



IC² Institute University of
Texas at Austin, USA



Defence Research & Development Organisation
Ministry of Defence



DRDO-FICCI

Accelerated Technology Assessment
and Commercialization Programme

Selected Technologies for Commercialization





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Introduction

Hon'ble Prime Minister of India, Dr. Manmohan Singh in his speech on the occasion of Technology Day Celebrations, 12 May 2008 stated that:

*“The fruits of our technological progress must also **reach to the common man**. This is the only way in which we can make every citizen of India a productive participant in India's growth story. **DRDO has a crucial role to play in leading by example**”.*

Defence Research and Development Organization (DRDO), the R&D arm of Ministry of Defence, Government of India joining hands with FICCI - the apex industry chamber of India, by initiating a "Accelerated Technology Assessment and Commercialization (ATAC) Programme" for the Assessment of DRDO developed technologies for commercial markets is the first step taken by DRDO in this direction.

DRDO - FICCI ATAC programme aims:

- To create a commercial pathway to deliver technologies developed by DRDO for appropriate commercial markets for use in civilian products and services. These markets may be in India and abroad.
- To enhance the spirit of innovation within the ranks of DRDO Scientists and agencies.
- To facilitate the growth of the organization as a technology provider.

This programme is first of its kind to be undertaken by DRDO in association with FICCI to actively spinout several of DRDO's technologies for appropriate commercial markets both nationally and internationally. In the very first year of operation of the programme as many as 26 DRDO labs across India have participated and over 200 technologies are being assessed under this programme by FICCI. The technologies that are currently assessed are from sectors as diverse as **electronics, robotics, advanced computing and simulation, avionics, optronics, precision engineering, special materials, engineering systems, instrumentation, acoustic technologies, life sciences, disaster management technologies, information systems, etc.**

Under a unique process of technology Accelerated Technology Assessment and Commercialization (ATAC), FICCI along with the IC2 Institute of University of Texas at Austin has identified technologies which were initially only exposed to the defence sector but have large commercial potential also . The ATAC programme jointly initiated by DRDO and FICCI has received very encouraging response from the Industry for acquiring the technologies selected under the programme. Several NDAs, MTAs, BEAs have been signed. MoUs have been finalized for various technologies including DEPA Multi Insect Repellant Cream, RO based mobile water purification system, Explosive Detection Kit and HAPO chamber.

While DRDO continues its effort in developing cutting edge technologies for Indian Armed Forces, it has started to actively pursue spinning out relevant DRDO developed technologies for non military applications. This in the long run will help the industries to produce high quality, high reliable industrial products and systems at an affordable cost. A proposal for providing incentives to those scientists who are behind these innovations is also on the anvil and DRDO hopes to introduce it soon.

The products and technologies under ATAC process have been selected very carefully after due diligence and a number of deliberations to ensure that the common man benefits from these technologies developed by the brightest minds of DRDO. Through the ATAC initiative, DRDO has enabled the industry to leverage the knowledge and capabilities developed by its scientists and technologists. The transfer of technologies to the Indian industries will enable them to be technologically self reliant and would enable them to contribute effectively to economic growth of the country.

DRDO has done phenomenal innovation work for creating a large degree of self-reliance for the Indian defence. There are many innovative technologies within the DRDO framework, which could lead to significant success in the civilian side as well. This programme is an attempt to make that happen. This commercialization framework could be institutionalized in the interest of Indian Industries and society at large.

Africa Initiative

The Indian Prime Minister's Opening Statement at the India-Africa Forum Summit in April 2008 and his visit to Africa in May 2011 paved new ways for Indo-African collaboration. The Indian government's initiative of offering a \$5 billion line of credit over the next three years to the African region was a major milestone in this regard.

Subsequent to a cabinet decision after the Prime Minister's Africa visit, various initiatives have been taken to further strengthen Indo-African ties. The Defence Research & Development Organization (DRDO), the Research arm of the Ministry of Defence, Government of India, is committed towards taking the vision of the Hon'ble Prime Minister to a concrete reality.

DRDO and FICCI, working under the banner of the ATAC Programme, have started taking joint initiatives in this direction and DRDO's recent participation in the India-Africa Business Partnership Summit at Hyderabad during October 12-13, 2011 is a strong testimony towards its commitment to forge strong Indo-Africa ties. Further, DRDO intends to participate at the forthcoming 'India Show at Nigeria' to be held at Lagos, Nigeria between 02-03 February, 2011.

46 technologies currently identified for commercialization through ATAC process are covered in this compendium. They are from varied sectors, including Communications, Electronics, Materials, Medicines, Mechanical, Medicine/Health Sciences, Security & Surveillance, and Waste Management/Environment

'Aahar' Initiative

Under the DRDO- FICCI Accelerated Technology Assessment and Commercialization (ATAC) Programme, Defence Research and Development Organisation (DRDO), BASIX - a Social Enterprise Group, and Federation of Indian Chamber of Commerce and Industry (FICCI) have come together to collaborate on long term basis to develop and execute viable and scalable models for commercialization of the technologies developed by DRDO with the specific intent of developing and enhancing livelihoods. The three partners will identify and commercialize sub-set of technologies/products/processes developed by DRDO focusing on the base of the pyramid as both producers and consumers and thereby improving the lives of the disadvantaged and creating livelihoods for them.

Initially, this collaboration will focus on the food technologies developed by Defence Food Research Laboratory (DFRL), formed under the aegis of DRDO. The aim of the project is to build women-oriented enterprises using food technologies of DFRL. The first pilot under this collaboration is the project 'Aahaar' that encompasses a set of technologies and products including ready-to eat *Roti*, and two variants in *dal* - instant *Palak Dal* with *Masala Channa* curry mix. BASIX shall subject the identified technologies/products/processes to three levels of testing viz. Technical Feasibility, Economic Viability and Consumer Acceptance.

BASIX will play the lead execution role in bringing together all aspects of this project and conduct the commercialization pilot. The pilot will involve developing a model of creating small production units comprised predominantly of women, by organising and building of a range of skills and deploying simple technologies developed by DFRL. For the consumer, Aahaar is a hygienic, nutritious and convenient meal that tastes fresh yet has longer shelf life, and is tasty and quick to serve. *Roti* has a shelf life of 15 days and the two variants of *dal* have a shelf life of 12 months. This is a differentiated and unique positioning in the market place in this category of foods.

Dr. Montek Singh Ahluwalia, Deputy Chairman of the Planning Commission, Government of India launched 'Aahaar' on **February 28, 2012** and has subsequently referred the technology to the National Advisory Council to be considered for various national programmes, particularly the Mid-day meal scheme.



DRDO

Defence Research & Development Organisation (DRDO), the R&D wing of the Ministry of Defence, Government of India has completed 50 years of dedicated service to the Nation. The year 2008 marks its Golden Jubilee Year. With 50 research and development laboratories under its umbrella, DRDO has developed and produced several state-of-the-art military hardware & strategic systems. DRDO has synergised with the Armed Forces in capability building, both in terms of equipments and technologies. DRDO owes its success to the participation and contribution made by more than 100 academic institutions and over 500 industries from within and outside the country. Research centres, S&T establishments and various departments of the State and the Central Governments have also contributed to its success story.

Website: www.drdo.org



FICCI

Established in 1927, FICCI is the largest and oldest apex business organisation in India. Its history is closely interwoven with India's struggle for independence, its industrialization, and its emergence as one of the most rapidly growing global economies. FICCI has contributed to this historical process by encouraging debate, articulating the private sector's views and influencing policy.

A non-government, not-for-profit organisation, FICCI is the voice of India's business and industry.

FICCI draws its membership from the corporate sector, both private and public, including SMEs and MNCs; FICCI enjoys an indirect membership of over 2,50,000 companies from various regional chambers of commerce.

FICCI provides a platform for sector specific consensus building and networking and as the first port of call for Indian industry and the international business community..

Our Vision

To be the thought leader for industry, its voice for policy change and its guardian for effective implementation.

Our Mission

To carry forward our initiatives in support of rapid, inclusive and sustainable growth that encompass health, education, livelihood, governance and skill development.

To enhance efficiency and global competitiveness of Indian industry and to expand business opportunities both in domestic and foreign markets through a range of specialised services and global linkages.

Website: www.ficci.com



Technology Sector: Social Impact

S.No.	Technology Name	Industry Partner
1.	Acoustic Life Detector (Sanjeevani)	Kerala State Electronics Development Corporation Limited
2.	Biodigester	Banka Enterprises
3.	Bio-larvicide	-
4.	Herbal Mosquito Repellent Vaporizer	-
5.	Multi-Purpose Foldable Cot	Yorco Sales Pvt. Ltd.
6.	RO based Mobile Water Purification System (MWPS)	-

1. Acoustic Life Detector (Sanjeevani)



Naval Physical & Oceanographic Laboratory (NPOL), Cochin

The technology is used to detect and save human beings trapped under the debris of collapsed buildings due to earth quake or land slide. This equipment is based on highly air sensitive acoustic sensor and audio signal processing to clearly listen to the victim's low frequency sound from below the debris. The sensors and related equipment are hermetically sealed and hence it can be used in wet or raining environment after a calamity.

Industry Partner through DRDO-FICCI ATAC

Kerala State Electronics
Development Corporation
Limited
Keltron House, Vellayambalam
Thiruvananthapuram - 695
033, Kerala, India

T : 0471 - 2724444, 4094444

F : 0471 - 2724545

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The Acoustic Life Detector has three sub systems, namely probe assembly, electronics control unit and a head phone set.

The probe assembly consists of a low frequency acoustic sensor that is highly sensitive, to pickup even very low human voices or any other sound made by the persons trapped under the debris.

The sensor uses a highly sensitive piezoelectric material for converting the sound signal to electrical voltages.

The probe head is rigidly coupled with a rigid aluminum telescopic tube, which can be extended up to 2 m, which will help to the probe head through the gap of debris, if required.

The electronics unit is designed using ICs. An amplifier in the assembly gives sufficient output to hear through head phones. It consists of a volume control switch and tone selector switch, sensor and headphone sockets. The electronics module is powered by four 1.5V AA type battery cells. It is very small and compact and is provided with a nylon waist belt for the operator to wrap around his waist. The headphone is a standard stereo type headphone with extended microphone facility for two way communication between the operator and victim

The systems is designed to have high reliability and for continuous field use in any environment (-10 deg to +45 deg).

No external power is required for operation and it is battery (1.5Vx4) operated, which can work for 10 hours of continuous operation before recharging or changing new batteries.

The overall weight of the system (all sub assemblies) is less than 1.5 kg and can be easily packed within the bag and plastic casing provided.

The acoustic sensor is designed for higher sensitivity (up to -170 dB) to detect low frequency acoustic signals like hitting, tapping, scratching or moaning sounds made by the victims.

The sensor can detect victim's sound who are trapped about probe distance of 6 to 8 m below the debris.

Areas of Application

It is fixed inside a compact metallic housing which can pass through 50mm dia gap into the debris without causing any damages to the sensor.

The sensor housing can be extended for searching of victims up to 2m into the gap of debris. Sanjeevani can be used by the following:

1. Disaster management team
2. Earth quake response forces
3. Local district administration
4. Police and fire service department
5. Army

This device is equipped with a highly sensitive acoustic sensor that can pick up very low sound signals like moaning, tapping and scratching made by the persons trapped under the debris.

2. Biodigester



Defence Research & Development Establishment (DRDE), Gwalior

Bio-Digester technology has been developed for resolving the problems of un-decomposed human waste. The innovation degrades and converts the human waste into usable water and gasses in an eco-friendly manner. The generated gas can be utilized for energy/ cooking and water for irrigation purposes.

The process involves the bacteria which feed upon the faecal matter inside the tank, through anaerobic process which finally degrades the matter and releases methane gas that can be used for cooking, along with the treated water.

The Bio-digester tank can be manufactured and customised as per the requirement.

Salient Features:

- No bad smell in toilets from the tanks
- Faecal matter in the tank not visible
- No infestation of cockroaches & flies
- No clogging of digester
- Effluent is free from off odour and solid waste
- Reduction in pathogens by 99%
- Reduction in organic matter by 90%
- No maintenance required
- No requirement of adding bacteria/ enzyme
- No need of removal of solid waste
- Use of phenyl is permitted upto 84 ppm

Areas of Application

Bio-Toilets

Industry Partner through DRDO-FICCI ATAC

Banka Enterprises
105, Babukhan Mall
Somajiguda Circle,
Dwarakapuri Colony,
Panjagutta,
Hyderabad - 500082

3. Bio-larvicide

Defence Research Laboratory (DRL), Assam

Mosquito larvae are generally killed using synthetic insecticides, which are very detrimental to environment. However, development of eco-friendly mosquito larvicides would be a positive approach to maintain sustainable eco-environment. The lab has isolated a potential entomopathogenic soil bacteria, *Bacillus sphaericus* and developed a mosquito biolarvicides of 10% powder formulation using this bacteria. The identified bacteria act on mosquito larvae through its paraparal crystal delta endotoxin. The endotoxin acts on mid-gut epithelium causing disintegration of gut wall, cessation of feeding activity, starvation and leakage of gut contents into haemolymph and body cavity of the mosquito larvae causing paralysis and death. Recommended dose for field use is 200-500 gm/ha to be sprayed uniformly over the water surface of mosquito breeding site with Knapsack sprayer. Spheritox is a biological larvicide based on highly effective strain of *Bacillus sphaericus* GC Subgp. IV isolated from mosquito breeding habitat. The bacillus isolates were inoculated in growth media and incubated for 48 hrs and the biomass harvested was lyophilized and thoroughly mixed with filler inert material at the ratio of 1:10 and used as water dispersible powder 10%WDP. This innovation acts as a stomach poison and shows high larval mortality than other commercial formulations available in the market.

Areas of Application

The biolarvicide is very effective against *Culex* and *Anopheles* larvae and therefore, it has potential uses in controlling vector borne diseases in areas where these vector species are prevalent.

4. Herbal Mosquito Repellent Vaporizer

Defence Research Laboratory (DRL), Assam

The innovation is a herbal based eco-friendly, non-toxic and sweet smelling formulation of mosquito repellent liquidator, which is very effective and has long shelf life. The chemical repellents available in the market all contain toxic chemical and may cause some health problems after long use. The innovation is based on natural products incorporating safety from accidental application by human, particularly by children and quick in action to cause repelling / mortality in mosquitoes with an environmentally accepted sweet fragrance. It is produced from herbs with repelling and medicinal properties and it is non-toxic & non allergic. It suits children.

Areas of Application

This herbal formulation keeps away insects and therefore, has potential application in hot and humid areas where water borne diseases are most prevalent.



5. Multi-Purpose Foldable Cot



Institute of Nuclear Medicine & Allied Sciences (INMAS), New Delhi, India

DRDO's INMAS in Delhi has developed a Multi-Purpose Foldable cot that can be carried as backpack, due to its compact folding configuration and light weight. It has been designed to be used as a stretcher for fast evacuation of jawans/patients and is also useful in all types of terrains to be used as a sleeping bed for comfortable sleep to Jawans. The accessories like pouch for toilet/ medicines and I-V fluid pole, make it suitable to use it as medical bed in emergency situations. Its backpack size and lightweight make it user friendly and important life saving device. The high strength low density aluminum alloy used in its frame is anodized to make the structure corrosion free to increase its durability and aesthetics. The fabric being used is of high strength, low weight and it is even washable.

Industry Partner through DRDO-FICCI ATAC

Yorco Sales Pvt. Ltd.
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23286624
F : 91-11-23264042
E : sales@yorco.com

Areas of Application

- Disaster management
- Training institutes, camping, night shelters etc
- Field operations, transit camps, hospitals and ambulances
- In railway waiting halls for old, disabled persons and ladies. Further to provide first aid to the passengers in case of medical emergency.
- Can be used as additional beds in rooms of hotels/lodges
- Domestic application as beds, specifically in metropolitan cities.

6. RO based Mobile Water Purification System (MWPS)

Defence Laboratory Jodhpur (DLJ)

Large-scale biological and chemical contamination of environment, equipment, food and water may take place in case of an Industrial accident, natural calamity, terrorist activity, etc. Water is one of the most basic requirements for survival of human beings during any type of calamity.

Keeping the above scenario in view to meet the challenges of post disaster management, the lab has developed a reverse osmosis based Mobile Water Purification System (MWPS) mounted on Stallion vehicle for efficient removal of suspended solids, dissolved salts (up to 4000 ppm) and biological and toxic chemicals from contaminated water. WPS is a mobile unit fitted on 5/7.5-ton stallion vehicles along with a self-supporting power system by a DG set. It has a capacity to produce up to 3000 litres of drinkable water per hour from brackish water, contaminated water with biological and toxic chemicals.

The NBC Water Purification System has undergone the extensive trials by various agencies, proving its capabilities. The vehicle has proved its efficacy in the relief work after various natural calamities like TSUNAMI at Nagapattinam district of Tamilnadu and Kawas floods at Barmer distt of Rajasthan.

Areas of Application

The reverse osmosis based MWPS could be of immense value and utility in the following situations:

- Post Industrial disaster purification of contaminated water to provide drinking water to masses. Toxic chemicals, heavy metals & microbial contaminants are very efficiently handled by the system.
- Post disaster (natural or man made) management, especially for providing potable water. Systems high mobility is of very good use in such situations.
- Provision of Potable water during temporary gatherings of masses like various religious fairs (e.g. Kumbh fair, Urs fair, etc), public gatherings, etc





Technology Sector: Energy

S.No.	Technology Name	Industry Partner
7.	Electrochromic Window	-
8.	Dissipative Acoustic Silencer	-
9.	Phase Change Material (PCM) Based Cool Panel	-

7. Electrochromic Window



Defence Laboratory Jodhpur (DLJ)

The technology is an electrochromic window, alternatively known as smart window. The electrochromic window can be darkened or lightened electronically and can be controlled through a remote control device. A small voltage applied to the windows causes them to darken and reversing the voltage causes them to lighten. This capability allows for the automatic control of the amount of light and heat that passes through the windows, thereby presenting an opportunity for the windows to be used as energy-saving devices.

This innovation can be effectively used towards reducing electricity loads by integrating it within the buildings. It can also be used in cars for reducing the effects of headlight glares which otherwise cause visual discomfort and diminishing ability to see the surroundings during nighttime driving and during bright, sunny days.

The developed EC window technology has got advantages in many folds over the existing technologies (such as liquid crystal window, thermo chromic window and photo chromic window) like (i) Dynamic control of solar transmission i.e. between 17- 70% achievable with fast switching time and low dc power consumption i.e. from 1 to 3v (ii) Control is possible through a dimmer switch or remote control device (iii) Transmits high levels of visible light while reflecting invisible solar heat and therefore provide both visual and thermal comfort (iv) Response time is very fast i.e. < 1 minute (v) The raw material Costs are comparatively less. Approx. Cost is Rs. 800/-sq. ft. and reducible on bulk production.

Areas of Application

- Residential & commercial buildings
- Motor industries
- Rear view mirror
- Front glass window
- Sun roof for energy saving
- Air force helicopter canopies
- Safety goggles

8. Dissipative Acoustic Silencer



Naval Science and Technological Laboratory (NSTL), Visakhapatnam

The subject technology is a sound absorption device to moderate the sound effect of a machine. Noise reduction can be achieved by modification of source or path or receiver. Among these, modification of path is most practicable. For intakes and exhausts of air/gas handling systems, Dissipative Acoustic silencers is one such solution. These silencers attenuate noise in ducts through which gas/air flows by baffling process. The silencers are made up of ducts filled with spaced baffles. They work on the principle of sound absorption for reducing the noise. Dissipative acoustic silencer is a noise control device for ducts in which gas flows. Broadband sound attenuation can be achieved by using these silencers. The silencer works on the principle of sound absorption through its baffles. Each baffle consists of a perforated metallic sheet filled with sound absorbing material. Silencer attenuation takes place by ing dissipated sound energy into heat. The technique was employed in developing acoustic silencers for various shipboard equipment such as Gas Turbines and Ventilation fans.

Dissipative acoustic silencer is an important noise control device which is widely used to attenuate the noise in ducts through which gas flows and in which the broadband sound attenuation must be achieved which a minimum of pressure drop across the silencer. Dissipative silencers attenuate sound by converting the acoustical energy propagating in the passages into heat. NSTL has developed acoustic silencers for Gas turbine intake and Ventilation fans. With these silencers, 10 to 12 dB (A) noise reduction was achieved.

Areas of Application

These can be used for reducing air borne noise caused by air flow at the intake and exhaust ducts of gas turbine, air conditioning and ventilation ducts connected to small and large industrial fans, cooling tower installations etc.

9. Phase Change Material (PCM) Based Cool Panel

Defence Laboratory Jodhpur (DLJ)

The technology is a phase change material based cool panel. PCM is a substance with a high heat of fusion, which melting and solidifying at a certain temperature, is capable of storing and releasing large amounts of energy. Heat is absorbed or released when the material changes from solid to liquid and vice versa. Thus, PCMs are classified as latent heat storage (LHS) units.

PCMs can smooth daily fluctuations in room temperature by lowering the peak temperatures resulting from extreme external daily temperature changes. PCMs are solid at room temperature. When the temperature becomes warmer, PCMs liquefy and absorb and store heat, thus cooling the house (or inside of vehicles). Conversely, when the temperature drops, the material will solidify and give off heat, warming the house. By incorporating PCMs in the building envelope, they absorb the higher exterior temperature during the day, and dissipate the heat to the interior at night when it is cooler, thereby, moderating the outdoor temperatures.

This technology has been tested in extreme weather conditions (for a prototype shelter of the size 240 Cm L × 120 Cm W × 180 Cm H) and it has been concluded that even during acute hot days of summer, the temperature never goes beyond 40 degree C. This is an extremely useful technology having all desired properties of a PCM such as being non-toxic, non-corrosive and non-hygroscopic and can find applications in residential use, telecom shelters and vehicles, particularly railway coaches and for military use in extreme weather conditions.

This technology offers several advantages such as energy saving and increase in productivity levels by making the working conditions more favorable for those employed or residing in locations with harsh, extreme weather conditions.

Areas of Application

These panels can be used to reduce heat load passively on temporary and permanent buildings, telecom shelters, railway coaches and vehicles.





Technology Sector: Water, Waste Management, Environment

S.No.	Technology Name	Industry Partner
10.	Sludge/Wastes containing Heavy Metals by Stabilization Technology using Polymeric Resins	-
11.	Treatment of Heavy Metal Contaminated Effluent/Water by Electrochemical Technique	-

10. Sludge/Wastes containing Heavy Metals by Stabilization Technology using Polymeric Resins



Centre for Fire, Environment & Explosive Safety (CFEES), New Delhi

The innovator has developed stabilization technology for different heavy metal wastes containing chromium, lead, mercury, nickel, manganese, zinc, cadmium and arsenic. The technology employs polymeric resins as immobilization materials, which helped to overcome the deficiencies in existing technologies such as:

- Low leachability good bonding with contaminant
- Minimum effect of temperature and water absorption
- Outstanding chemical & corrosion resistance (acids, alkalies, salts) atmospheric degradation
- High mechanical strength (tensile, compressive & flexural) & impact resistance (15-22 kg.cm/cm)
- Thermal stability
- Excellent adhesive properties with metals (active hydrogen)
- Dried metal bearing sludges can be directly incorporated into matrix without any wetting medium
 - Volumes of hazardous materials handled are minimized
 - Economical equipment sizing
- Simple processing procedure and curing at room temperature

Areas of Application

- Electroplating units
- Leather tanneries
- Steel Pickling units
- Solid-state wafer processing units
- Initiatory compositions manufacturing units
- Incineration units (bottom ash)

11. Treatment of Heavy Metal Contaminated Effluent/Water by Electrochemical Technique

Centre for Fire, Environment & Explosive Safety (CFEES), New Delhi Technology description

The technology is an electrochemical-based technology for treatment of heavy metal (chromium, mercury, cadmium, copper, nickel and lead) contaminated wastewaters. Experiments were carried out and 4200 L of effluents containing toxic heavy metal concentrations were brought down to within environmentally acceptable levels.

Areas of Application

- Electroplating units
- Tanneries
- Pickling units



Technology Sector: Medicine, Health Sciences

S.No.	Technology Name	Industry Partner
12.	Alocal Cream	-
13.	Chikungunya Antigen ELISA	Tulip Group of Companies
14.	Chikungunya RT-LAMP	Biotron Healthcare (India) P. Ltd
15.	Chikungunya IgM Elisa Detection Kit	Tulip Group of Companies
16.	Crataegus Crenulata: Herbal Health Drink to Overcome the Problem of Hypertension	-
17.	Dengue-CHIK Duplex RT-PCR	-
18.	Dengue IgM ELISA	-
19.	DEPA - Multi Insect repellent	Jyothy Laboratories Limited
20.	JE IgM ELISA	Tulip Group of Companies
21.	H1N1 Swine Flu Detection Kit	RAS Life Sciences Pvt Ltd
22.	Herbal Adjuvant: DIP-HIP	-
23.	Herbal Hypolipidemic: DIP-LIP	-
24.	High Altitude Pulmonary Oedema (HAPO) chamber	-
25.	Herbal Health from Dillenia Indica	-
26.	Protocol for in Vitro Culture of Cordyceps Sinensis, Indian Strain	-
27.	Roachtox & Roachline	-
28.	Typhigen Kit	-
29.	UMBRIEL: The High Altitude Herbal UV Screen	Percos India Pvt. Ltd.
30.	Woolcare	(i) Ganesha Impex (ii) Jyothy Laboratories Limited

12. Alocal Cream



Defence Institute of Physiology & Allied Sciences (DIPAS), New Delhi

“Alocal” is an Aloe vera based cream to use locally on the surface of skin. It does not freeze or flakes off up to -30 degree Celsius. It helps in prevention and management of cold injury / frostbite. It improves blood flow in the extremities thereby maintaining warmth / body temperature at low ambient temperature. Clinical field trials conducted on soldiers posted in the glacier areas, significantly proved the usefulness of Alocal in prevention as well as management surgeries related to of Frostbite cases.

Alocal is prepared from Aloe vera and several other constituents, which does not freeze or flakes off up to -30°C. It is to use locally on the surface of skin. It helps in prevention and management of cold injury / frostbite by improving blood flow in the extremities thereby maintaining warmth / body temperature at low ambient temperature. Aloe vera has been identified to have the anti-freezing properties and the preventive local application of Alocal or curative use for a week, has been found to be efficacious in preserving and in reducing the extent of tissue loss remarkably.

Areas of Application

The beneficial effect of prophylactic/therapeutic application of Alocal cream may be attributed to its anti-inflammatory, antibacterial, vasodilatory, wound healing and tissue regenerating properties. It helps in prevention and management of cold injury / frostbite by improving blood flow in the extremities thereby maintaining warmth / body temperature at low ambient temperature. Clinical field trials conducted in the glacier areas, significantly proved the usefulness of Alocal in prevention as well as management surgeries related to of Frostbite cases.

13. Chikungunya Antigen ELISA



Defence Research & Development Establishment (DRDE), Gwalior

Chikungunya has recently emerged as an important arboviral infection of medical importance, with explosive outbreaks in many areas of India and Indian Ocean islands. There is no effective therapy or prophylaxis available against this disease. Therefore early diagnosis plays an important role in proper control and effective management of patients.

This assay is based on the principle of double antibody sandwich ELISA. Purified rabbit anti-Chikungunya virus polyclonal antibody was coated on the ELISA wells to capture CHIKV antigen in patient sera. After binding, the rabbit anti-CHIKV antibody was used in a sandwich format. The resulting complex is detected using enzyme substrate reaction. Appearance of color change to brown indicates positive result.

This kit is validated with more than 100 clinical samples (Serum and CSF), collected from recent Chikungunya outbreaks in different part of India (2006-2008). It revealed >80% correlation with virus isolation and gene based molecular assays.

The present innovation is a kit for early detection of Chikungunya (CHIKV) with high degree of sensitivity and specificity is based on the principle of double antibody sandwich ELISA. CHIKV is an insect-borne virus, of the genus, Alphavirus, that is transmitted to humans by virus-carrying Aedes mosquitoes in a human subject of Chikungunya infection. The kit will be useful for early clinical diagnosis of Chikungunya virus. Purified rabbit anti-Chikungunya virus polyclonal antibody was coated on the ELISA wells to capture CHIKV antigen in patient sera. After binding, the rabbit anti-CHIKV antibody was used in a sandwich format. The resulting complex is detected using enzyme substrate reaction. Appearance of color change to brown indicates positive result.

Areas of Application

These kits will be useful for early diagnosis of Chikungunya infection with high sensitivity and specificity.

Industry Partner through DRDO-FICCI ATAC

Tulip Group of Companies
Orchid Biomedical Systems &
Qualpro Diagnostics
88/89, Phase II C, Verna
Industrial Estate,
Verna, Goa - 403 722, India

T : 91-832-6682000

F : 91-832-2783139

T : 91-832-6682020

E : orchid@tulipgroup.com

W : www.tulipgroup.com

14. Chikungunya RT-LAMP



Industry Partner through DRDO-FICCI ATAC

Biotron Healthcare (India) P. Ltd

301, Coral Classic, 20th Road,
Chembur, Mumbai 400071

T : (91-22) 61406420
61406400

M : (91) 98200 10799

F : (022) 2528 1012

W : www.biotronhealthcare.com

Defence Research & Development Establishment (DRDE), Gwalior

Chikungunya has recently emerged as an important arboviral infection of medical importance, with explosive outbreaks in many areas of India and Indian Ocean islands. There is no effective therapy or prophylaxis available against this disease. Therefore early diagnosis plays an important role in proper control and effective management of patients.

This assay is intended for detection of genomic viral RNA in clinical samples (serum and CSF) as well as in culture supernatant. This is a new generation innovative gene amplification assay and is based on the principle of autocyclic strand displacement mechanism employing a set of six primers comprising two outer, two inner and two loop primers that recognize eight distinct regions spanning over 205 bp conserved regions of structural E1 gene.

The result can be monitored either in the form of visual turbidity or visual fluorescence through color change by naked eye. The better appreciation of apple green fluorescence can be achieved by a simple UV hand held torch.

This assay has been extensively validated with more than 500 suspected serum and CSF samples at DRDE Gwalior, NIMS Hyderabad, CIIMS Nagpur and Kottayam Dist Hospital Kerala. The result indicated excellent correlation in terms of sensitivity and specificity compared to RT-PCR.

This technology is based on isothermal gene amplification principle for detection of genomic viral RNA in clinical samples (serum and CSF) as well as in culture supernatant. This is a new generation innovative gene amplification assay and is based on the principle of autocyclic strand displacement mechanism employing a set of six primers comprising two outer, two inner and two loop primers that recognize eight distinct regions spanning over 205 bp conserved regions of structural E1 gene. The result can be monitored either in the form of visual

turbidity or visual fluorescence through color change by naked eye. The better appreciation of apple green fluorescence can be achieved by a simple UV hand held torch.

Areas of Application

This assay will be useful for detection of viral RNA in clinical samples and will be useful for early diagnosis of chikungunya infection with very high sensitivity and specificity.

15. Chikungunya IgM Elisa Detection Kit



Industry Partner through DRDO-FICCI ATAC

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Defence Research & Development Establishment (DRDE), Gwalior

Chikungunya has recently emerged as an important arboviral infection of medical importance, with explosive outbreaks in many areas of India and Indian Ocean islands. There is no effective therapy or prophylaxis available against this disease. Therefore early diagnosis plays an important role in proper control and effective management of patients.

This kit is based on indirect ELISA principle, using recombinant Chikungunya protein antigen. The wells of ELISA plate was coated with recombinant Chikungunya antigens. The Chikungunya specific antibodies present in the test sera bind with antigen. The reaction was further processed with the addition of antihuman IgM-HRP conjugate. The reaction was observed through colorimetric interaction with chromogen. Color development is indicative of the presence of Chikungunya virus specific IgM antibodies in the test sample.

Areas of Application

This kit is very useful for early and rapid diagnosis of chikungunya infection with high sensitivity and Specificity

16. Crataegus Crenulata: Herbal Health Drink to Overcome the Problem of Hypertension

Defence Institute of Bio-Energy Research (DIBER),
Haldwani

Under prevailing circumstances there is a large demand in the modern society for the soft drinks of herbal origin, which are completely free from hazardous chemicals, colours and preservatives. Secondly, the people like to have a beverage having medicinal properties in the form of nutraceuticals to cure the common human ailments of the society. Hypertension is a common health problem of masses now a days. Changed food habit and life style of modern society has aggravated this problem considerably.

Several synthetic drugs under the different trade names are available in the market to overcome the problem of hypertension. People taking these synthetic drugs regularly for a long period may face some problems due to the side effects of these drugs. Since herbal products are safe to consume even for a long span of time. Keeping this in mind a herbal beverage from fruits berries of *Crataegus crenulata* having anti hypertensive properties has been developed by DRDO. *Crataegus crenulata* is endemic to Himalayan hills ranging from 900 to 2400m altitude and is locally known as "Ghingaroo". Owing to its nutraceutical, pharmaceutical, biotechnological and environmental usage, DRDO has made a successful attempt in exploitation of *Crataegus crenulata*. The beverage developed from its berries are very nutritious, having flavonoides 2-3%, Vitamin A 289 IU/100g, vitamin B12 110 ug/100g, Vitamin C 57.8 mg/100g, Vitamin E 289mg/100g protein 1.6%, calcium 3.79 mg/100g, magnesium 1.38 mg/100g, potassium 1.39mg/100g. Flavonoids and oligomeric proantho-cyaninidins are the most bioactive constituents present in berries of *C. crenulata*. Modern scientific research has shown that this shrub has patients with hypertension have shown that total flavanoides of *Crataegus* reduce cholesterol level and improves cardiac functions. Besides this the beverage is useful in case of insomnia, neurasthenia, anxiety and anorexia. No such herbal beverage is available in India so far hence keeping in view the healthcare of the people attempt was made to introduce the beverage in the form of nutraceuticals. DRDO has developed herbal beverage from its berries.

17. Dengue-CHIK Duplex RT-PCR

Defence Research & Development Establishment (DRDE), Gwalior

Dengue (DEN) and Chikungunya (CHIK) have emerged as two most important arboviral infections of global significance. The similarities in clinical presentations, their circulation in the same geographical area and transmission through same vector necessitate an urgent need for the differential diagnosis of these two infections. The incidence of dual infection in the same individual further complicates the task of the clinicians to arrive at a definitive diagnosis. In the absence of any specific therapy or vaccine, early diagnosis is crucial for patient management.

This assay is based on the principle of duplex RT-PCR, by targeting genomic regions of both dengue and chikungunya virus. This assay is developed as a one step method by combining both RT and PCR steps. Further both primers are included in the single tube, making it a one-step, single tube protocol.

The presence of 511 bp indicates dengue complex and of 205 bp indicates Chikungunya infection. Presence of both amplicons suggests the dual infection in the same patient.

The evaluation was carried out with more than 400 clinical samples from recent chikungunya and dengue outbreaks in India. This assay could also able to detect dual infection of CHIK and DEN in patients. This kit has potential clinical and epidemiological application for rapid, sensitive detection, differentiation and genotyping of DEN and CHIK viruses in clinical samples.

The innovation is a testing kit for detection of Dengue (DEN) and chikungunya (CHIK) infection with high degree of sensitivity and specificity in a single clinical sample. Dengue and CHIKV is an insect-borne virus, of the genus, Alphavirus, that is transmitted to humans by virus-carrying mosquitoes in a human subject. The present innovation is based on the principle of duplex RT-PCR (Reverse Transcriptase Polymerase Chain Reaction) assay. The assay includes one-step method of combining both RT and PCR steps and targeting genomic strands of both

Dengue and chikungunya virus. The presence of 511 bp indicates dengue complex and of 205 bp indicates Chikungunya infection. Presence of both amplicons suggests the dual infection in the same patient. There are various antiviral agents used against Chikungunya and Dengue infections but these antiviral agents are not effective. Further, till now there is no effective prophylaxis treatment available for Chikungunya and Dengue. The present innovation is better than the existing solution as it can detect the presence of Dengue and CHIKV virus in a single sample i.e. dual infection in the same patient. This assay could also be able to detect dual infection of CHIK and DEN in patients. This kit has potential clinical and epidemiological application for rapid, sensitive detection, differentiation and genotyping of DEN and CHIK viruses in clinical samples. The kit will be useful in public health sector for early clinical diagnosis and surveillance of Dengue and Chikungunya infection.

Areas of Application

This assay will be useful for early detection and differentiation of dengue and chikungunya infection with very high sensitivity and specificity.

18. Dengue IgM ELISA



Defence Research & Development Establishment (DRDE), Gwalior

Dengue is the most important arboviral infection of medical importance. It is now endemic in many parts of tropics and sub tropics, including India. There is no effective therapy or prophylaxis available against this disease. Therefore early diagnosis plays an important role in proper control and effective management of patients. The innovation is a type of medical equipment and reagents in the form of kit for early detection of dengue fever. The subject technology is based on indirect ELISA principle, using recombinant dengue protein antigen. The wells of ELISA plate is coated with recombinant dengue antigens. The Dengue specific antibodies present in the test sera bind with antigen. The reaction is further processed with the addition of antihuman IgM-HRP conjugate. The reaction is observed through colorimetric interaction with chromogen. Color development is indicative of the presence of Dengue virus specific IgM antibodies in the test sample. The technology claims that the cross reactivity with other co-circulating members of flavivirus group are ruled out by employing recombinant antigen thereby making the kit more specific for dengue virus only. Whereas the commercially available Dengue IgM ELISA kits are reported to have false positive results with malaria, leptospira, typhoid etc This kit is validated with more than 100 serum samples collected from recent Dengue outbreaks in India. It revealed >85% correlation with widely used commercial diagnostic kit

Areas of Application

This kit will be useful for diagnosis of dengue infection with high sensitivity and Specificity

19. DEPA - Multi Insect Repellent



Industry Partner through DRDO-FICCI ATAC

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Defence Research & Development Establishment (DRDE), Gwalior

Insects are carriers (vectors) of dreaded diseases such as malaria and dengue. Various methods have been used for the control of these vectors in different ecological conditions with certain limitations. Application of insecticide residual spraying as a method of vector control through practiced today is resented by many. Primarily it causes inconvenience to children and other persons suffer from the toxicity. A better method would be to use a personal protection measure that is sufficient to protect human from the painful bites of blood sucking organisms such as mosquito, sand fly, black fly, rat flea and bed bugs . A multi - insect repellent DEPA (diethylphenylacetamide) cream formulation has been developed. Extensive studies have been carried out for its bio efficacy and toxicity including inhalation. No untoward effect on mammalian systems has been observed. The cream formulation has been accepted and recommended by the Director General Armed Forces Medical Services (DGAFMS).

The present innovation is a Multi Insect Repellent based on DEPA (Diethyl Phenyl Acetamide) formulation, which is:

- Very effective against variety of blood sucking organisms including mosquitoes, horse flies, rat fleas and land leeches
- Safe to human i.e. Non-Toxic, Non-Irritant and Cosmetically Acceptable
- Has been found to be superior to the commonly available repellents
- No need for frequent application of cream. One application of DEPA cream in the evening will protect the user throughout night.
- Highly cost effective and efficacious against several organisms even in hot humid conditions of the country
- Equally useful in open places
- Can be formulated as a cream, lotion or spray as per customer's choice.

Unlike the other mosquito repellents available in the market, which are mostly pesticide-based and hence toxic, the present innovation is based on Diethyl Phenyl Acetamide (DEPA) formulation which is safe on people. It can also be used as room or body spray with its anti-mosquito content lasting for about 6 hours.

Areas of Application

The formulation is very useful for:

School Children, Field Workers, Tourists, Railways and Transport Employees, Armed Forces, Patrolling Parties, Foresters & Coastal Guards, Religious Gatherings People, Victims of Natural Disaster, Villagers, Jail Inmates, etc

20. JE IgM ELISA



Industry Partner through DRDO-FICCI ATAC

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Defence Research & Development Establishment (DRDE), Gwalior

Japanese encephalitis (JE) is the most important viral encephalitis of public health significance. It is endemic through out south east Asia, including India. Approximately 45,000 JE cases with 10,000 deaths were notified. Early diagnosis plays an important role in proper control and effective management of patients.

The innovation is a ready to use device for early detection of Japanese Encephalitis fever which is a mosquito borne arboviral disease that can affect the central nervous system and cause severe complications and death. JE virus is a member of the genus Flavivirus, family Flaviviridae, and is transmitted between vertebrate hosts by mosquitoes, principally by *Culex tritaeniorhynchus*. There is no effective therapy available against this disease. Therefore early diagnosis plays an important role in proper control and effective management of patients.

The subject technology is based on indirect ELISA principle, using recombinant protein antigen. The wells of ELISA plate is coated with recombinant JEV antigens. The JEV specific antibodies present in the test sera bind with antigen. The reaction is further processed with the addition of antihuman IgM-HRP conjugate. The reaction is observed through colorimetric interaction with chromogen. Color development is indicative of the presence of JE virus specific IgM antibodies in the test sample. The technology claims that the cross reactivity with other co-circulating members of flavivirus group are ruled out by employing recombinant antigen thereby making the kit more specific for JE virus only. Whereas the commercially available kits are reported to have false positive results with malaria, leptospira, typhoid etc This kit is validated with more than 120 clinical samples (Serum and CSF), collected from different regions in India during outbreak of JE Virus. It revealed >85% correlation with commercially available diagnostic kits.

This kit will be useful for diagnosis of Japanese encephalitis (JE) infection with high sensitivity and specificity.

21. H1N1 Swine Flu Detection Kit



Swine Flu detection kit used for early and rapid detection of **H1N1 virus**. It uses a simple technique called real-time loop amplification methodology (RT LAMP) to detect the H1N1 virus. Every virus has a DNA structure. The loop of the DNA, specific to the virus, gets amplified. Here, one can visually see the change of colour to know whether the A(H1N1) sample is positive or negative, The Technology is self contained comprehensive kit packs. H1N1 detection kit give test reports in 1-2 hours and will come at a low cost. The present kit is kit was found more specific and sensitive as compared to other similar kits available in the market.

Industry Partner through DRDO-FICCI ATAC

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22. Herbal Adjuvant: DIP-HIP

Defence Institute of Physiology & Allied Sciences (DIPAS), Delhi

The technology is a herbal adjuvant which is an agent that may stimulate the immune system and increase the response to a vaccine, without having any specific antigenic effect in itself. Adjuvant, have been used for decades as important agents for generation of strong immune response to vaccine antigens. Classically the adjuvants are determined by their ability to potentiate strong antibody response. However, besides generating strong immune response, they also act as immunomodulators by influencing the type and character of antibody generated. Therefore, the choice of adjuvant is of immense importance for the isotype and subclasses of IgGs, patterns of cytokine and recruitment of T cells. Currently, Freund's Adjuvants are predominantly used in raising antisera in animals, whereas for humans only Aluminium hydroxide (Alum) is in routine use. The lab has developed a new herbal adjuvant, called DIP-HIP, and compared its efficacy with complete Freund's Adjuvant and Alum. Animals were immunized with different antigens. The results indicated that antigen specific immunoglobulin levels were significantly enhanced by DIP-HIP. The cytokine profile also correlated very well with the Th1 and Th2 type of immune response generated on administration of DIP-HIP. Interestingly, using different strains and different species, DIP-HIP responded better than CFA. The sustenance of antibody response in the body was for about more than four months using DIP-HIP. Immunization through different routes like intraperitoneal and intramuscular did not show any significant difference nor caused any muscular damage, granulomatous reaction or dystrophy. The shelf life of DIP-HIP as such is for more than 3 years where as in the form of formulation with and antigen is about 4 months at 40 C. There is no haemolytic activity observed on treatment of both human and animal erythrocytes with DIP-HIP.

Areas of Application

Incorporation of DIP-HIP will result in enhancing, accelerating and prolonging the antigen specific-antibody responses in animals. The results are at par with Oil adjuvant but more significant than those of alum. Thus the new adjuvant developed can substitute oil and Alum adjuvants. Further advantages of DIP-HIP are the enhancement of immunogenicity, the reduction of antigen amount needed for a successful immunization, the reduction of frequency of booster immunization without any muscular damage or side effects.

23. Herbal Hypolipidemic: DIP-LIP

Defence Institute of Physiology & Allied Sciences (DIPAS), Delhi

Herbal Hypolipidemic, called DIP-LIP obtained from a high altitude growing plant, is rich in essential fatty acids like linolic acid (26%), linolenic acid (20%) and other important fatty acids such as oleic (30%) and palmitic acid (17%). Presence of these fatty acids and total carotenoids (430 ppm) and tocopherol (1175 ppm) imparts its potent bioactivities. It has significant hypocholesterolemic activity and inhibits cholesterol deposition in cholesterol-fed animals besides increasing HDL cholesterol levels. Herbal hypolipidemic also showed significant vasorelaxant activity in aortic ring model. Besides that it was also found to possess increased resistance to hypoxia and cold stress.

Areas of Application

DIP-LIP can be widely used for atherosclerotic cases for its hypolipidemic and vasorelaxant properties. Being hypocholesterolemic, it also inhibits cholesterol deposition. Above all it helps in increasing HDL cholesterol. Nevertheless, use of DIP-LIP imparts resistance to hypoxia and cold stress.

24. High Altitude Pulmonary Oedema (HAPO) Chamber



Defence Bioengineering and Electromedical Laboratory (DEBEL), Bangalore

High Altitude Pulmonary Oedema (HAPO) chamber is a portable first aid device used for treating varying degrees of acute mountain sickness including HAPO. The most effective treatment for HAPO is to move the patient to a lower altitude, which is often not practical, especially at the forward posts, due to non-availability of aircraft or hostile weather condition. HAPO chamber which is a light weight (5 kg) cylindrical one-man chamber runs on the principle of increasing the atmospheric pressure around the patient thereby simulating descent in altitude. The patient is kept inside the chamber and can be inflated to a maximum pressure of 130 mm Hg thereby simulating a descent of about 2500m 8000 feet without any physical movement. The principle feature is the APC unit which when connected to AC power supply maintains the pressure between 110 mm Hg to 130 mm Hg. 3. In the absence of AC power supply, the unit can also be powered by a battery and an inverter unit provided along with chamber. The chamber is durable and cold resistant. It has a long air/water-proof zip running across the length and has three transparent windows for the observation of the patient. A pressure gauge is provided for reading the maintained pressure of the chamber and a release valve is provided to protect against any inadvertent pressure build-up. This chamber opens automatically in case the pressure goes above the permissible limit. An adjustable leakage valve is provided for maintaining a reasonable leakage rate for prevention of carbon dioxide build-up and excessive heat accumulation.

Areas of Application

High altitude mountaineering expedition, Kailash Manasarovar Yatra etc

25. Herbal Health from Dillenia Indica



Defence Research Laboratory (DRL), Assam

The present innovation involves the processing of the fruit pulp of *Dillenia indica* to make the health drink. Its nutritional data, bacteriological and toxicological studies were conducted as per guidelines. The herbal product is manufactured from herbal plant fruits such as elephant apple (*Dillenia Indica*). It is used as an alternative medicine for digestive health problems. Further, it may be taken as energy drink in summer or humid environments for relief from heat stress, and the like. Moreover, such herbal products are better than other conventional herbal drinks because of high calorific value thereof and easily digestible nature. Additionally, such herbal products are highly rich in antioxidant properties.

Herbal health drink is currently under development from the fruit of Elephant apple (*Dillenia Indica*). Because of unique taste and flavors of the drink, derived from non conventional fruits of North East India, it will have a dominant over health drinks of other fruits presently available in the market. Nutritionally also, it will be better than other health drinks because of its high calorific value and easily digestible nature. It is highly rich in antioxidant properties.

Areas of Application

It is highly recommended for anyone stationed in hot and humid climatic environments to get rid of heat stress.

26. Protocol for in Vitro Culture of Cordyceps Sinensis, Indian Strain

Defence Institute of Bio-Energy Research (DIBER),
Haldwani

Cordyceps sinensis is a high value medicinal fungus found growing rarely on the insect caterpillar in higher Himalayan hills. Life cycle of the moth is very long 3-4 years hence its rearing in the laboratory is totally cumbersome and uneconomical. The species has become endangered due to overexploitation by the local people. Being an important nourishing tonic and adaptogen it increases the physical stamina and is found beneficial in case of impotence, emission, neurasthenia, rheumatoid arthritis, cirrhosis, flabby waist and knee.

Because of its medicinal value and scarcity in nature the artificial cultivation of mycelium of this fungus is very much important and is a need of the day. Standardization of the media protocol includes optimization of physical culture conditions and media composition. This new approach was made keeping in view the standards of good manufacturing practices which ensured the mass production of fungus having optimum quantity of active ingredients. With this innovation higher quantity of active ingredients is obtained in comparison to the existing innovations.

DRDO has successfully developed the protocol for mycelium culture of *Cordyceps* in the laboratory. The availability of the specimens in nature is in scant and it involves a high labor cost to collect the fungus from the natural habitat. Under such circumstances, laboratory culture of this fungus is an alternative solution to fulfill the demand & supply of such a high medicinal value and prized fungus. Optimization of protocol for laboratory production of the mycelium of *C. Sinensis* will definitely prove a great success in formulation of various products from the dried mycelium, which has numerous therapeutic potential applications.

27. Roachtox & Roachline



Defence Research & Development Establishment (DRDE), Gwalior

ROACHTOX

Roachtox is a toxicant-attractant tabletized bait development specially by experts in insects control to kill all the species of household cockroaches. This product is first of its kind in India. It is far superior to available baits in terms of its efficacy, safety and cost. This novel bait has undergone extensive field evaluation in naval ships and also in household. Based on our research, the Indian Navy have shown keen interest in this product and could be a market for this. Since cockroach menace is a common to virtually every household in India, Roachtox is expected to meet with immediate acceptance in the civil sector too.

Advantages

- Licensed by CIB.
- Safe to use by house wives with no health hazard. However it is advisable to keep away from children
- Roachtox is effective for 2 years when kept in closed container
- Inexpensive, one tablet costs approximately 50 paise
- Patent filed
- Ecofriendly

Roachline

It is said that cockroaches can even survive a nuclear war. Indeed we know that they survive in kitchens where food is in abundance so also in restaurants, hotels, ships and other dwelling places. Insecticidal spray and common baits can not reach their hiding places such as cracks and crevices. A long term solution is to draw them towards this bait. Roachline is a simple and a novel approach to get rid off all kinds of cockroaches (big, small, lean and stout) and also ants. All that is

required is to draw a thick line around their hiding places and area should be cordoned off. The crawling insects when cross such a line pick up lethal dose of insecticide and die instantaneously. Roachline is simply a chalk stick with a safe but effective insecticide and an attractant.

Advantages

- Licensed by CIB
- Easy and safe to use. However it is advisable to keep this beyond the reach of the children
- Effective against cockroaches and other crawling insects such as ants
- Shelf life 18 months

28. Typhigen Kit



Defence Research & Development Establishment (DRDE), Gwalior

Typhoid, an infectious disease caused by *Salmonella typhi* is a major public health problem all over the world especially for third world countries including India due to hygienic reasons, unsatisfactory water supply etc. as the disease spread by faecaloral route. Incontrovertible diagnosis of typhoid infection is based on isolation of organism from blood or urine of the suspected patient by culture and / or demonstration of rising antibody titers to 'H' and 'O' antigens by Widal test. However, isolation of organism takes 2-5 days and requires microbiological facilities, which are not always available in the area where disease is endemic. Besides, it becomes negative if patient had already been administered with antibiotics. Widal test of single serum sample is not useful in endemic areas and the detection of rising antibody titers is too slow to allow quick decision by the clinician. Therefore, a latex agglutination based detection system has been developed, using recombinant DNA technology and immunological techniques to detect typhoid antigen directly in patient's serum or plasma within 3 minutes. The system has been packed in the form of a kit, which can be used in field conditions. The kit has undergone extensive third party evaluation at premier medical institutions (AIIMS, PGI, AFMC) of the country and has been found to be highly satisfactory.

The innovation, rapid diagnostic 'typhigen' kit using recombinant DNA technology, enables direct detection of the salmonella typhi antigen in the patient's serum within one to three minutes, thus allowing early treatment of the affected persons. The test detects *S. typhi* antigen directly in patient's serum within 1-3 minutes, which is very important for initiating early treatment and saving human life. The test has been packed into a form of kit. Whereas the conventional method of typhoid diagnosis is based on the isolation of *S. typhi* from patient's blood or detection of antibodies by Widal test. Both tests have limitations. Blood culture is time consuming and requires culture facilities, which at times are not available in primary health centers in remote areas and hospitals. Besides, it becomes negative if patient had already been administered

with antibiotics. Widal test requires paired serum samples from the patient at an interval of one week and test protocol is time consuming. Besides, test is less sensitive and specified.

Areas of Application

The kit is useful for early and rapid diagnosis of Typhoid fever.

29. UMBRIEL: The High Altitude Herbal UV Screen

Industry Partner through DRDO-FICCI ATAC

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Institute of Nuclear Medicine & Allied Sciences (INMAS), New Delhi, India

The military units deployed at high altitude regions face challenges posed by the harsh environment. The excessive ultraviolet radiation at high altitude regions, together with hypoxia, cold, wind, dryness and solar radiation adversely impact the performance of troops. Providing health service support to the Armed Forces is the key mandate of INMAS. “Umbriel”- The High Altitude herbal UV screen has been specifically developed to protect the subjects from damage caused by the UV flux prevalent at high altitudes. Umbriel (a registered trademark of DRDO), is a unique combination of herbal agents developed by INMAS, DRDO. It is non-toxic, prophylactic, dermal ointment which has been scientifically tested to cut off more than 90% UV rays, prevent DNA damage, regulate melanin content in skin, prevent immuno-suppression, counter oxidative stress and photosensitivity. This product has passed highly sensitive tests such as infra-red thermography.

Areas of Application

This innovation is useful for

- People living in high altitude regions.
- Tourists visiting high altitude areas,
- Sportsmen participating in snow/ winter games at high altitudes
- People who migrate from plane to high altitudes and are un-acclimatized to the extreme UV radiations prevalent at high altitudes.

30. Woolcare for Protection of Woolens Store



Industry Partner through DRDO-FICCI ATAC

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Research and Development Establishment (R&DE), Pune

The innovation is ready to use safe insecticidal spray for moth proofing/ beetle proofing to protect carpets and woollen textiles including wool-synthetic blends from insect damage by clothes moths and carpet beetles. The subject technology is. The formulation can be adopted at various manufacturing stages without disturbing protocol. It is effective against both beetles and moths and very effective throughout the service life of fabrics. Its effect last beyond 10 washes (drycleanings). The innovation is very effective in providing complete and durable protection to the woollen textile & clothing, fur & feather lined clothes, upholstery furniture, etc both in store and use. Spray formulation of this technology does not produce bad and harmful smell on clothes after application. One application of spray is enough to protect woollen items throughout their storage from all wool pests. Further, sprayed woollen items remained protected even if left unattended for long period. Spray does not produce any colouring or discoloring of woollen items after application. Spray protects items even usage such as carpet, rugs and upholstered furniture.

Areas of Application

1. Protection of woollen items throughout their storage from all wool pests.
2. Woollen items remained protected even if left unattended for long period.
3. Spray does not produce any colouring or decolouring of woollen items after application.
4. Spray protects items even usage such as carpet, rugs and upholstered furniture.
5. It can also provide protection to the textiles & clothing during their transport and use.



Technology Sector: Communications / Security & Surveillance

S.No.	Technology Name	Industry Partner
31.	Interrogator	-
32.	Short Range Surveillance Radar	Bharat Electronics Limited (BEL)
33.	Explosive Detection Kit (EDK)	(i) Vantage, (ii) Crowe and Company, LLC
34.	Remotely Operated Vehicle (ROV) / Unmanned Ground Vehicle (UGV)	-

31. Interrogator

Centre for Air Borne Systems (CABS), Bangalore

The Interrogator system also called Secondary Surveillance Radar (SSR) in civil application plays a vital role in the Air Defence system of a country. In an emerging complex security environment, timely and accurate identification of all targets – friendly and hostile as well as locating threat targets – is of paramount importance. This can be achieved with the help of Interrogator system.

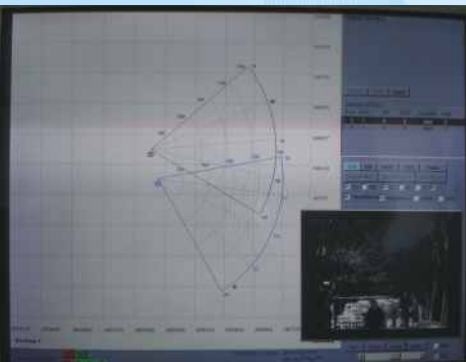
The system consists of two sub-systems, namely the Interrogator and a Transponder. It operates as per the recommendations of Annexure 10 of International Civil Aviation Organisation (ICAO) and STANAG 4193. SSR Interrogator operates in conjunction with a compatible Transponder that is fitted on the target aircraft. The airborne interrogator transmits pulsed signal with suitable spacing as per the desired mode of interrogation in a specified direction. Aircraft fitted with compatible transponder receives the interrogation signal and replies back in the form of another coded signal. These coded replies are received by the interrogator and processed for identification. It differentiates between friendly and enemy targets, by comparing the response received from the interrogated target with its own database.

It provides additional target details such as height, range and azimuth. In addition, it can extract the target status like Communication Failure, Emergency and Hijack. Operation in mode – '4' enhances its capability to be secured, jam resistant and resistant to spoofing. Mode S or mode “select”, is a way to interrogate an airframe by using a distinct address, such as an aircraft address, that only a particular airframe will respond. The IFF Interrogator system consists of E-Scan or M-Scan Antenna Array, Transmitter, Receiver and Signal processor.

Main Applications:

Security and Surveillance, Air Traffic Control

32. Short Range Surveillance Radar



Electronics & Radar Development Establishment (LRDE), Bangalore

The innovation is the state-of-the-art Lightweight, Man-Portable Battery-Powered Electronic Short Range Battlefield Surveillance Radar to provide All-Weather Surveillance against intrusion.

The present radar system is capable of:

- Searching a specified sector and performing track while scanning for multiple targets

- Detecting, tracking and aiding in classifying the moving targets

The radar has a detection range of:

- Upto 500 meters for a crawling man

- Two kms for a walking man

- Five kms for a group of people or light vehicles and

- Eight kms for heavy vehicles

The entire radar system can be carried by two persons and operated on a tripod. The radar is compact and weighs about 27 kg (packed in two modules; each weighing not more than 15 kg) and can be set up within six minute to match the speed and requirements of the users.

The radar has sophisticated built-in software algorithms to detect, track, and classify targets like crawling man, group of walking men, light and combat vehicles, and low flying helicopters. It also has a built-in interface for automatic transfer of target data to remote locations and capability of integration with imaging sensors. The radar is amenable for mast-mounted role on any light vehicle.

Industry Partner through DRDO-FICCI ATAC

Bharat Electronics Limited

BANGALORE

Areas of Applications

Major application areas include, Homeland Security Applications e.g. Border Enforcement, Maritime Domain Awareness, Critical Infrastructure, Industry Premises Protection, Law Enforcement and Coastal Surveillance, Avian (Bird) Tracking for Bird-Aircraft Strike, Hazard Management, Natural Resource Management, Environmental Impact Assessments, Ornithology Research, and Marine Surveillance.

33. Explosive Detection Kit (EDK)

High Energy Materials Research Laboratory (HEMRL), Pune

An explosive test kit has been developed for identification of explosives in pre and post explosion field conditions. Explosives in trace quantities (as low as 10 g) can be identified using the kit. It is in use by paramilitary forces etc.

Salient features of this technology are:

- It is an explosive test kit has been developed for identification of explosives in pre and post explosion field conditions.
- The Explosive Detection Kit (EDK) has potential application in detection of traces of explosive from the debris after explosion. It can also be used to detect the explosive materials from the unknown samples before explosion.
- Explosives in trace quantities (as low as 10-4 g) can be identified using the kit.
- It is capable of detecting explosives like TNT, RDX, PETN, Black Powder, Dynamite, NC, NG, CE, inorganic nitrates, and RDX based plastic explosives.
- It can also identify the explosive from unknown samples.
- It is designed and developed on the basis of compound specific colour producing spot test. Four reagents are used for detection of the specific explosive ingredient.
- It is indigenously developed and cost effective. It is sensitive, simple, rapid, precise and economical.
- It can be used by police forces, paramilitary forces, and other investigating agencies for detection of explosives both before and after explosion.



Industry Partner through DRDO-FICCI ATAC

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- This kit can frequently be used at various check posts, railway stations, airports, bus stands, metro stations, big factory establishments, etc. to detect the explosive from the ambiguous materials on the spot.
- It is being used by Armed Forces, Forensic Science Labs, Police Personnel and Paramilitary Forces.

Areas of Application

The Explosive Detection Kit (EDK) has potential application in detection of traces of explosive from the debris after explosion. The kit developed by the lab (HEMRL) is being used by Armed Forces, Forensic Science Labs, Police Personnel and Paramilitary Forces.

34. Remotely Operated Vehicle (ROV)/ Unmanned Ground Vehicle (UGV)

Research and Development Establishment (R&DE), Pune

The Remotely Operated Vehicle has been developed to handle Improvised Explosive Devices, detect or confirm its presence and also to diffuse it. Additionally it can also measure Radiation and Chemical Contamination levels. It has been designed for the Army, Police and other paramilitary forces engaged in counter terrorist operations.

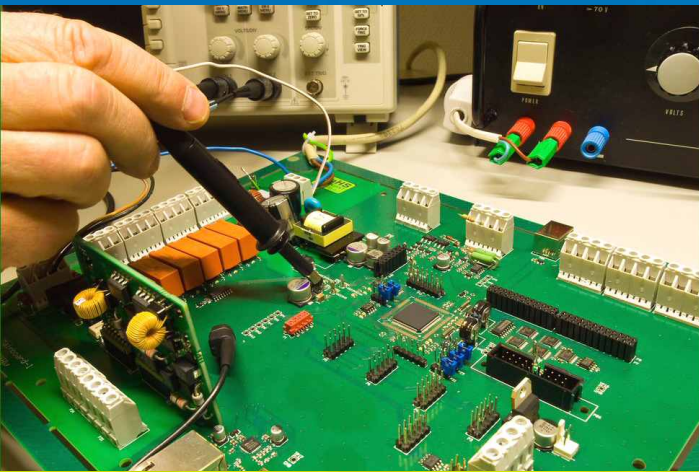
- Robot based Remote Controlled Unmanned Ground Vehicle (UGV) to handle Improvised Explosive Devices (IED)
- To detect and confirm presence of explosive and also to diffuse it. The ROV can detect the IED by a portable X-Ray mounted on the platform.
- The on-board Water Jet Disrupter can be used to diffuse the IED.
- It can also measure Radiation and Chemical Contamination levels.
- Robotic platforms that are used as an extension of human capability.
- Is capable of operating outdoors and over a wide variety of terrain, functioning in place of humans.
- The ROV is capable of being remotely controlled over a range of 500m line-of-sight or up to three walls within buildings.
- The ROV can be deployed within buildings and climb stairs for handling hazardous material.
- It has a robust manipulator arm having six degrees of freedom with gripper for handling suspected objects up to 20kg from 2.5m.
- It is electrically powered by special batteries and can be utilized continuously for three hours before a recharge.
- It has multiple cameras on-board for aiding the operator to drive as well as pick and handle sensitive objects.



- The present technology is better than the existing solutions as it is cheaper in cost and easy to maintain.
- The present technology has many additional features than the existing solutions.

Areas of Application

- Is useful for the Police and other Paramilitary Forces engaged in counter terrorist operations.
- Any suspected object or baggage can be taken to a safe spot, inspected or X-Rayed in-situ and diffused if necessary thereby not endangering the personnel engaged in such missions.
- This can be used by the Police, NSG and other para-military forces for counter insurgency operations.
- In addition it can be used at the Airports, Railway Stations, Shopping Malls etc. where such IED attacks are anticipated.



Technology Sector: Electronics / Software

S.No.	Technology Name	Industry Partner
35.	Apparatus for simultaneous generation and detection of the optical diffraction pattern for vibration monitoring	-
36	Code "VEDA"	-
37.	Opto- Electronic System for real time monitoring of motions in stratified fluids	-
38.	Two-Stage Vibration Isolation System	-

35. Apparatus for Simultaneous Generation and Detection of The Optical Diffraction Pattern for Vibration Monitoring

Naval Physical and Oceanographic Laboratory (NPOL),
Cochin

The invention relates to the field of opto-electronics in general, with particular emphasis in the area concerned with optical techniques for vibration monitoring; and more specifically in the field of opto-electronic devices for monitoring remote sound, and, or mechanical vibrations.

The invention elucidates an innovative method and apparatus for the simultaneous generation and detection of optical diffraction interference pattern on a photo detector. The vibration monitoring device discussed herein comprises of a (any) continuous wave coherent collimated beam of light (or a laser) falling on an (any) optically reflective coating on the surface of the body with inherent vibrations, or with manifest vibrations induced from another source through any medium where the said light is reflected, and then received on the surface of a (any) photo detector in such a way that the received light falls partially on the sensing area, and partially on the outer perimeter of the active sensing area(annular ring surrounding the perimeter of the active sensing area) of the said photo detector.

The spatial intensity pattern produced on the photo detector due to the interference between the directly incident light and the optically diffracted light, changes, if the incident light emanating from the reflecting surface undergoes changes in its path length as a result of vibrations felt on the reflecting surface. The photo detector records the precise time varying optical diffraction interference pattern, corresponding to the time varying vibrations experienced by the optical reflector. The output signals from the photo detector are recorded and compared with the vibrations fed on to the reflecting surface to demonstrate the efficacy of this method.

Areas of Application

- Apparatus to work as an optical microphone, which is operable over the entire range of acoustical frequencies.
- Non-contact apparatus for monitoring vibrations of objects
- Apparatus for underwater acoustic detection
- Apparatus to work as an optical hydrophone
- Apparatus for remotely detecting sound from outside, when the said sound is produced in a room with an optical reflecting outer surface
- Apparatus for detection of hydrodynamic disturbances in the ocean
- Apparatus for gravitational wave detection in the atmosphere
- Apparatus for optical fencing
- Apparatus for survivor detection from inaccessible rubbles caused by natural calamities
- Simple and portable apparatus for listening to sound emanating from distant locations

36. Code “VEDA”

Gas Turbine Research Establishment, Bangalore

The subject technology is software to do piping layout in virtual environment. In Virtual environment virtual reality navigation is easy, Layout the pipe as we do in real environment imagine a rubber elastic pipe in 3D. Then take the info to CAD and create the actual pipes in a very short time.

VEDA is a Virtual Reality software for Structural visualization and virtual Walkthru's. User can visually inspect the 3D models, walkthrough the assemblies and inspect any interferences. Better visualization facilities like 3D Stereo visualizations are provided. Users can take planar cross-sections and measure the clearances on the section. Highly useful tool in mechanical design.

Areas of Application

The software can be used for better 3D visualizations and walkthrough the assemblies. It can be used for visual checking of interferences and for observing the clearances when components are assembled.

37. Opto- Electronic System for Real Time Monitoring of Motions in Stratified Fluids

Naval Physical & Oceanographic Laboratory (NPOL),
Cochin

The present invention elucidates an innovative method and system for real time monitoring of motions in stratified fluids (like waves and mean currents in the ocean and atmosphere). The novel system is applied to monitor internal waves and tsunami waves simulated in a laboratory tank filled with stratified salt water. An inter comparison of the data recorded using this invention and the data records obtained from an ocean industry standard pressure transducer, variations of which are currently being used for surface wave and tsunami wave monitoring by many researchers around the world, demonstrated the efficacy of this invention as a sensitive method for real time monitoring of ocean waves.

The opto-electronic system described herein is an in situ device which could be deployed in the ocean for the real time monitoring of ocean waves like surface waves, internal waves, tsunamis etc. Ocean is a stratified fluid medium. The opto-electronic system for real time monitoring of ocean waves comprises of a (any) continuous wave, coherent, collimated beam of light (or a laser) falling on the surface of a (any) photo detector in such a way that the received light falls on the active sensing areas of the photo detector, after passing through the stratified fluid medium. That is the stratified fluid medium spatially separates the light source and the photo detector. The light intensity falling on the photo detector undergoes changes due to changes in the optical refractive gradient generated as a result of wave motions in the stratified fluid (caused by surface waves, internal waves or tsunami waves). The photo detector records the precise time varying light intensity pattern, corresponding to the time varying motions experienced in the stratified fluid due to wave motions. The output signals from the photo detector are recorded and compared with those obtained from a standard pressure sensor. The efficacy of this method and system for real time monitoring of ocean waves is demonstrated.

Areas of Applications:

1. Apparatus for real time monitoring of surface waves in ocean.
2. Apparatus for real time monitoring of internal waves in ocean.
3. Apparatus for real time monitoring of tides in ocean
4. Apparatus for real time monitoring of density changes in the ocean.
5. Apparatus for real time monitoring of Kelvin and Rossby waves in ocean
6. Apparatus for real time monitoring of mean current in the ocean.
7. Simple and portable apparatus for underwater seismic disturbances.
8. Apparatus for detection of hydrodynamic disturbances in the ocean.
9. Apparatus for detecting pressure vibrations in any optically transparent medium.
10. Apparatus for monitoring tsunami's in the ocean.
11. Apparatus for monitoring motions in stratified fluids (like waves & mean currents in ocean atmosphere)

38. Two-Stage Vibration Isolation System



Naval Science and Technological Laboratory (NSTL), Visakhapatnam

The subject technology is a vibration attenuation system. Two-stage vibration isolation systems are employed where there is a requirement of higher structure borne noise attenuation than isolation obtained by conventional single stage isolation systems. This system is based on the idea of introducing one more elastic level with an intermediate mass, compared to single stage isolation system. The dynamic behaviour of the intermediate mass and mounts has a strong influence on the noise reduction performance of the whole mounting system. NSTL has developed these systems for ship board machinery like Motor driven HP air compressor, Refrigeration plant etc. These systems are working satisfactorily onboard ships providing 25 to 40 AdB vibration isolation .

Areas of Application

This system can be used where protection is required from high structure borne noise/vibration levels of machinery such as diesel generators, HP air compressors, pumps in industry.



Technology Sector: Materials

S.No.	Technology Name	Industry Partner
39.	Arsenic Removal Water Filter	-
40.	Bioremediation of Oil in Marine Environment	-
41.	Ceramic-Composite Integral Armour	-
42.	Composite Laminates with Tailorable Electrical Properties	-
43.	Non-Sparking Tools / Cu- Ti Alloy	-
44.	Electrically Conducting Structural Foams	-
45.	Friction Surfacing: Novel Technique for Metal Matrix Composite on Aluminium-Silicon Alloy	-
46.	Heat Stabilized Narrow Fabrics (Tapes & Webbing) and Cordages for Improved Elastic Recovery Property	-
47.	Heptafluoropropane (HFC-227ea): a Halon Alternative	Gujarat Fluorochemicals Limited
48.	Hydrogen Storage Materials - Metal Hydride Stockers	-
49.	Magnetorheological Fluid	-
50.	Magneto- Resistive Electrical Switching Fluid	-
51.	Masterbatch of Photodegradable Plastics	Calco Polychem Pvt. Ltd.
52.	Preparation of Cadmium Telluride Nanoparticles from Novel Single Source Molecular Precursor	-
53.	Silicon Carbide Foam	-
54.	Syntactic Foams	-
55.	Through Thickness Permeability Measurement Set up	-
56.	Ultrasonic Fuel Guage	-

39. Arsenic Removal Water Filter

Naval Materials Research Laboratory (NMRL), Ambernath

A large population in Gangetic belt of India is alarmingly affected by arsenic poisoning. Effects of arsenic are severe and responsible for skin cancer, carcinoma, stunted growth, etc. To mitigate the problem of arsenic contamination, a novel technology has been developed at NMRL. This technology is based on the principle of co-precipitation and adsorption.

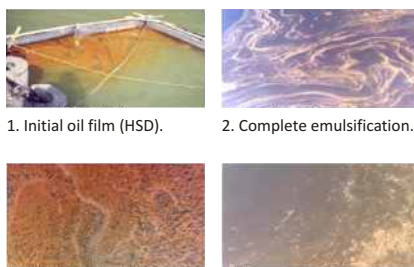
Salient Features

- Suitable for house hold use without power
- Environment friendly, easy to operate and maintain
- Easily available reactant materials
- Flow rate: 15 lph & 30 lph
- Filtered water quality as per WHO/EPA drinking water standards
- Waste utilization in the form of non-leachable M-25 grade cement bricks
- Cost-effective

The field trials have been successfully completed in the arsenic-affected villages of West Bengal. An international patent has been filed and the technology has been transferred to three entrepreneurs including an NGO.

40. Bioremediation of Oil in Marine Environment

Effects of Bioremediation



1. Initial oil film (HSD).

2. Complete emulsification.

3. Fragmentation & precipitation.

4. Dispersion of oil film.

Sequential change in floating oil film after treatment with NMRL technology

Naval Materials Research Laboratory (NMRL), Ambernath

Hydrocarbon pollution in marine environment is known to affect man, material and marine eco-system. These hydrocarbons are known to cause permanent inheritable changes in exposed individuals leading to increased incidents of cancer, allergies, asthma and also make people vulnerable to contract other bacterial and viral diseases. NMRL has developed an eco-friendly approach for such oil spill management.

The bioremediation of pollutant oil using NMRL developed technology is brought about by spraying bioemulsifier, oil degrading marine bacteria and nutrient mixture at polluted site in 3 days intervals for complete removal of oil. The oil hydrocarbons are degraded by bacterial alkane monooxygenases and associated enzymes releasing CO₂ and water and no toxic substance. The other biomolecules generated get incorporated as biomass and 'Bioemulsifier' as a byproduct. Bioemulsifier is a surface active biomaterial which facilitates emulsification of oil-in-water, enhancing bioavailability of oil for biodegradation in ecofriendly manner.

The bioemulsifier developed is a heat stable compound (initial decomposition temperature 192°C) having a molecular weight of ~5000 as determined in a gel permeation chromatography (GPC). The GC-MS spectrum indicated presence of 16 fatty acids which are contributing to its surface active properties. The finished material has greatly reduced the surface tension of distilled water from 72 mN/m to 30 mN/m.

Areas of Application

The material has become an obvious choice for bioremediation of floating pollutant oil when used along with NMRL oil-degrading bacteria and nutrient mix. The same has been demonstrated in various trials at Naval Harbour, Mumbai and Vizag. A process patent has been filled for the two materials, viz., Bioemulsifier and Nutrient mixture.

41. Ceramic-Composite Integral Armour

Research and Development Establishment (R&DE), Pune

The present innovation is a unique technology to produce lightweight, maintenance free and easily repairable multifunctional alternative engineered material known as Ceramic Composite Integral Armour which can be used for structural requirements and ballistic threats. The innovation is lighter and more efficient than metals and it can be integrated with the composites to provide alternative solutions to the current bulky metallic structures with add-on/strap-on armour. The present technology can be used to manufacture large and complex structural parts with integrated ceramics. This technology offers substantial weight advantages (over 40%) on the conventional technique of strap-on externally applied armour. Further, integral armour exploits the benefits of ceramics more than strap-on armour because of the additional confinement of ceramics achieved due to integration of structure and armour. The strap-on armour is made in flat rectangular pieces and cannot be applied to complex curved surfaces whereas integral armour can easily comply with complex shapes. Large structures such as armoured vehicles and assault boat hulls with complex shapes and curves can be made in few pieces with minimum joints. Features such as watertight and amphibious construction can easily be incorporated. The solution also significantly lowers the fabrication time making large-scale production cost effective. Cost-effective and easy repair of damaged armour is also possible due to modular construction. Parasitic mass such as spall-liners and additional backing material for ceramics essential in strap-on armour is completely eliminated in integral armour. Further, modular construction of integral armour using small ceramic tiles allows for its easy repair after impact. The present technology is based on Vacuum Assisted Resisted Resin Transfer Moulding VARTM process for manufacture of composites structures. Ceramic-composite integral armour has ceramic layer, rubber layer, backing composites structural layer, cover layer and other functional layers such as layers for fire-protection. The whole structure along with the integral armour is manufactured in one go. The ceramic layer provides primary ballistic protection while the composites layer is the structural layer.

Ceramic armour is lighter and more efficient than metals. When integrated with composites, it acts as a significantly lightweight multi-functional alternative catering for structural requirements and ballistic threats. Technology has been established to manufacture large and complex structural parts with integrated ceramics. This technology offers substantial weight advantages (over 40%) on the conventional technique of strap-on externally applied armour. Further, integral armour exploits the benefits of ceramics more than strap-on armour because of the additional confinement of ceramics achieved due to integration of structure and armour. The strap-on armour is made in flat rectangular pieces and cannot be applied to complex curved surfaces whereas integral armour can easily comply with complex shapes. Parasitic mass such as spall-liners and additional backing material for ceramics essential in strap-on armour is completely eliminated in integral armour. Further, modular construction of integral armour using small ceramic tiles allows for its easy repair after impact.

Areas of Application

Ballistic protection for VIP vehicles, low intensity conflict vehicles, urban warfare systems, ballistic protection for unmanned vehicles, missile transport vehicles, armoured vehicles, underwater structures, assault boats, other naval structures, aircrafts, helicopters and any other structures subjected to ballistic threats. This technology offers a significantly lightweight, maintenance-free and easily repairable composite-ceramic integral armour based alternative to the currently heavy and bulky metallic structures with add-on/strap-on armour.

42. Composite Laminates with Tailorable Electrical Properties

Aeronautical Development Establishment, Bangalore

The technology enables the design and development of composite laminates with tailorable surface resistivity values. A structural composite with a surface resistivity of any given order (in the range of 10^0 to 10^9 /sq.) may be developed using this particular technology. Based on the exact resistivity requirements, the base reinforcements may be either insulating (i.e. glass) or conducting (i.e. carbon) whereas the matrix may be any of the commercially available thermosetting resins which have to be loaded with a critical recipe of fillers like carbon nanotubes etc.

Areas of Application

Structural composite materials with any of the following electrical / electromagnetic requirements:

- a. Antistatic
- b. EMI shielding
- c. Space Cloth
- d. Functionally graded radar absorbing materials

43. Non-Sparking Tools / Cu- Ti Alloy

Defence Metallurgical Research Laboratory (DMRL), Hyderabad

Non-sparking tools are widely used in mining, petroleum and explosive handling industries where fire hazards are to be prevented. There are a number of non-ferrous materials, which are non-sparking; however, they do not possess enough strength to provide a good cutting edge. Though Cu-Be alloys exhibit sufficient strength and electrical conductivity required for non-sparking applications, they are toxic and emit invisible toxic fumes during hot working, heat treatment, machining and pickling operations due to the toxicity of Be, which causes serious health hazards such as chronic pulmonary illness. Further, Cu-Be alloys are highly expensive due to the limited resources of Be.

Copper base Cu-4.5Ti alloy is mainly used for making 'non-sparking tools'. The subject technology is a Cu-4.5Ti alloy for use as a non-sparking material. Salient features of this alloy are high strength (TS: 890 to 1380 MPa), certified non-sparking material and possesses low magnetic permeability (1.26×10^{-6} H/m). Due to abundant resources of Ti, Cu-4.5Ti alloy is relatively cheaper and economical. The alloy can be manufactured with ease and without any health hazards.

Areas of Application

Non-sparking tools are widely used in mining, petroleum and explosive handling industries in defence as well as civil sector.



44. Electrically Conducting Structural Foams

Aeronautical Development Establishment, Bangalore

The subject technology is the development of a special material for functional core material in sandwich designs for EMI shielding structural applications like electronic enclosures.

The present technology involves tailoring hollow glass microspheres embedded polymeric syntactic foams for electrical conductivity applications by incorporation of certain lightweight conductive in critical quantities, so as to ensure the initiation of the electrical percolation phenomenon in the bulk materials. These additives not only render the resultant composite foams with sufficient electrical conductivity, but also reinforce them structurally. Such electrically conducting lightweight structural foams can be tuned for a wide range of densities, thermal with standability, mechanical and electrical properties by judicious selection of material compositions and chemistries. Further, these foams can also be subjected to near net shape fabrication, even for components with critical contours.

Areas of Application

Core material for any lightweight sandwich structures for EMI shielding applications, including those demanding critical contours and near net shape fabrication.

1. Antistatic surfaces.

45. Friction Surfacing: Novel Technique for Metal Matrix Composite on Aluminium-Silicon Alloy

Defence Metallurgical Research Laboratory (DMRL),
Hyderabad

Aluminium alloys are used in applications demanding lightweight and high strength. These applications could be in wrought or cast form. Some of the components need to exhibit wear resistance, which is dedicated by the surface property. For better wear resistance the surface should be hard. The approach to impart hardness is by hardening as well as by some surface treatment involving surface alloying, hard-face coating etc. Aluminium alloys do not exhibit wear resistance, as do not response to surface hardening heat treatments. The general approach to impart wear resistance in such situations is to build a surface layer consisting of metal matrix composites. These MMCs contain ceramic particulates. One such metal matrix that has high wear resistance is MMC with SiC particulate. Deposition of this MMC through fusion route result in the formation of Al₄C₃ that gets embrittled when exposed to moisture. Keeping the aforementioned in view, studies were carried out to bring the potential usefulness of friction surfacing technique to improve wear and corrosion behavior of A356 Al-Si alloy. The coatings exhibit excellent bonding with the substrate. The coating also has adequate corrosion resistance.

Areas of Application

Automobiles

46. Heat Stabilized Narrow Fabrics (tapes & webbings) and Cordages for Improved Elastic Recovery Property

Aerial Delivery Research and Development Establishment, Agra

This technology is a heat stabilized narrow fabric tape for improved elastic recovery property. It has been developed and tested such that it proves that heat setting narrow fabrics (tapes & webbings) and cordages at particular conditions of temperature, time and stretch leads to improved elastic recovery property in the material. Also, the creep property of the material has been found to be improved. This makes the material particularly advantageous where the material is to be subjected to repeated loads such as rigging lines of parachutes, rigging lines of sails, ropes for mountaineering, etc.

Areas of Application

The possible areas of applications are whenever the material is subjected to loads and particularly advantageous where repeated loads are observed:

- (i) Rigging lines of parachute- all types
- (ii) Rigging lines of sails
- (iii) Mooring ropes for boats, ships
- (iv) Ropes for mountaineering
- (v) Tether applications
- (vi) Straps of brassiere

47. Heptafluoropropane (HFC-227ea): a Halon Alternative



During the past 20 years it has become widely accepted that the release of volatile man-made halocarbons (notably CFCs and bromine containing Halons into the earth's atmosphere) causes depletion of stratospheric ozone. In response to society's concern over potential effects of ozone depletion, a variety of national and international regulations have been promulgated, the best known being the Montreal Protocol- 1987 on substances that deplete the Ozone Layer. This landmark international agreement has already been revised from time to time in response to ever-worsening news about stratospheric ozone levels.

The unique combination of properties associated with certain fluorinated methanes and ethanes has led to their widespread use in fire suppression systems. These fire suppression agents are characterized by high fire suppression efficiency, low toxicity, low residue formation after extinguishments, low electrical conductivity and long term storage stability.

The three popular halogenated fire suppression agents are bromotrifluoromethane (CF₃Br, BTM, Halon 1301), bromochlorodifluoromethane (CF₂BrCl, BCF, Halon 1211) and 1,2-dibromotetrafluoroethane (BrCF₂CF₂Br, Halon 2402). Currently Halon-1301 (Bromotrifluoromethane, CF₃Br) and Halon-1211 (Bromochlorodifluoromethane CF₂ClBr) are used as fire extinguishers and have high ozone depletion potential. However, because of their recent implication in the destruction of stratospheric ozone, the production and use of these life-saving agents is being severely restricted. As a result, intensive research efforts are currently underway in both the industrial and academic sectors to find suitable replacements for these agents. It is being realized world over that in the absence of Halons due to Montreal Protocol to phase out Ozone Depletion Potential (ODP) substances, the search for alternatives was begun and identified Heptafluoropropane (HFP) as one of the best and closest chemical substitute for Halons.

Heptafluoropropane (HFP) is a hydrofluorocarbon and has been accepted world over for many applications due to its zero ODP, low GWP & toxicity in comparison to other chemical substitutes like NAFS-III (A blend of HCFs), PFCs (C₄F₁₀) etc. Heptafluoropropane (HFP) may find wide applications where Halon-1301, was the choice of user industries in the past.

To meet futuristic requirement of Defence users like Army, Air force, Navy, DRDO and PSUs & Govt. undertakings like ONGC, IOL, OIL, CIL, etc. Civil sectors like Industries & Fire Services, Educational Institutes. Halon based systems will be replaced by Heptafluoropropane based systems. Keeping the above point in view, CFEES has developed Heptafluoropropane gas which will replace halon in the existing halon based fire protection system.

The preparation of Heptafluoropropane has been successfully carried out by catalytic vapour phase hydrofluorination continuously using a single tube modular reactor on a Pilot Plant scale and the product was obtained at a rate of 70g/h. For scaling up of the product the multiple tubes modular reactor can be used.

Heptafluoropropane (HFP) has internationally been approved for Halon 1301 substitute for new generation fire protection systems. All international standards are now specifying HFP in their fire safety regulation both in civil & military applications. Under the Montreal protocol treaty halon production world over is banned and European Union has even brought out regulation to decommission the existing halon systems by their member countries including U.K.

48. Hydrogen Storage Materials - Metal Hydride Stockers



Defence Metallurgical Research Laboratory (DMRL), Hyderabad

Hydrogen storage is an emerging area of technology for efficient and safe storage of hydrogen, which is a highly combustible gas. The technology involves storage of hydrogen in metals and alloys as metal hydride, and the gas can be released at controlled rate when required. Several alloys have been developed at the lab, such as LaNi₅, Mm Ni etc. to name a few. These materials have good volumetric but poor gravimetric storage capacity of hydrogen. The lab has also developed stockers of hydrogen storage alloys on small scale.

Areas of Application

- Ni MH (Nickel Metal Hydride) batteries
- Fuel cells
- Automobiles

49. Magnetorheological Fluid



Naval Physical & Oceanographic Laboratory (NPOL), Cochin

Magnetorheological fluid is a smart fluid, which responds by changing its viscosity from liquid state to a near solid state by the application of a magnetic field within milliseconds of time. NPOL has successfully developed and patented fluid in many countries like USA, France, UK & Japan. The material is a suspension of surfactant coated magnetic particles in a carrier fluid medium. When a magnetic field is applied, the magnetic particles align themselves along the direction of magnetic flux and provide a viscosity change. Several studies made in NPOL shows that the fluid is stable and non reactive towards many of the engineering materials. Similar fluids developed by a couple of firms elsewhere are based on petrochemicals, whereas the present fluid is based on renewable agro seed oil such as or oil. The other essential additive required for formulation is also a derivative of or oil. The formulation does not contain any additive of petroleum origin, simple to make, environmental friendly and cost effective.

Areas of Applications:

Magnetorheological fluid is an ideal material for developing smart brake, torque transfer devices, shock and vibration damping suspension/mount. The device made of this fluid can replace the conventional system by providing varying torque/damping force. Hence the device made of this fluid will be a smart device whose characteristic output can be turned by external magnetic filed or automated by closed loop feedback controller. This smart material can be used to develop new brake; clutch and torque transfer systems, smart shock absorbers/suspensions for automobiles for automobiles, haptic interfaces, artificial limbs, earthquakes resistant civil structures/ buildings and smart dampers for cabled bridges to counteract wind guest etc. MR fluid can be useful in: - Automotive applications, Rapid prototyping, Bio medical, Aero space, Space applications, Vibration Damping, Exercise machines and much more.

50. Magneto- Resistive Electrical Switching Fluid

Naval Physical and Oceanographic Laboratory (NPOL),
Cochin

The subject technology is smart fluid whose electrical resistivity can be varied by order of several magnitudes by using an external magnetic field. This sharp and reversible change in resistivity make the fluid transform from an insulator to a conductor. In the presence of a magnetic field typically 0.7 tesla, the resistivity of the fluid changes from 2×10^8 ohm to 1 ohm within a fraction of second. Materials with such characteristics are not reported in literature and this development is a breakthrough. The composition of the fluid includes magnetic responsive particles, conductive dopant, particle stabiliser and carrier fluid. In the absence of magnetic field, the magneto responsive electrical switching fluid has a measurable electrical resistivity. However, in the presence of an external magnetic field, the electrical resistivity of the fluid decreases to a very low value as the suspended particles align themselves resulting in rapid physical gelling of the fluid. This facilitate transport of electrons induced by the added dopants (either by mutual contact or by tunneling effect). Once the magnetic field is removed, the electron transport is no longer possible as the particles return to the disoriented pattern and it becomes an insulator.

Areas of Application

This novel material has potential for several applications. Few applications that can be thought of are non arcing lighting switch for use in explosive areas (explosion proof switches), magnetic field sensors, magnetic mine activators, proximity fuses for torpedoes, over voltage protectors, tilt sensors, smart microwave absorbers, earth current leak sensors and the like.

51. Masterbatch of Photodegradable Plastics



Centre for Fire, Environment & Explosive Safety (CFEES), New Delhi

The master batch (PDP) developed by DRDO modifies the polymer matrix during the processing to make the plastic oxo-biodegradable, which leads to chain scissions and hence a lowering of molecular weight besides creating a hydrophilic surface which can be bio-assimilated by microorganisms in the soil.

Salient Features of the Technology

- Cost effective as it needs to be added in small percentages
- Additive is compatible with PP, HDPE, LDPE and LLDPE
- Material can be injected and blow moulded on conventional machines
- Additive does not affect the clarity of films
- The photo degraded polymer is biodegradable and gets converted into carbon dioxide and water. The same has been tested at NMRL, DRDO.
- The final degraded residue is non-toxic in nature
- The degradation speed and the intensity can be controlled by altering the percentage of additive
- The material has been tested to be food grade by DFRL, DRDO.

Areas of Application

- Agricultural films
- General Purpose single use packaging materials
- Disposable Food containers
- Shopping carry bags
- Refuse Sacks
- Garment and Grocery bags



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52. Preparation of Cadmium Telluride Nanoparticles from Novel Single Source Molecular Precursor

The Defence Materials & Stores Research & Development Establishment (DMSRDE), Kanpur

The innovation is a convenient method for the preparation of cadmium telluride CdTe nanoparticles under mild conditions from a novel single source molecular precursor, i.e. cadmium II complex of bisisopropyltelluromethane and bisaminopropyloditelluride. The precursors are solid and non-toxic & non-explosive. Nanoparticles of CdSe, CdTe, which are the compound semiconductors of elements in group II and VI of the periodic table, have been extensively investigated because of their exclusive features such as, size-dependent emission wavelength due to the quantum size-effect and strong luminescence and these particles are expected to be applied to various fields such as informational home electronics and biomarkers as new phosphores. Nanosize semiconductor materials exhibit high emission efficiency when the surface state of the particles is controlled properly. A wide variety of capped nanoparticles have been prepared from metalorganic precursor through solvo-thermal route in presence of various capping agents. However, most of these reactions require the conventional chemicals like dimethyl cadmium and diisopropyl telluride, which are extremely toxic, pyrophoric, and explosive. The use of single-source molecular precursor for the preparation of nanoparticles avoids such potential problems.

A convenient solvo-thermal route has been developed for the preparation of cadmium telluride nanoparticles using a novel single source molecular precursor. The X-ray diffraction pattern confirms the face-centered-cubic structure and average diameter of the nanocrystallite is calculated to be 30 nm. SEM image clearly shows the needle-like structure, which is further supported by TEM image where pearl neckless like² nanoparticles are clearly seen.

Characteristic features of CdTe Nanoparticles

- (i) Batch Size : 0.5 g/batch (optimized at lab scale)
- (ii) Structure : FCC (XRD)
- (iii) Shape : Needle like (SEM)

Pearlneckless type (TEM)

- (iv) Size : 30 nm
- (v) Dispersivity : Monodispersed in solvents

Areas of Application

1. High efficiency solar cells
2. Light emitting diodes LEDs
3. Transistors
4. Lasers
5. Switches
6. Fluorescent biolabeling

53. Silicon Carbide Foam

The Defence Materials & Stores Research & Development Establishment (DMSRDE), Kanpur

The technology is a meltable and soluble material, which on heating swells forming foam and afterwards pyrolysed to yield desired shape and size silicon carbide foam. The porosity of the foam could be controlled and manipulated up to micron size level. The density and the poly type nature of SiC could also be manipulated depending on the rate of heating and retention time of the material at final temperature. This art of SiC foam is entirely different than international state of art where such foams are prepared using a slurry of coarse and fine powder of SiC and fixing it to organic foams and on pyrolysis yielded silicon carbide foam.

54. Syntactic Foams

Naval Physical and Oceanographic Laboratory (NPOL), Cochin

Syntactic foam is a liquid castable system that can be produced in desired intricate shapes. The material technology developed is in the form of a liquid-paste form and can be easily formulated into the desired shape. The density of the syntactic foam can be controlled to the desired values. Syntactic foams of various predefined shapes and densities are available from limited number of sources, however none of them provide flexibility to form custom shapes and customized densities as per user requirements.

Syntactic foams of various predefined shapes and densities are available from limited number of sources. However, none of them provide flexibility to form custom shapes and customized densities as per user requirements.

Syntactic foams are a special class of low density and high strength materials, which has macro balloons inclusion uniformly in a polymer matrix. Since the material is a liquid casting system, it can be tailored to the varieties of properties and shape over a wide range of densities and strength. The lab has developed syntactic foams formulations based on polyster, epoxy, polyurethane as matrix material and glass, PAN and phenoset micro spheres as fillers material. Syntactic foam formulations having densities varying from 0.2 gm/cc to 1 gm/cc with various rheology, pot life, hydrostatic compressibility, water absorption, and density, compressive and tensile modulus are developed for various applications.

Areas of Application

The material has immense underwater applications such as for making floats, buoys, buoyancy modules for sensors, instruments collar, bend restrictors for cables. Also, they can be used as putty and FRP repairing material. It can also be used as a replacement for honeycomb structure in constructions. It can also be used for thermal insulation coating material and pattern making material.



55. Through Thickness Permeability Measurement Set up

Research and Development Establishment (R&DE), Pune

The innovation is a device to measure the in-plane and through-thickness permeabilities of the preform in the Vacuum Assisted Resin Transfer Molding (VARTM) process in which resin flows under action of vacuum through dry reinforcement. The resin flows over the surface of the reinforcement through the resin distribution medium and through the thickness to wet the volume of the reinforcement preform. Time taken for resin to flow through the preform in-plane and through thickness depends on preform permeability. The present technology will help to know the various permeabilities in advance. The device allows planar flow through thickness of the preform and time for flow is recorded. Darcy's law is employed to determine preform permeability. The innovation claims that this has been successfully tested for different fabric material, architectures, thickness and lay ups and consistent results have been obtained for through thickness permeability. Fabrication of composite structures by resin infusion has evolved over the past decade and has become one of the most promising low cost processes for realization of large high performance structural composites. Vacuum Assisted Resin Transfer Molding (VARTM) process involves flow of resin under action of vacuum into dry reinforcement laid over the mold. This process is ideally suited for manufacture of large composite structures with good structural properties. Since resin flows into dry reinforcement under action of vacuum, permeability of the reinforcement stack is the most crucial parameter for consideration of the process designer. Successful fabrication depends on complete saturation of the reinforcement by resin and process has to be designed to achieve this. Resin Transfer Molding (RTM) process, which uses a hard mold instead of a vacuum bag, also has similar requirement.

There is no ready solution available in public literature for permeability measurement. Through-thickness permeability measurement is a most daunting

task. The lab has developed methodology for measurement of permeabilities in all three directions and developed a simple set up for measuring through thickness permeability of reinforcement. A patent has been filed for this concept with Indian patent office. This set up has been tested for different fabric material, architectures; thickness and lay-ups and consistent results have been obtained for through thickness permeability. Measured permeability values are regularly used in process simulation for realization of large composites structures. The setup has following features:

1. No limit on the thickness of lay up. Thus the same set up can used for a wide range of thickness of lay ups.
2. No presence of any intrusive sensor
3. No requirement of any expensive post processing system
4. Very compact set up and easy to handle

Areas of Application

VARTM process pioneered by boat manufacturers, is extensively used by wind turbine rotor blade manufacturers. It is also finding extensive application in transportation sector, automotive industry and civil infrastructure rehabilitation industry. Anyone using VARTM process would find use of the process-monitoring device.

56. Ultrasonic Fuel Guage

Naval Physical & Oceanographic Laboratory (NPOL), Cochin

Fuel gauges find versatile application in the industry. In Ultrasonic Fuel Guage, the property of an acoustic wave getting reflected at the fuel-air boundary as echo and capturing/ processing the echo to obtain the travel time information is used to determine the height of the fuel in fuel tank. From height of the fuel in the tank, the volume of the fuel in the fuel tank at any instant of time is derived. An ultrasonic transducer acts as an acoustic wave transmitter as well as a receiver. A narrow pulse of ultrasonic energy is injected into the fuel tank by means of the transducer. The pulse travels through the fuel, gets reflected at the at the fuel-air boundary and reaches back the same tranducer after a time delay, which is propotional to the height of the fuel. The major advantages of Ultrasonic Fuel guage are the reliability, accuracy and precision in any environment and fluctuating temperatures

Areas of Applications:

It has a wide range of applications. It can be used for gauging the volume of any liquid in containers. Guage can engineered for use in any environment and a wide range of temperatures. Can be used for static as well as dynamic conditions in:

- a) Transport vehicles air, rail, sea or road transport
- b) Industrial equipments



Technology Sector: Mechanical

S.No.	Technology Name	Industry Partner
57.	Hydraulic and Lube Filters	-
58.	Liquid spring based Shock Absorption System (SAS)	-

57. Hydraulic and Lube Filters



Combat Vehicles Research and Development Establishment (CVRDE), Chennai

The hydraulic system of LCA-Tejas operates at 280-bar pressure and provides power for quadruplex digital flight control system and aircraft utility services. LCA-Tejas hydraulic system is fitted with filters having mesh sizes in the range of 10 to 25 micron. Filters are used in pressure, return and drain lines, to ensure supply of clean oil to the system components for their reliable operations as per NAS (class-1) cleanliness level.

These filters have a higher filtration rating ($\beta \geq 100$) and operate at $-54\text{ }^{\circ}\text{C}$ to $135\text{ }^{\circ}\text{C}$ temperature conditions. Filters have been provided with unique by-pass valve & automatic shut-off valve arrangement, visual clogging indicator with manual reset and excellent resistance to flow fatigue. Filters developed are qualified for aircraft applications, in conformity with requirements of MIL-F-8815D standard.

These filters have been approved in the year 1999 for fitment in aircraft by CEMILAC and DGAQA and all the LCA-Tejas aircrafts are fitted with these filters.

CVRDE has also developed filters for MBT-Arjun, Kaveri Engine and for ALH winch.

Major Applications

Military and commercial aircraft applications, marine applications and automobile applications.

58. Liquid spring based Shock Absorption System (SAS)

Research and Development Establishment (R&DE), Pune

The innovation is a compact designed Shock Isolator based on Liquid Spring based Shock Absorption System mainly meant for automotive applications to reduce/eliminate the jerking effect. It works on principles of hydraulic piston and cylinder having holes on piston. Very high shock (in general term jerk) can be absorbed/isolated and accepted shock level can be imparted to the system mounted on it. In technical term, fluid inside the Liquid spring plays the role of Spring and holes on piston plays the role of damper. Compare to conventional SAS (isolator), its size can be almost 4-5 times less and it can be designed and developed for the restricted space. The relative size of the Liquid Spring is very small compared to conventional shock absorbers and hence it can be successfully and efficiently utilized in a comparatively smaller space, thus leaving more space that can be utilized by the other devices, if required. Other possible areas of applications include, Aircraft Landing Gear, Civil Structure prone to earthquake zone.

Liquid Spring based SAS is different from the conventional shock absorption system (generally known as suspension in automobile field). It works on principles of hydraulic piston and cylinder having holes on piston. Very high shock (in general term jerk) will be absorbed/isolated and accepted shock level can be imparted to the system mounted on it. In technical term, fluid inside the Liquid spring plays the role of Spring and holes on piston plays the role of damper. Compare to conventional SAS (suspension), its size will be almost 4-5 times less or and it can be designed and developed for the restricted space.

Areas of Application

This can be used for automobile industries, Aircraft Landing Gear and any system which requires very less space for isolation of shock. This also can be used for recoil system. It may be used for civil structure prone to earthquake zone.

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