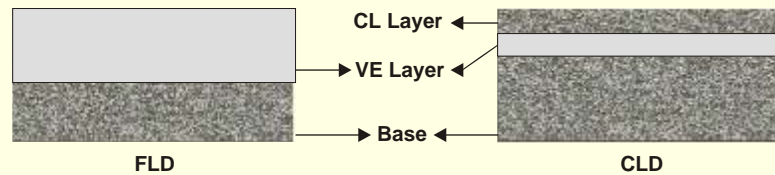


Salient Features

Vibration attenuation for aluminium/steel plate	:	6 dB to 18 dB
Operational temperature	:	20 °C to 58 °C
Elongation	:	700 % to 1000 %
Frequency range	:	10 Hz-10000 Hz

Free Layer Dampers.

A series (CNT 4L, CNT 4H, CNT 15 LA, CH 15 LC, CN 15 F) of special blends have been developed with high dynamic shear modulus and shear loss factors suitable for low frequency structural damping without constraining layer at temperature prevalent in a ship's machinery compartment such as engine room, and turbine casing in power plants, etc. Technology for optimum area coverage, manufacture of FLD tiles and application on substrates with rigid adhesive bonding is available.



Salient Features

Vibration attenuation for aluminium/steel plate	:	7 dB to 8 dB
Temperature of operation	:	30 °C to 60 °C
Frequency range	:	200 Hz to 5000 Hz

Technology Focus highlights the technological developments in DRDO, and also covers the products, processes and technologies.

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Materials are the basic substances that can be natural like wood, or human-made like plastic. There are a large number of different known materials. As the scientists create and combine materials in new ways, the number is almost infinite. Most materials fit into a few big, general categories like metals, ceramics, semiconductors, polymers, composites, biomaterials, and exotic and strange materials such as buck balls and nanotubes.

DRDO has developed large number of products using these materials leading to self-reliance in this area. These materials are being used very widely in civil applications also.

One of the main activities of DRDO is the development of metallic and non-metallic materials and corrosion preventive technology for specific application in the marine environment. The basic studies like hydrobiological data collection, toxicity studies, biofilms and behaviour of materials in the marine environment though have taken roots as continuing activities of DRDO. Some of the products developed by DRDO have been covered in this issue.



LM25/TiB₂ Metal Matrix Composites

Aluminium alloy LM25/TiB₂ metal matrix composites (MMCs) have been developed. This Al-based MMC provides higher strength, higher stiffness and improved wear resistance compared to monolithic LM25 alloy. It can be used for lightweight wear-resistant structures and areas where high specific stiffness is required. The technology is available for transfer.



Cast ingots of composite

Salient Features

Compressive strength	:	12 Mpa
Density	:	0.83 g/cc
Shore hardness 'D'	:	49-54
Water absorption	:	0.3 %
Flammability (LOI)	:	24



Poly-List dock blocks

Polymeric Humidity Sensor

A conducting polymer-based composition has been developed for sensing the relative humidity (RH) through variation of electrical conductivity. The electronic instrumentation has been accomplished for digital display of RH. The sensor package is lightweight, compact, portable, and battery operated. The humidity measurement range of the sensor is 20-80 per cent. The technology is ready for transfer.



Polymeric humidity sensor

Salient Features

Sensing range	:	20-80 %
Accuracy level	:	±0.5 %
Sensing time	:	2 min
Recovery time	:	0.1 min

Vibration Damping Materials

Elastomeric materials are used to attenuate noise and vibration of machines. A range of polymer blends and interpenetrating networks (EAP) have been developed, which show excellent damping capabilities in a wide range of frequency (20 Hz to 20000 Hz) and temperature (-25 °C to 55 °C). The material can be used for shock vibration mount for machines, structural vibration damping material, bush and washers for transducers, and isolators/absorber of noise.

Some of the items are currently being used by the Indian Navy. The two major types of dampers developed by the DRDO are constrained layer dampers (CLD) and free layer dampers (FLD).

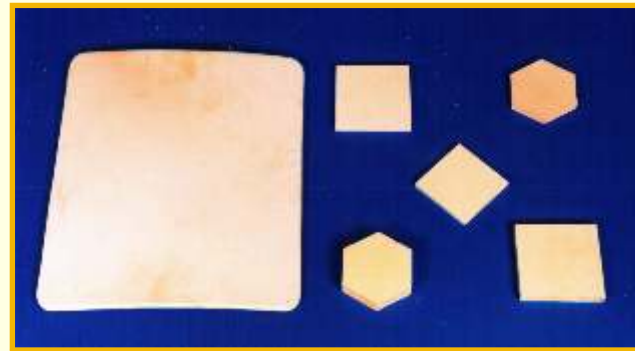
Constrained Layer Dampers

Constrained layer damper technology involves designing of damping system using indigenously developed viscoelastic damping polymer blends, mathematical algorithm and application technique on various substrates with optimal solutions. Four types of materials (EAP1, EAP2, EAP3, EAP4) with optimum dynamic shear moduli and loss factors have been developed for CLD application. The complete technology of manufacturing the CLD and optimal application with rigid adhesive bonding is available.

used as vehicle armour, in wear-resistant coatings, high temperature structures, and cutting tools. Technology has been transferred for large scale production.

Salient Features

Hardness : 15.5 Gpa
Strength : 450 Mpa
Fracture toughness : 8 Mpa m



ZTA ceramic tiles for armour

PZT-Polymer composite Materials

PZT-polymer composite materials with 1-3 ceramic-polymer connectivity and with reproducible properties have been fabricated using partial dicing technique. Composite hydrophones have been fabricated by moulding the composite in a low temperature curing neoprene rubber. The process of electroding and encapsulation of piezocomposite materials has been optimised. Further work is in progress to develop large area hydrophones for bulk production of these piezo-composites by injection moulding of PZT preforms.



Piezocomposite hydrophones

Salient Features

Sensitivity : -200 dB re IV/ μ Pa
Flat frequency response : 100 Hz to 10 kHz

Poly-List Dock Block

Polymer-based composite dock blocks have been developed for use as a substitute to teak wood dock blocks on which ships sit in the dry dock. These blocks have lightweight foam filled aluminium structure embedded inside for improving the stiffness and reducing the weight of the composite blocks. They are easily moldable and can be used with the Himalayan fir capping for use as dock blocks. The blocks are stiffer than wood and polymer under compression and their vibration damping capacity is better than monolithic polymer. The blocks have sufficient resilience to withstand multiple shock loading suitable for rubbing fender application, excellent sea water resistance, and are reusable.

The blocks can also be used in ship building industry, railway sleepers, fire/shock resistant structures, and in domestic structural applications. Production of the item is under progress for user trial.

Salient Features

TiB₂ particle size : < 1 μ m
TiB₂ volume fraction : 6 %

Comparative Mechanical Properties

	LM25	LM25/TiB ₂
Hardness (VHN)	60	85
Ultimate tensile strength (Mpa)	185	250
Elastic modulus (Gpa)	74	81
Corrosion rate in sea water (mpy)	0.5	4
Wear rate (x 10 ⁻¹¹ m ³ /m)	2.7	1.2

Electrochemically Reacting Composition

Electrochemical reacting composition has been developed for warming the packed food, and as thermal pads for body warming in cold regions. The composition consists of Mg-Al-Fe alloy which reacts electrochemically in the presence of an electrolyte and produces heat. It gives about 10-12 kJ/g of heat. The heating can be activated by adding small amount of water to the alloy. Temperature of packed food can be raised to 75 °C in 20 min. The technology has been transferred to private entrepreneurs.



Flameless ration heater set up for ready to eat meals

Salient Features

High heat content
Acts as portable heat source
Environment friendly by-products

Phosphoric Acid Fuel Cell-based UPS

An uninterrupted power supply device based on 700-1000 W phosphoric acid fuel cell has been developed for backup power supply. The device use hydrogen as fuel and oxygen/air as oxidant. A 47 litre hydrogen gas cylinder with a running capacity of 8 hr at full load, and a blower for compressed oxygen have been provided for generating electricity. It also has an in-built electrolyser option to generate and store bottled hydrogen and oxygen when line power is available. The technology has been transferred for further production.



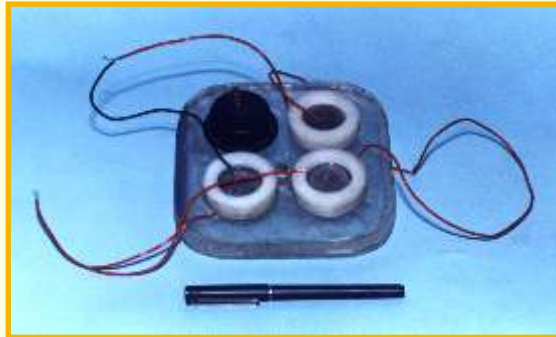
One kilowatt fuel cell

Salient Features

Output : 200 V AC, 700 VA
 Size : 60 cm x 30 cm x 40cm
 Weight : 50 kg

Miniature Fuel Cells

Polymer electrolyte membrane-based miniature fuel cells (cylindrical and air breathing) have been developed for powering small hand-held telecommunication/electronic devices. A super corroding alloy cartridge has been used for the generation of hydrogen used in the cells. The output voltage can be selected according to end usage and the type of cell used.



Miniature fuel cell

Salient Features

Output
 Cylindrical cell : 2 W (4 V)
 Air breathing cell : 5 W (2 V)

Size
 Cylindrical cell : 9 cm x 6 cm
 Air breathing cell : 12 cm x 12 cm x 2 cm

Weight
 Cylindrical cell : 400 g
 Air breathing cell : 500 g

Selective output voltage : 1.5, 3, 6, 9 V

Self-Sustained Power Pack

Self-sustained power pack equipment is a lightweight power generation equipment capable of generating 100 W (maximum) power. The size of the equipment is 52 cm x 27 cm x 25 cm and it weighs 15 kg. A 100 g snap-fit type calcium hydride canister, and super corroding alloy have been used to generate hydrogen. The calcium hydride canister lasts for an hour and can be changed when required. The power pack also comprises an in-built DC-DC stabiliser. The equipment can be used for charging of batteries, and powering telecom devices at remote and high altitude areas, etc. The technology is ready for large scale production.



Self-sustained power pack

Salient Features

Output : 12 ± 5 V DC
 No power lines required
 Uninterrupted and noiseless power generation
 Environment friendly
 Only consumable is 100 g snap-fit calcium hydride cartridge

Flameless Bukhari

Conventional *bukharis* (room heater) used in cold regions are a source of health hazard due to emission of carbon monoxide. A catalytic flameless *bukhari* has been developed, which is free from all the hazards. Alcohol like methanol, ethanol, etc is being used as fuel in the *bukhari*. Heat output of the *bukhari* is tunable and without any soot. It can be enhanced with change of design. The *bukhari* can be used in poorly ventilated rooms in cold regions. The technology is available for transfer.



Flameless bukhari

Salient Features

Thermal capacity : 1-5 kW
 Size
 Diameter : 30-90 cm
 Height : 40 cm
 Weight : 5.5-10 kg
 CO emission : less than 10 ppm
 Nitrogen oxide and particulate : Not detectable

Advanced Ceramics

Advanced ceramics have gained high importance due to stringent demands put forth by the advancing technologies in nuclear power generation, chemical, electrical as well as mechanical sector. These products find application as sensors, actuators, structural materials, biological implants as well as other innumerable applications.

ZTA Ceramics

DRDO has developed fine particle technology for preparing high purity, fine, homogenous teragonal zirconia polycrystalline (TZP) ceramic powders, wherein the dopant oxides have been mixed on a molecular level. These powders have been utilised to prepare zirconia toughened alumina (ZTA) powders. ZTA tiles having excellent mechanical properties such as high hardness, high strength, and high fracture toughness have also been developed using ZTA ceramic powder. The ZTA ceramics can be