known as the Polish mine detector, was used by the Allies alongside mechanical methods, to clear the German mine fields during the Second Battle of El Alamein when 500 units were shipped to Field Marshal Montgomery's Eighth Army.

Whereas the placing and arming of mines is relatively inexpensive and simple, the process of detecting and removing them is typically expensive, slow, and dangerous. This is especially true of irregular warfare where mines were used on an ad hoc basis in unmarked areas. Anti-personnel mines are most difficult to find, due to their small size and the fact that many are made almost entirely of non-metallic materials specifically to escape detection.

Manual clearing remains the most effective technique for clearing mine fields, although hybrid techniques involving the use of animals and robots are being developed. Animals are desirable due to their strong sense of smell, which is more than capable of detecting a land mine. Animals like rats and dogs can also differentiate between other metal objects and land mines because they can be trained to detect the explosive agent itself.

Other techniques involve the use of geo-location technologies. A joint team of researchers at the University of New South Wales and Ohio State University is working to develop a system based on multi-sensor integration.

The laying of land mines has inadvertently led to a positive development in the Falkland Islands. Mine fields near the sea from the Falklands War have become favorite places for penguins, which do not weigh enough to detonate the mines. Therefore, they can breed safely, free of human intrusion. These odd sanctuaries have proven so popular and lucrative for ecotourism that efforts exist to prevent removal of the mines. Norwegian NGO Norwegian People's Aid is one organization involved in the safe removal of land mines.

## **7. Anti-Personnel Mine Ban**

The use of land mines is controversial because they are indiscriminate weapons, harming soldier and civilian alike. They remain dangerous after the conflict in which they were deployed has ended killing and injuring civilians and rendering land impassable and unusable for decades. To make matters worse, many factions have not kept accurate records (or any at all) of the exact locations of their minefields, making removal efforts painstakingly slow. These facts pose serious difficulties in many developing nations where the presence of mines hampers resettlement, agriculture, and tourism. The International Campaign to Ban Landmines campaigned successfully to prohibit their use, culminating in the 1997 Convention on the

Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction, known informally as the Ottawa Treaty.

## **8. Clearing Landmines**

- Clearing mines is a dangerous and very costly job. Mines can cost as little as \$3 to produce yet the necessary care involved in clearing a landmine costs more than US\$2,000 a mine. Even then, one accident occurs for every 1,800-2,000 mines cleared. For every one hour spent in laying mines, over 100 hours are spent de-mining to remove the same number of mines. If we stopped laying mines NOW and continued clearing at current rates, the world would be free of mines in the year 3100. One estimate of the cost of clearing the world's landmines is US\$33 Billion. Unfortunately, mines are being laid 25 times faster than they are being cleared
- Landmines (particularly anti-personnel mines) are often scattered indiscriminately over a wide area (often by air)
- There are over 110 million landmines extant today (mostly in underdeveloped nations)
- Clearing landmines is an extremely dangerous occupation
- Clearing landmine demands forcing many restrictions, over a long period of time, on local population that may involve the restriction of the use of a large area of privately owned residential and or farm land.

Any solution to the problem must have the following characteristics:

- Must be cost effective in order to encourage countries and government to expedite the removal of the mines
- Limit the risk involved to local populations and to the removal team involved.
- Detect all kinds of explosive devices (purpose built landmines and homemade devices)
- Must be able to present a tested and an effective solution to a problem that exist now.

Some of the current demining technologies available in the market today involve build a self-contained, self-sustaining, insect-like robot that can sniff for mines then attempt to defuse them or simply just mark their locations. Also, certain technologies made it possible for developing a specific type of plants which change colour in the presence of specific compounds within the soil, opening the way for the first bomb and land-mine detection plant.

All current available demining solutions in the market either are costly, risky, time consuming or yet to be perfected, in the mean time, thousands of people are falling as victims every year to land mines.



## 9. Solution:



**Petro-BAAB, Inc.**, with the cooperation of their research and development team, has developed an effective technology for the demining of anti-personnel landmines. This technology involves spraying a specific solution mix by air on top an area that is infected with personnel landmines. The solution can penetrate the soil up to 50 centimeters and within seconds will detonate safely the land mine that it touches.

**10. Advantages of Petro-BAAB's demining technology in comparison with the currently existing ones:**

- a. Extremely effective with 100% success rate
- b. Rapid solution (minutes instead of days, weeks or months)
- c. More cost effective than the currently existing solutions (cost on average \$300 compared to over \$2,000 per mine removal).
- d. Safe to use and operate by the demining team.
- e. The equipment used is the mixer of the solution that needs to be sprayed on top of the infected area using a helicopter or fixed wing equipped with spraying equipment.
- f. The mixed solution used for spraying is non hazardous and non toxic
- g. No specialty training is required for the demining team.
- h. The mines are detonated within seconds after the mixed solution is sprayed.
- i. The treated fields are safe to go on within minutes after the treatment.
- j. The unused material fully evaporates from the ground in about 24 hours.

**12. Cost and application method details:**

- 1) Approximately 20 metric tons (20,000 kg) of demining chemical solution mixture is required to cover 1 sq kilometer. The exact quantity is subject to 10% increase due to wind speed, how close to the ground the mixture is sprayed and the outside temperature.
- 2) Approximate cost of 1 kg of the chemical mixture is \$25 US dollars
- 3) To completely and effectively cover an area of 1 square kilometer, the total cost will be \$500,000.00 (Five Hundred Thousand USD). The exact quantity is subject to 10% increase due to wind speed, how close to the ground the mixture is being sprayed and the outside temperature.
- 4) The above cost does not include the cost of the usage of the equipment needed to spray the chemical solution mix.
- 5) A rotary wing aircraft will need to fly at a low altitude (under 50 feet) for the 1 square kilometer area to be effectively treated.
- 6) A concentrated and heavy spraying method will be utilized in order to completely soak the infected areas. The device will be mounted on a rotary wing aircraft equipped with a liquid holding tank and the spraying devices.