

TECHNOLOGY FOCUS



Bulletin of Defence Research & Development Organisation

Technology Focus is published bi-monthly by the Defence Scientific Information & Documentation Centre (DESIDOC) on behalf of the Defence Research & Development Organisation (DRDO), Ministry of Defence, Government of India. It focuses on the technological developments of the Organisation, covering the products, processes and technologies.

DEFENCE TECHNOLOGY SPIN-OFFS FOR HEALTH CARE

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Printing

SB Gupta

Special issue on

Defence Technology Spin-offs for Health Care

Guest Editor

Dr T Lazar Mathew

Director

Defence Bioengineering & Electromedical
Laboratory, Bangalore

Readers of *Technology Focus* are invited to send their communications to the Editor, *Technology Focus*, DESIDOC, Metcalfe House, Delhi-110 054, India.
E-mail: pub@desidoc.ernet.in
Tel: 011-2919151

Under the aegis of newly formed Society for Biomedical Technology, an interministerial initiative to utilise Defence technology spin-off for medicare, DRDO has developed a number of biomedical products. These equipment, diagnostics and medical devices have ushered in a new era in the indigenisation of medical technology in our country with a view to provide appropriate and affordable health care for the common man.



Cytoscan—a computer interactive system for cell morphometry. Inset: A view of parabasal (left) and cancerous (right) cells identified in Cytoscan



एयर चीफ मार्शल एस के सरीन
प वि से मे अ वि से मे वा मे ए डी सी

Air Chief Marshal SK Sareen
PVSM AVSM VM ADC



वायु सेना मुख्यालय
नई दिल्ली-११००११
Air Headquarters
New Delhi-110 011

MESSAGE

I am happy to note that the Defence Research & Development Organisation (DRDO) is generating an awareness about its programmes and achievements through its bi-monthly publication, the **Technology Focus**.

The dedication of DRDO towards achieving the objectives of self-reliance in defence requirements and in development of state-of-the-art technologies has been commendable. The Indian Air Force looks forward to greater collaboration with DRDO to meet its future requirements.

I take this opportunity to convey my best wishes to the officers, staff and other personnel of DRDO for success in all their future endeavours.

Air Chief Marshal
Chief of the Air Staff

Guest Editorial

Biomedical technology is in its infancy in our country. Most of the equipment, diagnostics, therapeutic systems and high technology medical consumables and devices are imported at high cost. The health care is gradually becoming highly technology-oriented and thereby highly cost-intensive. The situation is creating a wide gap between haves and have-nots in our health care delivery system.

Considering the need to make health care affordable to the common man, the Society for Biomedical Technology was formed in 1993 under the Chairmanship of Dr APJ Abdul Kalam, Scientific Adviser to Raksha Mantri. This interministerial initiative has brought DRDO scientists from a number of DRDO

laboratories, medical specialists from well-known health care centres and a few chosen representatives of the industry to a common platform, and this experiment of bringing together 'brain power' to relieve pain from suffering fellow citizens has resulted in the development of a number of medical equipment, diagnostic consumables and devices. Some of these success stories are depicted in these columns of *Technology Focus*. I do hope that this exposure will create a meaningful interaction among scientific organisations, medical centres, industries and social organisations and will provide considerable support to solve our health care problems.

T Lazar Mathew

The country's quest for 'self-reliance' in Defence technology invariably results in enhancing the quality of life of the common man through spin-off benefits. The dynamics of Societal Missions can be seen more clearly from the fact that a

host of systems and equipment developed for Defence are a result of research and advances made in biomedicine, human engineering, missile technologies, special materials, chemical science, etc, and these have led to production of useful

medical products, life saving devices and evolution of other dual-use technologies. Several such items have been developed for the first time in the country to keep them within the reach of the common man. Some of the recent successful developments are:

Technology for Cancer Diagnosis

Cytoscan

This is a PC-based system used to acquire and analyse the image of a cell with a view to detect and classify cell abnormalities. The system uses pattern recognition technology originally developed by DRDO for life support systems and also image

processing technology. The hardware consists of a PC/AT, a microscope, a CCD camera and a frame grabber. The multimodule software developed for this system is currently meant to detect uterine cervical cancer. Statistical programs have also been developed to analyse large volumes of cell data. This is the first equipment of

its kind in India and is expected to cost Rs 8 lakhs for colour and Rs 4 lakhs for B&W output devices. Some similar equipment are available abroad at very high cost. The technology has been validated and transferred for mass production and sale in India and abroad.

Cardiovascular Applications

Stress Test System

This is a PC-based system developed to carry out stress test on heart patients and probable heart patients. The system, comprising PC/AT, ECG data acquisition system, multi-module software and report generator all of which are controlled through a supervisor program, makes use of signal processing technology originally established by DRDO for its aero-bioengineering and underwater acoustics applications. Apart from the software, a special amplifier and a PCB card have been developed to use this technology for conducting stress tests using this system.

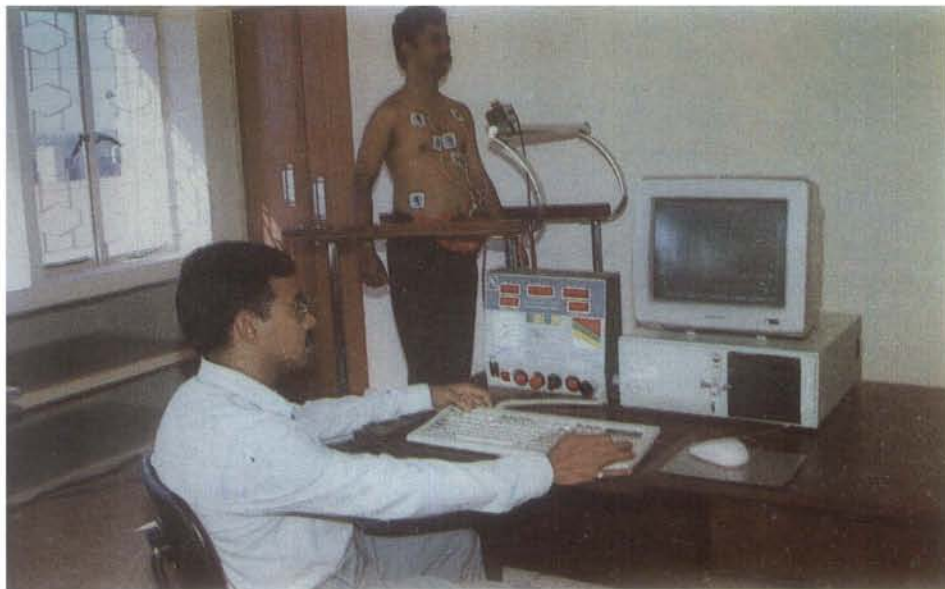
The main functions of the system are to monitor, analyse and document the ECG of a person doing exercise. The trends of heart rate, ST shift and BP during and after the test are used to infer the common abnormalities, like myocardial ischemia, angina pectoris and other coronary artery diseases. The system has been validated and the technology has been transferred to industry. The system costs Rs 3.5-4 lakhs as compared to the cost of

comparable imported systems which stands at Rs 12-15 lakhs.

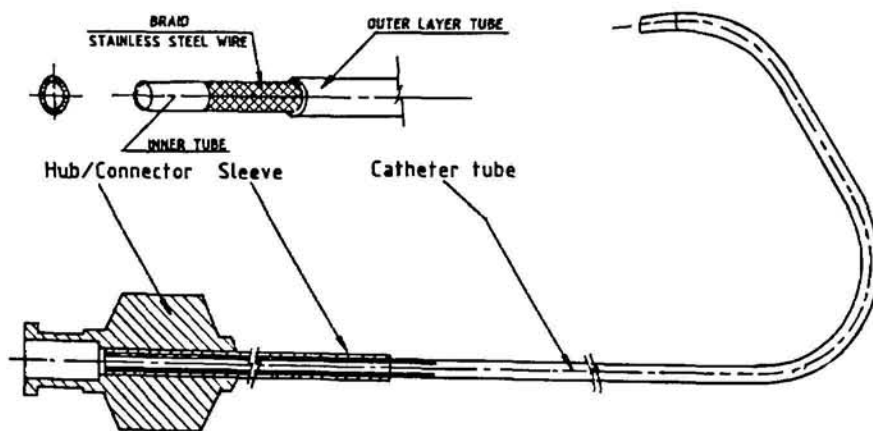
Cardiovascular Catheters

The catheter-based technique offers to a heart patient the choice of non-surgical treatment of defects within heart and the rest of circulatory system. DRDO exploited its competence in materials and ultrasound welding technologies for

indigenous development of cardiovascular catheters (diagnostic and angioplasty) mainly to bring down their price. The expected price of the indigenous catheter would be Rs 1500 as compared to Rs 4500 of imported one. The expertise gained through this development will also be useful to indigenise many more catheters like fallopian tube catheters and polymeric surgical consumables.



ECG stress test in progress



CROSS SECTIONAL VIEW OF CARDIOVASCULAR CATHETER

Cross-sectional view of cardiovascular catheter

Judkins type diagnostic catheters and 145 angled pigtail have also been developed.

Prototypes of catheters and guidewires have been clinically evaluated and the transfer of technology is in progress.

Coronary Stent

Coronary stents are used for recanalisation of occluded arteries. The stents, mounted on balloon catheters, are delivered to the clogged artery and dilated in situ. Production of the stent marks a breakthrough in

precision engineering technology. The stents were designed making use of special materials developed by DRDO for its Light Combat Aircraft and missile programmes. Special quality 316L grade austenitic stainless steel wire was used. Two types of stents have been developed. One with reinforcement 'spine' welded to the complex-shaped coil and the other with its ends welded to prevent lateral contraction. The steel wire has to meet the stringent metallurgical requirements of homogenous microstructure and the absence of delta ferrite. Special procedures have

been developed for casting, welding and electropolishing. After successful completion of the qualification tests, the stents were implanted in 30 patients; all of them have been reported functioning satisfactorily.

The stent developed by DRDO cost Rs 10,000 as against the market price of Rs 40-60,000 for a comparable stent.

Cardiac Pacemaker (External)

DRDO has undertaken the design, development and clinical application of pacemakers for the patients suffering from degenerative heart disease. Development of a programmable external pacemaker for intensive care and also a programmable implantable pacemaker is envisaged. The sensing and pacing software was developed and clinically validated at the Nizam's Institute of Medical Sciences, Hyderabad, through a PC-based temporary pacemaker system. Efforts are on to convert it into a portable pacemaker. The single sensing and pacing (atrium/ventricle) and dual chamber sensing and pacing have been successfully demonstrated. A commercial model of the external pacemaker is expected shortly.

Dental & Bone Implants

Titanium Dental Implants

The use of metal technology perfected by DRDO and biocompatibility and biofunctionality studies led to the development of titanium dental implants using CP titanium rods and other mill forms produced by MIDHANI, Hyderabad. The dental implant screw assemblies together with suitable surgical tool kit being imported earlier are now based on inhouse design. The trials have been conducted at four centres; so far 38 cases have been implanted. The implants are being produced in a



Abutments placed over titanium dental implants

limited number and efforts are on to scale up and optimise the pre-commercial production.

Dental Alloys



Dental alloys

Investment casting technology has been perfected by DRDO, to meet its

requirements for giving final shape to the super alloys. Using this technology, two cobalt-based alloys have been developed. These alloys contain additives to give various levels of strength and hardness suitable for casting partial dentures and crown and bridge work. The alloys exhibit excellent porcelain bonding characteristics as well as good corrosion resistance.

Titanium Bone Implants

Using the hi-tech material processing route of hot isostatic pressing, DRDO has developed hip bone implants made of *Ti-6Al-4V*, an alloy known for its excellent biocompatibility. Hip'ping is ideally

suited to produce these complicated shapes almost to near final dimensions, thereby resulting in minimal finishing operations. These hip'ped hip implants exhibit superior mechanical properties together with



Ti hip implant

light weight characteristics of titanium alloys.

Assistive Technologies

Artificial Larynx

This instrument is a speech aid for a laryngectomee—a patient whose infected vocal cords have been surgically removed. DRDO, using a suitable alloy processing technique, has successfully developed Permendur (49Fe-49Co-2V) diaphragm, a critical transducer component in the unit aiding conversion of electrical oscillations into mechanical vibrations.



Artificial larynx

Subsequent to successful user trials, the efforts are currently directed towards scale up. The system now being produced

indigenously, is available at one-third of the cost of the imported systems.

Floor Reaction Orthosis

The aerospace and missile programmes of DRDO have spurred the development of a wide variety of advanced composite products. The composite technologies and indigenous fabrication facilities are now being adapted for critical civil applications. A walking aid for polio patients—FRO (Floor Reaction Orthosis)—developed as a medical spin-off of advanced composite technology used in making missile nose cones has been widely acclaimed by medical

and social organisations in the country.

Contraception

Intra-Uterine Contraceptive Device

This is a mechanical device for insertion into the uterus to prevent pregnancy. It consists of barium sulphate-doped low density polyethylene T and high purity thin copper

wire wound around the T. DRDO has developed technology for the production of copper wire satisfying the specified metallurgical requirements with regard to dimensional accuracy, purity and biocompatibility. The domestic requirements for the

device are being met and foreign market is being explored.

Neem Contraceptive

Neem is a native tree of India. Neem preparations are reported to be

effective against skin diseases, boils, ulcers and infected wounds including burn injuries. DRDO has established efficacy of a fraction of neem oil (coded NIM-76) in killing human sperms besides its antimicrobial properties.

The active principle of NIM-76 is the basis of pre-coital vaginal

contraceptive for mutations. The formulation has been standardised and found safe for human pre-clinical trials. Besides spermicidal action, the NIM-76 is likely to promote vaginal health by its anti-fungal and anti-bacterial actions. The use of NIM-76 does not disturb the normal hormone and metabolic system and hence is safe.

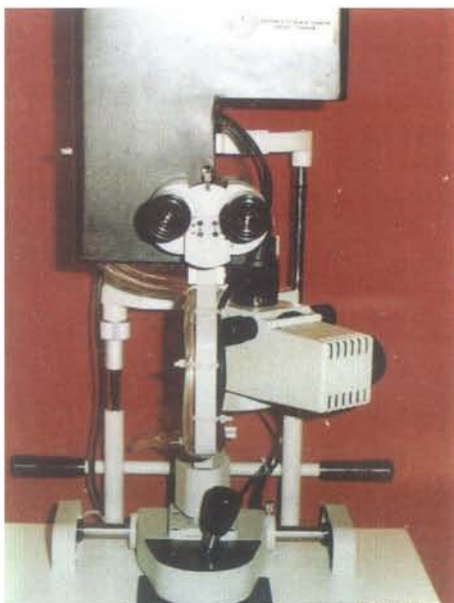
The NIM-76 being a herbal and native product, the contraceptives developed from neem are likely to be more acceptable by Indian women, particularly those living in rural areas, for family planning as compared to allopathic hormonal products. The clinical trials of NIM-76 being formulated in the form of cream are in progress.

Ophthalmology

Slit Lamp Microscope

This is a basic ophthalmic device required by all ophthalmologists for examining the eyes. The system developed by DRDO is the first of its kind in the country that can be retrofitted with Nd:YAG laser to perform posterior capsulotomy for treating secondary cataract.

The clinical trials of this system have been completed and the system is ready for transfer of technology. The expected cost of the system is Rs 40,000 as compared to Rs 1,20,000 for the comparable system abroad.



Drishti

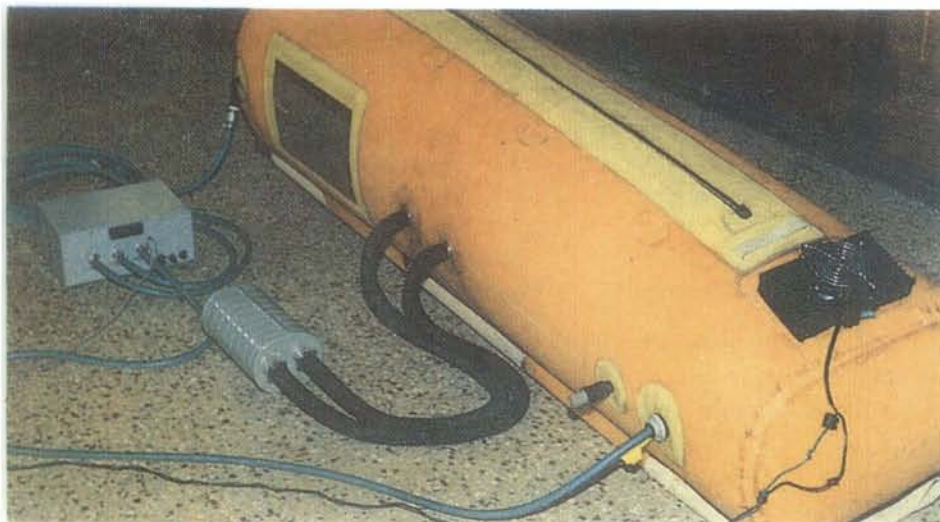
DRDO, in collaboration with the LV Prasad Eye Institute, Hyderabad, has designed a pulsed Nd-YAG laser with a delivery system for ophthalmological applications. The system is used as a photodisruptor for the treatment of glaucoma. It is configured as a Q-switched laser operating at its fundamental wavelength of 1064 nm.

Initial clinical trials of the laboratory model on about 100 patients have been successful and the system is ready for transfer of technology.

Drishti system

High Altitude Care

HAPO Bag



HAPO bag

System engineering by DRDO making use of oxygen therapy concepts and specially developed polyurethane material and air tight zip helped in the development of a portable one-man hyperbaric chamber which simulates low altitude conditions at hill station areas.

Designed and developed for the treatment of high altitude pulmonary oedema (HAPO) in Defence personnel serving at high altitudes, the chamber is also used by trekkers and mountaineers. It is an excellent first aid treatment used for shifting HAPO patients to lower areas. The 2 m long chamber is made up of neoprene

nylon and weighs approximately 3.5 kg.

The chamber can be pressurised up to 130 mm Hg pressure, which is equivalent to lowering the altitude by about 2000 m or 8000 ft.

Adaptogens

Studies have been made related to the magnitude of loss of performance on prolonged stay at high altitudes. The reversibility of deterioration in work performance and metabolism

has also been studied with a focus on the possibility of arresting the deterioration by the use of health food adaptogens. Two preparations, Composite Indian Herbal Preparation and Panax Ginseng have been found to be powerful adaptogens.

Diagnostic Kits for Common Diseases

Detection and Testing for Infectious Agents

Diagnostic kits have been developed for reliable and rapid detection of infectious agents causing a variety of diseases in human beings and animals. These kits are self-contained and can be used even by a general physician or by a layman having some training in science to replace the contemporary diagnostic procedures that are costly, complex, time-consuming and require the facilities of an expert and a well-equipped laboratory. The technologies developed in this regard are:

- Water quality testing for assessing its potability under field conditions.



Antigen detection kit for diagnosis of typhoid

- Detection of typhoid, bacterial meningitis, brucellosis (in both humans and animals), adenovirus, plague bacilli, glanders in horses and equine rhinopneumonitis.

Besides, the DNA probe technique has been employed for the detection

of *Y. Pestis*, toxigenic *E. Coli* and *Pseudomonas* strains. A simple and efficient method has been developed for isolation and preservation of DNA at room temperature.

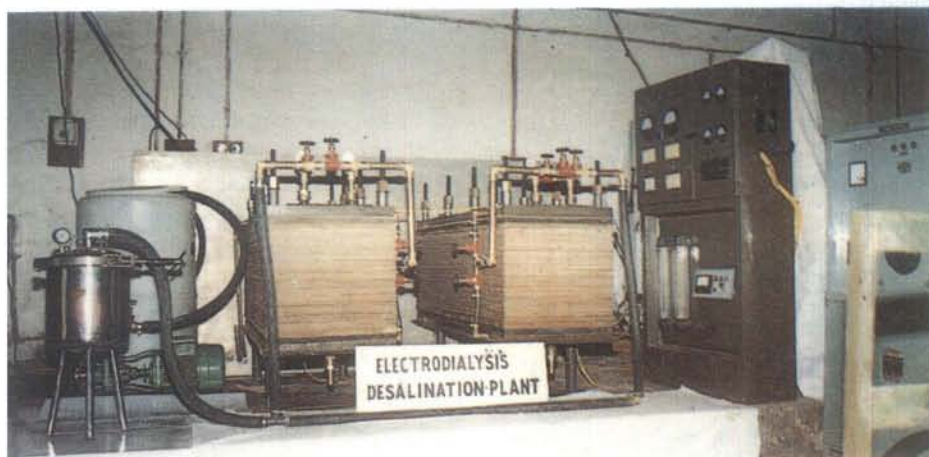
Pest Control Agents

Diseases like malaria wreak havoc on human lives in tropical countries like India. Preventive measures constitute the most viable solutions to control such diseases. A new generation insect repellent has been developed for protection against mosquito and other injurious insect bites in field conditions where nets or repellent mats cannot be used.

Besides, a toxicant attractant bait has been developed for the control of cockroaches.

Safe Drinking Water

DRDO had addressed the problem of providing safe drinking water to the troops operating in desert and snowbound areas. In this process, it has developed expertise in water quality survey, monitoring and surveillance including physico-chemical and microbial aspects, isotope hydrology, water desalination and disinfection, and quality improvement. The water testing field kit, desert desalination kit for brackish water, emergency survival kit for converting sea water into potable water and sterilization kit for converting snow-melted water into



Electrodialysis desalination plant

wholesome drinking water have all been evaluated extensively and the technologies transferred to civil sector for production.

DRDO is a major partner in the Rajiv Gandhi National Drinking Water Mission for providing safe drinking water to local inhabitants in rural areas of Rajasthan. Under the programme, DRDO has already installed 15 electro dialysis desalination plants in far-flung villages in Barmer district. An ongoing collaborative project envisages the installation of 115 desalination plants in 93 hard core villages at an estimated cost of Rs 33 crores.

For successful execution of this programme, DRDO will be using the following technologies:

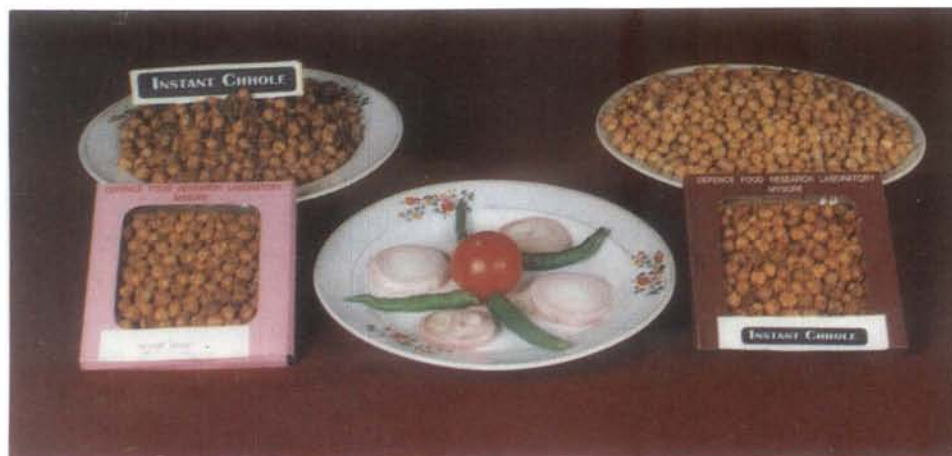
- The electro dialysis desalination plant provides 10,000 l of potable water containing less than 1,500 ppm as TDS in 8 hr from input water having salinity of 5,000 ppm as TDS. The output water conforms to drinking water standard of ICMR for desert areas. The plant can remove other harmful water-borne constituents, such as fluorides, nitrates, and high sulphate content.
- The easy-to-operate water testing kit can assess the chemical and bacteriological quality of water in

field conditions as per WHO/ICMR/BIS standards for drinking water. The kit can also be used for testing the presence of *E. coli* in milk, beverages, urine, and biological fluids.

- A domestic electro dialysis desalination plant based on electro dialysis reverse polarity and operated by solar photovoltaic cells, can be maintained by a housewife to meet the drinking water requirement of a family. It can be designed up to a capacity of 15 l/hr. The solar power plant for the plant has been developed by Rajasthan Electronics Instruments Ltd, Jaipur.

Processed Foods

A host of food technologies have been innovated, evolved and standardised for production of instant, convenient, processed and preserved foods for use in different situations in sea, mountains, arctic and space. These technologies have also exhibited immense potential for societal missions in the country in meeting food requirements in case of expeditions and natural calamities. Some of the technologies/products in this area are:



Processed foods

- Innovative technologies based on 'hurdle technique' have been developed to give shelf-stable high moisture fruit products storable for extended periods without refrigeration.
- A process of preservation of tender coconut water using a bio-preservative has been standardised to enable retention of original flavour even after 6

months storage and without loss of nutrients.

- Freeze-drying technology has been perfected for giving long-term protection to the fruits that can be stored without refrigeration under Indian conditions.
- Encapsulation techniques to protect the food ingredients from

the risk of development of 'taints' and to preserve aroma and flavour for extended shelf-life have been developed.

- Retort processing technology has helped in inpack sterilisation of ready-to-eat foods.

High Altitude Agriculture

DRDO has done pioneering work in protected cultivation of vegetables and flowers in high altitude areas of

Uttar Pradesh, Himachal Pradesh and Ladakh region of Jammu & Kashmir. DRDO has made it possible for the

farmers to grow green vegetables like coriander, mint, celery, palak, fenugreek, and parsley by using

polyhouse and trench cultivation techniques in sub-zero temperature conditions.

Besides, several technologies have been standardised for raising true potato seed, tomato and cucumber production using hydroponics, cultivation of certain potential commercially viable rare herbs, large scale production of mushroom, afforestation of cold desert areas with willow and poplars, organised dairy farming and successful rearing of broilers and layers in cold climate. An experiment is in progress to develop a self-sustaining village in Ladakh at a height of 12,000 ft employing DRDO developed agro-techniques with the help of the village cooperative as a vehicle—a model for planning overall development of Ladakh.



Tomato cultivation in a hydroponic system

Most of these technologies developed to provide appropriate and affordable health care for the common man are available for commercial exploitation. DRDO, as an organisation, is expecting collaboration of other willing industrial and R&D partners in this societal mission to take these societal activities to their new heights in the coming year. All correspondence regarding collaborative efforts, including technology transfer in this area may be addressed to :

The Programme Executive
Society for Biomedical Technology
Defence Bio-Engineering &
Electromedical Laboratory
PB No. 9326, CV Raman Nagar
Bangalore-560 093.

FIRST ISO-9001 CERTIFICATE FOR R&D ACTIVITIES IN INDIA*

The Defence Electronics Application Laboratory (DEAL), a premier R&D institution of DRDO, made a landmark achievement by becoming the first R&D organisation in the country to receive ISO-9001 Certificate from Standardization, Testing & Quality Certification (STQC). The ISO-9001 implementation at DEAL was triggered by constant encouragements from DRDO HQrs, New Delhi.

A study of existing system against the requirements of ISO-9001 revealed that some sort of quality system based on defence standards already existed there. As a result of this revealing study, the scientists became encouraged, feeling that the implementation of ISO-9001 requirements would not be difficult. Extensive interactive discussions with group quality leaders had a dramatic effect in breaking the barriers to ISO-9001 implementation. Further, the

clauses of the standard were interpreted in a user-friendly style, drawing specific examples from both completed and ongoing projects, and a healthy level of awareness of the standard was built up. According to Dr Khandelwal, Lead Assessor, "Assessing an R&D laboratory was a

challenging and learning experience for the laboratory as well as for the assessors". The ISO-9001 certification of DEAL will set the ISO-9000 momentum in other R&D institutions in the country.

At this stage, it is difficult to quantify the benefits achieved by the implementation of the quality system at DEAL. However, it has definitely helped the stages of design, development and validation of products. It has also helped in breaking barriers between various technical and project groups. It will also help the Laboratory in providing project deliverables to the customers on time. Finally, the implementation has also resulted in the development of a coherent and logically-integrated quality system at the Laboratory.

* Extract of the article published in *ISO News* No. 1, 1997.



AIRCRAFT ARRESTER BARRIER SYSTEM

An aircraft arrester barrier system engages a fighter aircraft to halt its forward momentum in the event of an aborted take-off or a landing overrun with minimal damage to the aircraft or injury to the crew. The technology for such an aircraft arrester barrier system was recently transferred by DRDO to the Indian Air Force.

The system consists of a multiple element net, stanchions, tape connector, purchase tape, pressure roller assembly, tape retrieval system and energy absorber. The kinetic energy of the aircraft is absorbed by a water twister type of energy absorber system comprising two velocity-sensitive, turbine type rotary hydraulic energy absorbers, one installed on each side of the runway. Each energy absorber consists of a tape drum assembly and a vaned rotor, both *splined to a common vertical shaft*. They are assembled in a vaned fluid filled housing.

An aircraft, having engaged the *cross-runway engaging device* (net or pendant) exerts a pull on the nylon purchase tapes which are spiral-wrapped on to the tape drum assembly of each energy absorber. The tape drum and rotor in each absorber are connected to a vertical rotor shaft. Therefore, the tape drum and the rotor rotate as a unit. Maximum rotor speed is quickly reached as the aircraft pulls the tapes from the tape drums. The liquid water ethylene glycol mixture in housing becomes agitated due to the rotation and interaction between the rotor and the stator vanes. The liquid turbulence during purchase tape payout converts the kinetic energy of an aircraft into kinetic and thermal energy of water,



Aircraft arrester barrier system

thereby causing a braking effect and slowing the aircraft to a safe stop.

The multiple element net assembly is raised with the help of stanchion system after receiving a command through a remote control located in the ATC tower, when emergency arresting of an aircraft is necessitated. As the net envelopes the aircraft, the pull exerted on the net releases the net bottom from the net anchors and breaks shear pins in the shear-off couplings, releasing the net top from the suspension system. The purchase



Testing of energy absorber using rocket firing

tapes attached to the net end loops are pulled through the fairlead tubes and begin paying off the two energy absorber tape drums, thereby turning the rotary hydraulic brakes. This action generates a uniform braking force which smoothly decelerates the aircraft to a safe stop.

After the aircraft has been safely arrested, the net is manually disconnected from the purchase tapes, removed from the aircraft and transported to the hanger for inspection and repair. The purchase tapes are rewound onto the energy absorber tape drums by the tape retrieval systems, thus allowing the system to be ready for another emergency arrestment.

Each sub system has been subjected to simulated testing in various stages, e.g., functional, performance, limit load and endurance testing.

DRDO PATENTS

Electronics

Window-cut Band Pass Filter

Band pass filters with low-pass band loss and high-stop band attenuation are extensively used in communications and radar systems, particularly in duplexers and triplexers. For low performance at millimeter wave frequencies, these filters adopt either pure metal insert configurations (class A) or large gap bilateral finlines (class B). The dimensional tolerance of pure metal insert waveguide filters is as stringent as in an air filter waveguide filter. The large gap finline filter with gap equal to the waveguide height alleviates this problem to some extent by concentrating most of the energy within the dielectric substrate. This filter, however, includes in it the loss due to the dielectric substrate.

The window-cut band pass filter alongwith its casing developed by IIT, Delhi, under a sponsored project of DRDO, gives minimum loss due to dielectric substrate even at millimeter wave frequency range. This improved filter has convenient size for economical industrial scale production and overcomes the drawback of filters of class A and class B and additionally offers advantages of the high Q-factor and more relaxed dimensional tolerance. The developed filter has insertion loss of 1.28 dB over a bandwidth of 500 MHz and stop band rejection of 60 dB at 750 MHz away from the centre frequency.

Process for Magnesium/Meta-Dinitrobenzene Battery

Meta-dinitrobenzene is a cheap organic cathode material and involves multielectron transfer to the extent of 12. The meta-dinitrobenzene-based batteries have the advantage of high electrochemical equivalence, easy availability, low cost and give steady voltage till the end of discharge. The

Central Electro-chemical Research Institute, Karaikudi, under the grants-in-aid scheme of DRDO, has developed a novel process for the preparation of magnesium/dinitrobenzene organic primary reserve battery which leads to the battery of high capacity (200 Ah). In this process cathode plates are prepared by pressing cathode mix of meta-dinitrobenzene and other chemical additives/binders. The battery is capable to perform to the extent of 80 per cent of its room temperature capacity of 70 Wh/kg even at low temperatures up to -40°C .

Materials

Process for Titanium Silicide

Titanium silicide and molybdenum-di-silicide are high temperature materials with applications in aerospace, heating elements in furnaces, turbine aerofoils, etc. In our country, where molybdenum is a scarce material whereas titanium sponge is easily available, titanium silicide offers an attractive alternative to molybdenum-di-silicide.

The processes currently in use for the preparation of titanium silicide require hot isostatic pressing for 5 to 10 hr at a high temperature of about 1300°C at high pressures. The expensive equipment required for this process is not available in the country. Besides, the known processes use commercially available coarse grain powder which is more expensive than titanium sponge and requires high energy milling in an inert argon environment for grinding to a fine powder.

The process developed by DRDO uses cheaper and easily available titanium sponge. The titanium powder is prepared *in situ* at an intermediate stage of the process without any high-energy milling. Besides, the process is

highly energy-efficient, faster and does not require hot isostatic pressing at high temperatures. This process leads to dense (density 98 per cent) and fine-grained material with superior mechanical properties like higher fracture toughness, hardness and flexural strength.

Process for Flouride Glass

Flouride glasses are known for IR transmitting applications. These materials are characterised by weak chemical bonding which is a manifestation of high IR transmission properties. These glasses have the additional advantages of improved chemical durability and excellent thermal stability as compared to the chalcogenide and oxide glasses which are also being used in IR transmitting applications. The process developed by IIT, Bombay, under a project funded by DRDO, has further enhanced chemical durability of the flouride glass against moisture/water thereby eliminating the need for special protective storage conditions for longer durations. The flouride glass obtained by this process has higher IR transmission capability. It is corroded only on the surface and can be reused by polishing. In the flouride glass obtained by the existing processes, bulk corrosion leading to bulk opacity takes place making the glass unfit for use.

Food Technology

Preconditioning Process for Dry Extruded Products

The dry-extruded wheat and rice products like vermicelli, noodles, spaghetti and macroni are required to be cooked by boiling for various lengths of time before they are soft enough to be used directly in the formulation of dry quick cooking, convenience product mixes for desserts and savoury snacks. The

pre-conditioning process developed by DRDO allows these food products to rapidly rehydrate at temperatures at least 30 °C below boiling point. Such products can be used as 'heat in the

bag foods' under space conditions, for cooking at high altitudes, and for cooking at home using baking oven/microwave oven. The product developed by DRDO absorbs between

100 to 150 ml of water & about 70 °C and rehydrates to a satisfactory softness in about 10-15 min.

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