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SEA MINE AND MINE COUNTER MEASURES (MCM)

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ABSTRACT: The paper describes briefly about the physical Factors which are of prime consideration to any nation facing a Mine threat. Various types of mines available in the world are listed in the paper. The details about number of mines laid during various wars, types of mine counter measures existing, the goals for naval mine countermeasures, type of mine layers, mine hunting sonars, mine countermeasures vessels, mine sweeps and sweeping are briefly covered in this paper. The paper is concluded with suggestions to bridge the technology gaps that exist in the field of sea mines threat.

Keywords: *Sonar, World war, Mine Layer, Mine Sweeps, Mine Sweeping.*

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1. INTRODUCTION:

The Gulf War, the War took place in the Arabian Gulf between Iran and Iraq, World War 1, World War 2 etc., highlighted Mine Warfare. The Mine which was thought to be a poor nations Weapon has been attained a position of prime importance in the armories of most Navies of the world. This is due to the technology development in the field of Electronics, Sensors, Composite materials, battery, advanced digital signal processing and digital filtering techniques, safety and arming.

2. PHYSICAL FACTORS FOR SUCCESSFUL MINE THREAT:

The physical factors which are of prime consideration to any nation facing a Mine threat are:

- The type of Mines held
- The number of Mines held
- Mine counter measures
- The Goals for Naval Mine Countermeasures
- The type of Mine layers held
- The type of Mine hunting Sonars available
- Mine countermeasures vessels held
- Mine sweeping capabilities and sweep systems held

The technologies of different types existing at present in the areas listed above, is given in the following paragraphs at seriatim.

3. Type of Mines:

Various types of sea mines available are shown in fig 1.[1]

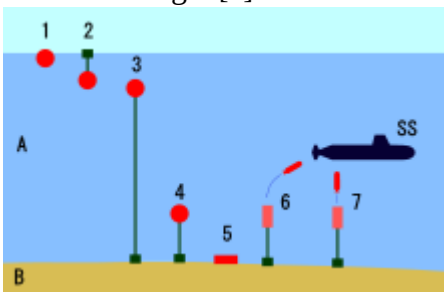

Fig.1. Types of naval mines: A-underwater, B-bottom, SS-submarine. 1-drifting mine, 2-drifting mine, 3-moored mine, 4-moored mine (short wire), 5-bottom mines, 6-torpedo mine/CAPTOR mine, 7-rising mine.

Besides there are many other types of mines as listed here:[2]

- Contact mines
- Limpet mines
- Bottom contact mines
- Remotely controlled mines
- Influence mines
- Moored mines
- Bottom mines
- Unusual mines

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- Anti-sweep mine
- Ascending mine
- Homing mines
- Mobile mine
- Nuclear mine
- Daisy-chained mine
- Dummy mine

Mines can generally be categorized into three main types:

- Moored or buoyant Mines
- Ground Mines
- Raising/Encapsulated mines (that is Self-propelled homing Mines).

Mines which fa1l into categories (a) and (b) are shallow water Mines which can be deployed in depths from 12 to 30 meters. Mines which fall into category (c) are deep water Mines used to counter the nuclear submarine threat.

4. Number of Mines laid during various wars:

In the North Sea, to limit access to the open Atlantic, the Allies laid 70,117 mines in a 230-mile area in the northern portion of the English Channel. Smaller fields were laid in the southern portion of the channel (Morison, 1995). By the end of World War I,[4] the mine had proven itself to be a highly effective naval weapon that dramatically changed war at sea.[3] During World War II, mines were of critical strategic importance. For example, German mine campaigns in the Baltic Sea effectively sealed the Soviet fleet in port for the entire war. In the Pacific, Allied "Operation Starvation" laid over 11,000 influence mines in Japanese shipping routes to Southeast Asia and also in Japanese harbor entrances (Morison, 1995). [48] This initiative resulted in the damage or destruction of most of the surviving Japanese merchant marine fleet, and it effectively sealed off sea trade to and from Japan. By the end of World War II, sea mines had again proven their effectiveness, and resulted in the sinking of one ship for every 35 mines laid. [3] [4]
Since sea mines provide offensive and defensive capabilities far exceeding their cost, post-World War II naval warfare saw expansions in the use of mines by underdeveloped nations in conflicts with larger superpowers. In the Korean War, offensive mining by communist forces immobilized U.S. Naval operations for more than a week during the landing at Wonsan (Zwolski, 1998). [5] [6] Approximately 3,000 Russian-made contact and magnetic mines caused a fleet of 250 ships to wait off the coast while 10 American minesweepers tried to sweep a clear channel through the minefield (Morison, 1995).[3]
As a background to examining the modern mine and its effectiveness, it is perhaps worth recalling one or two facts concerning Mine Warfare in World War II. For example, Germany laid well over 100,000 Mines in North European waters before and during the war, which sank some 656 ships. The Allies laid over 250,000 Mines which sank over l000 German and Italian ships. [4]

The modern threat is becoming increasingly significant with many Navies around the world acquiring Mines from a wide variety of sources. For example, USSR alone is believed to have a stock of over 422,096 Mines. [7]

5. Mine counter measures: [8]

The mine counter measures are of two types namely Passive and active.
Passive: Limit all influence signals emitted from target vessels.
Active: Mine hunting - The search for mines using magnetic, visual, and sonic means either through the use of divers, unmanned undersea vehicles (UUVs), or hull-mounted and towed instrumentation.
Minesweeping - Detonation using both mechanical and influence methods. Minesweeping methods are highly dependent on mine characteristics and need to be continually altered for new mine types.

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6. The Goals for Naval Mine Countermeasures (MCM) are: [3]

- Elevate status of MCM in naval operations:
- Full commitment of naval leadership to well-equipped and trained MCM forces.
- Treat MCM as an equal among major warfare mission areas.
- Provide more significant MCM personnel training.
- Integrate MCM, totally and realistically, into joint and fleet training exercises.
- Develop a Command and Control, Communications, Computers, and Intelligence (C^4I) architecture that supports the full range of MCM operations.
- Develop supporting and organic MCM systems that are capable of :rapid deployment and employment,
- High-area search rate with low false alarm generation,
- Rapid and wide-area detection, classification, and identification of mines, automatically adapting to the environment, autonomously destroying mines, and supporting avoidance and in-stride mine and obstacle breaching from deep water to inland objectives.
- Develop an all-source precision database with the capability to provide real-time environmental assessments and forecasts and make it available to all MCM forces.
- Develop self-protection measures, including mine avoidance, signature manipulation, and shock hardening.

7. Type of mine layers:

USA has developed a Mine laying system called the High Volume Mine Layer (HVML). The key to the system is a special pellet in which the Mines, mounted on cradles and pellets can be used interchangeably, either to deploy Mines out of a Hercules C 130 or of any ship with a flat deck leading towards the stern.

Other methods to lay minefields include: [9]

- Converted merchant ships – rolled or slid down ramps
- Aircraft – descent to the water is slowed by a parachute
- Submarines – launched from torpedo tubes or deployed from specialized mine racks on the sides of the submarine
- Combat boats – rolled off the side of the boat
- Camouflaged boats – masquerading as fishing boats
- Dropping from the shore – typically smaller, shallow-water mines
- Attack divers – smaller shallow-water mines

8. Mine hunting Sonars: [10] [11]

At present, Mines will become more difficult to be detected because of stealth shaping (polyester casings, anti- reflective anechoic coatings, better blending in with seafloor characteristics).

An electromagnetic wave, throughout the region of EN spectrum, is attenuated rapidly while propagating through the water. The minimum attenuation is obtained at ULF or at optical frequencies in the blue/green region, the attenuation coefficient in the coastal region is 0.13/m and that in the deep sea region is about 0.045/m i.e., the beam intensity falls by a factor of 10 for propagation lengths of approximately 100mm and 300m in coastal water and deep ocean respectively. Some Navies are developing devices utilizing blue-green lasers for detection of Mines which are transparent to sonar beams.

For example Northrop's Electronics Division developed Airborne Laser Radar Mine Sensor (ALARMS) for the US Defense Advanced Research Projects Agency (DARPA). ALARMS uses a pulsed blue-green laser operating at 512 nanometers.

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9. Mine Countermeasures Vessels: [12] [13]

Technology in Mine Countermeasures (MCM) is at present lagging behind the development of Mines. MCMVs fall into two main groups.

9.1. Minesweepers-developed to tow mechanical sweeps to cut the tethering wires of moored mines and to tow magnetic and acoustic influence sweeps.

9.2. Mine hunters-developed to search for ground influence mines which could not be adequately dealt with by sweeping methods alone. The main task o§ mine destruction is now carried out by small submersibles called Remotely Operated Vehicles (ROVS).

9.3. The ROVs are designed with a very low magnetic signature and can be guided automatically into a sonar beam from the parent vessel which has detected an object on the sea bed. This reduces the work load of the operator on the MCMV. The ROV carries a TV camera, an explosive cutter or destructive charges and a high resolution sonar.

9.4. Few countries are currently working on development of non acoustic under water signature management technologies. The arrangement will allow naval vessels to use cathodic hull protection systems and yet substantially reduce electromagnetic underwater fields - a feature practically important for vessels subject to a mining threat. The system named as ICCP (Impressed Current Cathodic Protection) is applicable to both surface ships and submarines.

9.5. During Iran-Iraq war, US Navy used RH-53D helicopter as Airborne Mine Countermeasures Vehicle.

10. Mine Sweeps and Sweeping: [12] [14]

Extensive mine laying during the World War 1 necessitated significant advances in MCM. The British invented most of these countermeasures, and some of these techniques are still in use today. Mechanical sweeping involves towing a wire sweep that catches moored mines and disposes of them by detonating their charges or by cutting their cables so that they raise to the surface, where they can be destroyed by ri§1e €ire or other means. This may be complemented by influence sweeping against weapons with magnetic, acoustic and pressure sensors, using a towed body that radiates the appropriate signature. Acoustic sweeps can be arranged to transmit virtually any combination of frequencies to which a mine can be expected to respond. Similarly there is a scope for reproducing a wide range of typical magnetic signature, for example by using variable- moment technology. Pressure signatures are more difficult to mimic and the pressure mine has been called the "Unsweepable" Mine. Other more speculative sensor types may or may not be sweepable.

CONCLUSION:

In the case of sea mine warfare, for achieving excellence based on the existing technologies throughout the world, the relevant systems listed here needs to be developed progressively.

- Raising/Encapsulated Mines.
- Increase quantity of Mines.
- Sonars operating at high Frequencies.
- Blue-Green laser detection systems.
- Remotely Operated Vehicles (ROVS)
- Remotely Controlled Mine Disposal Systems (RCMVDS)

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REFERENCES

I. https://en.wikipedia.org/wiki/HYPERLINK Naval warfare - Wikipedia, the free encyclopedia

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II. Naval **mine** - Wikipedia, the free encyclopediahttps://en.wikipedia.org/wiki/Naval_mine.
III. **Mine Warfare** - The National Academies Press. www.nap.edu/read/9773/chapter/4
IV. Youngblood, Norman (2006). The Development of Mine Warfare: A Most Murderous and Barbarous Conduct. Greenwood. p. 127. ISBN 0-275-98419-2.
V. National Park Service.Peleliu. Appendices.
VI. "The United States Strategic Bombing Surveys (European War) (Pacific War)" (PDF). Archived from the original (PDF) on 2003-08-25. Retrieved 2011-12-31.
VII. Youngblood, Norman (2006). The Development of Mine Warfare: A Most Murderous and Barbarous Conduct. Greenwood. pp. 129–130. ISBN 0-275-98419-2.
VIII. Tempest, Mark (2007-11-04). "Sunday Ship History: Degaussing Ships". EagleSpeak. Eaglespeak.us. Retrieved 2011-12-31.
IX. "Type 918 (Wolei Class) Minelayer". Naval Forces: Vessels. SinoDefence.com. 2008-06-16. Archived from the original on 2010-08-09. Retrieved 2011-12-31.
X. "Avenger Class Mine Countermeasures Vessels, United States of America". Naval Technology. Retrieved 3 July 2015.
XI. Keller, John. "Navy contracts with BAE Systems for 10 more upgraded AN/SQQ-32(V)4 mine hunting sonar systems". Military & Aerospace Electronics. Retrieved 3 July 2015.
XII. "Animals At Arms". Army-Technology.com. Net Resources International. 2010-12-22. Retrieved 2011-12-31.
XIII. Tempest, Mark (2007-11-04). "Sunday Ship History: Degaussing Ships". EagleSpeak. Eaglespeak.us. Retrieved 2011-12-31.
XIV. "Mine Sweeping Operations". Minesweeping. Charles Lees. Archived from the original on 2009-04-02. Retrieved 2011-12-31.