



# Technology

टैक्नोलॉजी फोकस

**FOCUS**

A Bimonthly S&T Magazine of DRDO

ISSN : 0971-4413

Vol. 24 No. 1, January-February 2016



A summary of the past year, thanks and New Year's greetings



I am just about the half way through of my first year as Director DESIDOC and thought the end of the year is a good time to reflect on where we and the *Technology Focus* have been and where we are going. It is therefore with great pleasure and sense of responsibility that I write today as the Editor of *TF*.

Serving as Director has given me some insight into what it takes to publish a magazine or a journal - it is, motivated individuals and team work; and, I put on record my appreciation for the excellent team effort encompassing DRDO labs, editorial team and honest readership that has made *TF* a hugely popular technology magazine. The editorial team and all those involved are determined to maintain and enhance the status of the magazine and its position. To that extent our readers will also note that the editorial handling process and consequently the turnaround of magazine have been speeded up over the past six months. The magazine is punctual and now comes out on its pre-established date. I encourage DRDO scientists to come forward to submit their excellent works. Your active participation is greatly appreciated.

*TF* has completed 23 years in 2015, through *TF* it is our endeavour to highlight state-of-the-art and cutting-edge defence technologies indigenously developed by DRDO. In 2015, six bimonthly theme based special issues were produced besides regular supplements which covered both scientific and general interests. The specialised areas were, Chem-bio Defence, Water Purification Systems, Microwave Power Modules and Compact Transmitters, Laser Technologies- Laser Sources, Laser Equipment, and Fire Safety Technologies. Overall our goal through *TF* is to provide a forum for the presentation of outstanding science, technology and product development.

As I look to the year ahead, I reiterate with confidence the commitment to DRDO that DESIDOC will continue with even greater enthusiasm and dedication. In the year 2016 we have planned to reorganise the magazine with the possibility of increasing the number of pages and adopting a new, easier-to-read format by adapting to e-publication and make them available on DRONA and DRDO website. I on behalf of DESIDOC promise to do our best not only to maintain the scientific excellence of the magazine, but to continue the work in improving *TF* as it enter into 24th year. I am sure that DRDO labs will come forward to reserve *TF* issues for specialised coverage to focus on specific technology/products which these laboratories are working on. I also believe that there are several areas where magazine can benefit from midcourse corrections therefore to do that we have enclosed a feedback form for your valued input.

The success depends on the equal partnership which I promise to improve and promote our role in this partnership. I look forward to your valued contributions in 2016 and beyond, which I believe can only be achieved with the continued cooperation of our contributors and valued readership.

In closing I wish DRDO community and all our readers the very best wishes for 2016 and assure that DESIDOC is now moving forward to new standards of excellence.

*“We are all very proud of our profession and together, can achieve great things for DRDO”*

Sincerely

**Gopal Bhushan**  
Director, DESIDOC



# Technology

टैक्नोलॉजी फोकस



ISSN No. 0971-4413

Vol. 24 No. 1, January-February 2016

A Bimonthly S&T Magazine of DRDO

## Detection, Protection and Decontamination of Chem-bio Agents



DRDO has designed and developed many state-of-the-art detection, protection and decontamination technologies against hazardous chemicals and microorganisms. DRDO has developed core competence in several areas including synthesis, evaluation and process development of toxicants and antidotes development of chemical and biological sensors, molecular and immunological detection techniques, vector management and bioremediation of organic waste.





## *From the Guest Editor's Desk*

Towards its evolution as a centre of excellence with proficiency in detection, protection and decontamination of chemical and biological agents, a large number of technologies and products have been developed by Defence Research & Development Establishment (DRDE) for chem-bio defence and majority of them have already been inducted into the Services. Besides, DRDE conducts regular advance training programmes for awareness of chemical and biological agents of defence importance for military and paramilitary forces.

In addition, various technologies have been for civil sector also. Biodigester technology, initially developed for biodegradation of human waste at high altitude areas like Siachen glaciers, now has been extended to civil sector and Indian Railways also. So far, several thousand digesters have been installed for Services, civil population and railways in various areas of the country ranging from Siachin Glacier to Lakshadweep through our registered industrial partners. Besides, DRDO has developed various detection and diagnostic kits, formulations for control of disease spreading vectors, water testing kits, etc. Several of these technologies have been transferred to private entrepreneurs for development of useful products both for service and civil application. Time to time, DRDE has contributed significantly in the investigation of various disease outbreaks and other calamities like Tsunami.

During the recent visit of Shri Manohar Parrikar, Hon'ble Raksha Mantri at DRDO, it was decided to bring out a special issue of *Technology Focus* highlighting the products for civilian use and other contributions of DRDE to the society. I hope that this issue of *Technology Focus*, which is based on contribution of DRDO towards the society will be useful and informative to the readers.



Dr. Lokendra Singh  
OS & Director  
DRDE, Gwalior

## Detection and Diagnostic Kits

Although various disease detection and diagnostic kits have been developed for defence. These products have great potential for use in civil society too.

### Chikungunya Detection Kit

Chikungunya fever is an acute arthropod-borne viral illness reported from Africa, Southeast Asia, Western Pacific and India. The causative agent is CHIK virus, and primarily transmitted by Aedes mosquitoes. Enzyme Linked Immunosorbent Assays (ELISAs) based diagnostic kits hold a great promise for economical and convenient diagnosis of viral infections. A highly sensitive and specific kit has been developed based on IgM ELISA, Sandwich ELISA and RT LAMP Assay techniques for early detection of chikungunya.

The kit has been validated with more than 100 clinical samples (serum and CSF), collected from chikungunya outbreaks in different parts of India. It is having 85 per cent concordance, 96 per cent sensitivity and 97 per cent specificity with commercially available ELISA kits. This technology has been transferred to private firms.



Chikungunya Detection Kit

### Dengue Detection Kit

Dengue is the most important mosquito borne viral infection of mankind. It is widespread through out tropical and sub-tropical regions of the world. Dengue is endemic in India and its outbreaks are reported at regular intervals from different parts of India. All the four serotypes of dengue are circulating in 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.

A highly sensitive and specific kit based on IgM ELISA and IgG ELISA techniques has been developed for early detection of dengue. These kits have been validated with more than 100 serum samples collected from recent dengue outbreaks in Madhya Pradesh and Andhra Pradesh (2006-2007).

The kits are having 85 per cent concordance, 89 per cent sensitivity and 94 per cent specificity with widely used commercial diagnostic kit (PanBio IgM capture ELISA). These kits have undergone multi-centric evaluation and ready for Transfer of Technology (ToT).



Dengue Detection Kit



## Japanese Encephalitis Detection Kit

Japanese Encephalitis (JE) is the most important viral encephalitis of public health significance. It is endemic throughout southeast Asia, including India. JE outbreaks are reported at regular intervals from many parts of India. There is no effective therapy available against this disease. Therefore its early diagnosis plays an important role for proper control and effective management of patients.

DRDO has developed and evaluated sensitive and specific kits based on IgM ELISA and Sandwich ELISA techniques for early detection of JE. These kits have been validated with more than 120 clinical samples (serum and CSF), collected from JE outbreaks in eastern UP. The kits have 85 per cent concordance, 93 per cent sensitivity and 98 per cent specificity with commercially available diagnostic kits. The technology has been transferred to private firms.



Japanese Encephalitis Detection Kit

## Glanders Spot Test

Glanders, caused by *Burkholderia Mallei* is primarily a disease of horses, mules and donkeys, and can be transmitted to humans causing severe infection. *Burkholderia mallei* is a listed bio-terror agent. Equine glanders is a notifiable disease and recently many outbreaks have been reported from various parts of India.

Presently, glanders are diagnosed by complement fixation test and mallein hypersensitivity tests both of which are laborious and time consuming. Spot kit is first recombinant protein based test kit ever developed for diagnosis of glanders.

In this, recombinant BimA protein antigen is coated on the nitrocellulose membrane. Antibody present in serum/plasma binds to this antigen which is subsequently detected by detector solution. Appearance of brown coloured test spot is indicative of positive result. The rBimA protein has been evaluated with over 1500 equine serum samples in ELISA format and the results are encouraging.

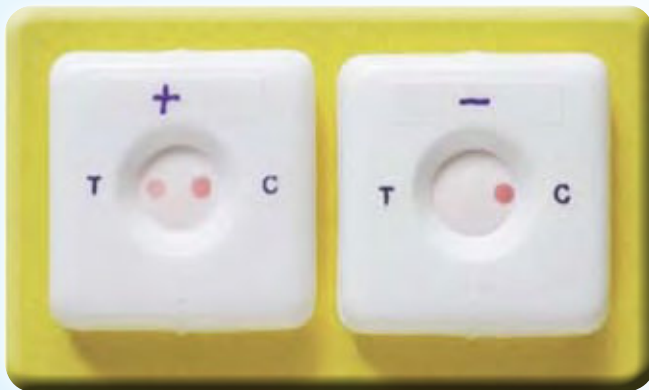


Glanders Spot Test

### Brucellosis Detection Kit

Brucellosis is a zoonotic infection usually transmitted to humans by contact with infected animals or by consumption of contaminated animal products. The ability of the bacteria to spread as aerosol makes them a potential biological warfare and biothreat agent. Several serological tests have been developed and being used for the diagnosis of Bovine brucellosis.

The most common of them is the agglutination based tests mainly, Rose Bengal Plate Agglutination Test (RBPT) and Standard Tube Agglutination Test (STAT). The plate ELISA kit for the detection of Bovine brucellosis is developed as an alternative to agglutination tests. This product is ready for ToT.



Brucellosis Detection Kit

### Lapto Sense Kit

DRDO has developed an effective kit for detection of Laptospirosis bacteria. The kit is based on IgM antibody DOT ELISA method. It requires only one drop of blood to detect the bacteria. Alternatively, plasma or serum can also be used for detection. It does not require any specialised training. The technology has been transferred to private firms.



Lapto Sense Kit

### Plague Sense Kit

Yersenia Pestis, which is responsible for plague epidemic, is regarded as one of the deadliest biological agent. DRDO has developed an effective kit for detection of the deadly vector of this disease. This kit demonstrates the presence of HA and HAI antibody of Yersenia Pestis. The kit is also cost-effective in comparison to other kits available in the market. The kit is ready for ToT.





## Anthrax Detection Kit – AnthrAb

*Bacillus anthracis*, the causative agent of anthrax, is a large, gram-positive, non-motile, spore-forming rod shaped bacterium. Besides being one of the most important biological warfare agents, it causes public health problems in both animals and humans in countries with warm climate. DRDO has developed a detection kit for anthrax, based on the principle of Indirect ELISA. In this test, patient serum/plasma is added to the antigen pre-coated membrane. IgM/IgG specific antibody, if present in the sample, binds to this antigen. All unbound materials are washed away and the colloidal gold conjugate is added to bind to this antibody-antigen complex, if present. The development of brown colour confirms the presence of IgM/IgG specific antibody in the sample. The intensity of colour developed depends on the amount of antibodies present in the sample. It takes only 2 min in its detection. This kit is validated with more than 400 serum samples collected from anthrax endemic and non-endemic areas. The kit has 100 per cent sensitivity and specificity with confirmed cases of anthrax. A patent is filed for this product and the kit is ready for ToT.



Anthrax Detection Kit-AnthrAb

## Swine Flu Detection Kit

The recent emergence of swine origin influenza A H1N1 Virus (S-OIV) with high efficiency of human to human transmission raised a concern for global pandemic. The swine flu pandemic in 2009 was caused by novel swine origin influenza A H1N1 Virus (S-OIV) that had not been recognised previously in pigs or humans.

DRDO has developed a one step real-time Reverse Transcription Loop Mediated Isothermal Gene Amplification (RTLAMP) assay for rapid and real-time detection of novel S-OIV RNA in clinical specimens by targeting the HA gene, and requiring only 30 min for confirmation. The S-OIV H1 gene specific RTLAMP assay reported is not only simple, rapid, reliable and inexpensive method but also highly sensitive and specific.

RTLAMP technology for clinical diagnosis of swine flu patients is validated by evaluation with acute phase throat swab samples collected from the ongoing epidemic in India. Two patents are filed in India for this. The technology has been transferred to private firms.



Swine Flu Detection Kit

## Ricin Detection Kit

Ricin is one of the most toxic proteinaceous substance that is extracted from the seeds of the castor plant commonly known as *Ricinus communis*. It is a glycoprotein with molecular weight of 62-65 kDa, and consists of two chains A and B of nearly equal size linked together by a disulfide bond.





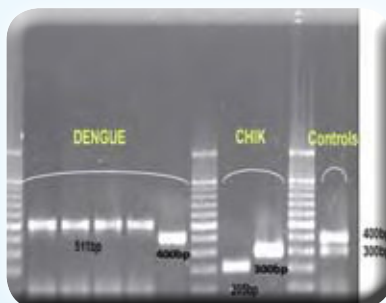
**Ricin Detection Kit**

It causes complete inhibition of cellular protein synthesis leading to cell death. Ricin has been considered as the biological warfare agent because of high toxicity and easy availability. Thus, a need was felt to have high sensitive and fast method for detection of ricin. DRDO has developed a single step ricin detection kit using the colloidal gold conjugated antiricin antibodies. A positive test shows two visible bands at the control as well as test antibody coated site whereas negative test results in only one visible band at the control antibody coated site. The test is completed in less than 5-7 min. The technology has been transferred to a private firm.

### Den-Chik Duplex PCR

Dengue and chikungunya have emerged as pre-cautious viral infection all over the world. Early detection of these infections is necessary keeping in view the similar symptoms, affected geographical area and vector.

DRDO has developed a one step single tube duplex reverse transcription polymerase chain-reaction (D-RT-PCR) assay for early detection of this infection. It can be used for testing infection of even one day old. This assay can be used to detect dengue and chikungunya infection in both human and mosquito.



### Water Testing Media

Water testing media is used for testing of potable water samples for detection of contamination with microorganism. The kit contains dried media which supports bacterial growth when water sample, to be tasted, is filled in it. After overnight growth at 30 °C to 37 °C if the colour turns black, the water sample is unfit for drinking purposes. The kit is low cost and does not require any expertise as the test can be conducted by any person in the field conditions.

Technology of this product has been transferred to large number of private firms for bulk production and the product is commercially available.



**Water Testing Media**

### Products for Vector and Insect Control

Scientists having expertise of different disciplines like entomology, synthetic chemistry and toxicology have been working for decades and have come out with formulations and products to control insects that are vectors of various diseases and biting nuisance, as well as a big problem for any household in the kitchen and stores.

### DEPA Spray and Cream

Mosquitoes are well known carriers of malarial parasites; dengue, chikungunya, JE viruses; filarial worms and many other pathogens. Moreover, they



are biting nuisance and different species affect human beings throughout the day at different times. Various products are available in the market to control mosquitoes either by killing or repelling. Physical protection is also a common practice to ward off these insects but not being preferred by all sections of people. Though repellents are more preferred option but they lack in efficacy. DEPA (N,N-Diethyl-2-Phenyl Acetamide) is a multi insect repellent developed and has been extensively evaluated in laboratory as well as field conditions against several haematophagous organisms like mosquitoes, sandflies, black flies, mites, bedbugs, land leeches, etc. and found highly effective in protection over other commercially available repellents.



DEPA Spray and Cream

Technology of DEPA as well as its formulations have been transferred to many commercial industries. All regulatory clearances have been obtained for its commercial production and marketing. It has also been included in the Indian Pharmacopeia. Director General Armed Forces Medical Services (DGAFMS) has accepted and recommended the DEPA spray which is being regularly procured and used by Armed Forces.

DEPA, available in three types of formulations—spray, cream and lotion. Spray formulation is easy to apply on fabric, curtains and bedsheets and provide protection overnight in closed room. The spray formulation can also be used to repel non biting insects like ants, cockroaches, etc. in a room or outdoor areas. Cream formulation has pleasant fragrance and can be applied to exposed body parts. The repellency against mosquito persists for nearly 6 hours as against 2 to 3 hours protection by other products available in the market. The cost of the spray and cream formulation is approximately ₹ 180 and ₹ 30, respectively.

## Attracticide

Dengue and chikungunya are spread by *Aedes aegypti* mosquito which bites in day time. These mosquitoes breed in fresh water container in and around houses and their eggs can survive more than a year without water at ambient temperature and humidity. DRDO has reported the oviposition attractant pheromone (C21) and developed the process for its synthesis. The attracticide formulation contains the attractant for eggs laying female mosquitoes (C21) and larval growth inhibitor (Diflubenzuron) and thus works to control the population of *Aedes aegypti* mosquitoes in surrounding environment



on the concept of lure and kill. An indigenous synthetic method has been developed for C21 and up-scaled it at pilot plant scale to meet the requirements. Attracticide is non-toxic and Central Insecticide Board of India (CIB) has granted registration of attracticide under export category. Patents have been filed in India and foreign countries (US, Europe and Japan). The technology for C21 synthetic process and attracticide has been transferred to four industries for its bulk production.

### Slow Release Insecticidal Paint

Use of paint for decoration and preservation of woods and metallic surfaces has been in vogue since long. Now a new dimension has been added which besides meeting these requirements also keep the mosquitoes, cockroaches, termites, ants and other crawling insects away at virtually no extra cost. DRDO has developed a Slow Release Insecticidal Paint (SRIP) in the form of blend material which is safe insecticide in a paint composition and its chemical is released in sustained manner over a period of time. The chemistry of formulation has been so delicately balanced that just sufficient quantity of insecticide is released for killing the insects which come in contact with it. Indian patent for this paint has been awarded. The successful field trials have been conducted in DRDO, Indian Navy INS Vikrant, Indian Railways and Indian Tourism Development Corporation. It is available as white colour, ready to use formulation for wooden and metallic surfaces. Colour of the paint can be changed with other paint materials. Painted surface dries rapidly within an hour. Ideally suited for use in kitchen, restaurants, warehouses, hospitals, ships, ports, etc. Painted surface retains insecticidal activity up to two years. The technology has been transferred to two commercial firms.



### Wool Care

Woolen garment including other woolen textiles such as blankets, carpets are highly susceptible to damage by insects such as cloth moths and carpet beetles. These insects deteriorates quality of garments leading to heavy losses of woolen textile at military, domestic and commercial woolen stores.

DRDO after a long research and extensive field trials has developed a new moth proofing agent in the form of Wool Care spray. It contains a synthetic Pyrethroid Permethrin as an active constituent at safe level to human beings. It is ready-to-use formulation which protects woolen garments from damage by wool eating insect effectively and useful for industries as well as house-holds. One time treatment of spray provides the protection to woolen cloths for atleast one year. The formulation has been granted European Patent and the technology has been transferred to private industry for commercialisation.



Wool Care

### Ratox

Rats are serious pest of crop plants. They not only damage food grains and other materials, but also are carrier of several diseases of human health importance. The economic loss caused by rats is enormous. RATOX is toxicant attractant bait developed by DRDE for commensal rats. The formulation contains fluoroacetamide as an active ingredient which paralyse and kills the rats.



Ratox

To control rat menace, bait is kept in the rat infected area. Due to the attractant present in the bait, rats prefer the bait over normal food available in the vicinity. After consumption, rats develop uneasiness, psychological disturbance and they get unable to reach the burrows and die in the near vicinity, i.e. near bait thus making it easy to identify the dead rats. This also helps in removal of carcass. Unlike other commercial baits, Ratox does not have problem of bait shyness because rat dies immediately when it consume the bait.

Ratox has been extensively evaluated in restaurants, shops and storage godowns by central warehousing corporation. This bait has also been found effective on naval ships for control of rats.

The efficacy has been further evaluated by Central Arid Zone Research Institute.

## Roachline and Roach Tox

Cockroaches are nuisance pest for every household and known as mechanical carrier of various food borne pathogens harmful to human being. They hide in cracks and crevices of kitchens and feed on wide variety of food stuff at home, restaurants, hotels, ships, trains and other dwelling places. Insecticidal sprays have limited application in the control of cockroaches, because of their direct access. DRDO has come out with insecticide impregnated chalk sticks in the form of Roachline and tabletised bait formulation called Roachtox for their control. Roachline is a simple and novel approach to get rid of all kinds of cockroaches, ants and other crawling insects. All that required is to draw a thick line around hiding places and area should be cordoned off. The crawling insects when cross such line picks up lethal dose of insecticide and die instantaneously. Roachtox is both attractant and toxicant. Three to four tablets should be used in the area infected with cockroaches. Tablets remain effective as long as they are present physically at the site.



Roachline and Roach Tox

## Products for Environmental Hygiene and Waste Management

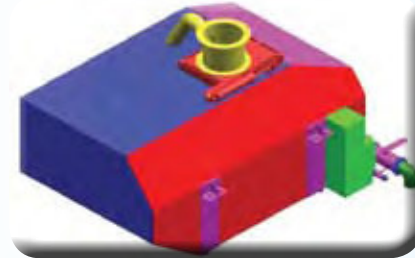
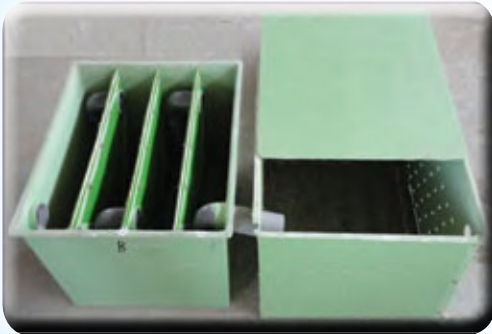
Human waste management is a challenging task for thickly populated countries like India inspite of the well developed and accepted technologies at international level. The problem is further aggravated in low temperature areas like Siachen glacier and Ladakh region where ambient temperature remains subzero during most part of the year. The prevalent technologies for plains are cost and maintenance intensive besides being inefficient. Even septic tank, the most popular technology, also has problems with respect to cost, evacuation, effluent quality and space requirement.

Biodigester technology developed by DRDO overcomes most of these problems and is affordable, environment friendly, maintenance free as well as efficient. The effluent is odourless and gets rid-off most of the pathogens. Biodigester technology has two main components: one is biodigester tank (fermentation vessel) and the other microbial consortium which can degrade human excreta in wide range of geo-climatic conditions and temperature. Various models of biodigester cater to the requirement of common man in different set of conditions like for individual houses, housing societies, multi-floor building and

even for community use in villages and urban slums. Moreover, mobile human population in rail and other carriers require different type of technological solution for human waste that has also been catered by different variants of biodigester. This technology provides complete solution to the problem of manual scavenging for which government is determined.

DRDO entered into several MoUs with different govt. and non-govt. organisations for implementation of biodigester in different civil sectors, viz., Ministry of Railways, BMTPC (Ministry of Housing and Urban Poverty Alleviation), Ministry of Drinking Water and Sanitation and Ganga Action Parivar. A large number of biodigesters have been installed in civil society of different states. Thousands of biodigester are being installed at Leh, Lakshadweep, Maharashtra Forest Department and other places.

biodigesters in next 5 to 6 years and is keen to take the technology abroad. So far, technology has been transferred to 55 industries of national and international repute located in different states and more and more industries are approaching DRDO in view of the growing need of technology to accomplish the **Swachh Bharat Abhiyan** of the Govt. of India.



Biodigester for Indian Railways



Biodigester for Coastal Areas and Islands (Lakshadweep)



Temperature Controlled Modular Biodigester for Glaciers

Indian Railways fitted thousands of its passenger coaches with biodigesters and so far 20,000 biodigesters have been installed in different trains. Indian Railways intends to fit all of its coaches with



Metal Biodigesters at High Altitude



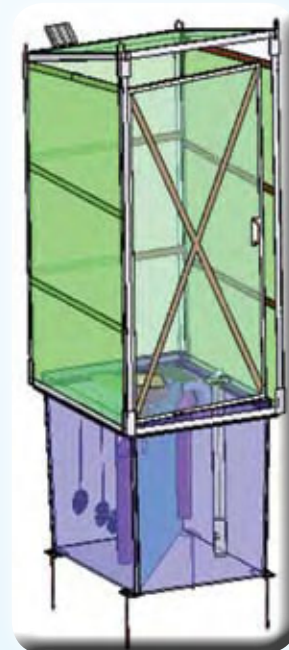
Mobile Biodigester at Kumbh Mela, Allahabad



FRP Biodigester for Low Temperature Areas (Leh)-Single Family

Salient features of biodigester technology are:

- ❖ Eco-friendly and cost-effective
- ❖ Wide applicability under different climatic conditions
- ❖ Customised and easily adaptable
- ❖ Maintenance free and no need to remove the sludge
- ❖ Minimises water consumption
- ❖ Reduction in organic waste by more than 99 per cent
- ❖ Recycling of effluent water for cleaning of toilet pan and gardening
- ❖ More than 99 per cent pathogens reduction
- ❖ Generation of odourless and inflammable biogas
- ❖ Use of toilet cleaning agents is permitted



FRP Biodigester for Plain Areas-Single Family



**Bioilets for Public Use at RML Hospital**

Anaerobic Microbial Consortium is the heart of this technology and is responsible for efficient biodegradation of human waste. The microbial inoculum for biodigester is being maintained at DRDE and is multiplied in inoculum generation facility with provision of stirring and temperature maintenance.

Besides DRDE, some of the industries (ToT holders) have created such facilities and meeting their own requirement as well as of other vendors.



**Anaerobic Microbial Inoculum Generation Facilities of 14 m<sup>3</sup> and 70 m<sup>3</sup> at DRDE**



## OPCW Designated Laboratory

DRDE is the first laboratory of the country to achieve the status of 'Designated Laboratory' from the Organisation on Prohibition of Chemical Weapons (OPCW), The Netherlands, The Hague. India is the signatory state of the Chemical Weapon Convention (CWC) since 1997 and therefore, obliged to abide the norms of the convention, which are administered by an international organisation, OPCW. This status provides the laboratory and the country to play a decisive role in proving the compliance or non-compliance of the international treaty of Chemical Weapons Convention (CWC). This status provides the strength to the country to fulfil the national commitment for the verification of CWC.

DRDO has developed expertise in analysis of chemical warfare agents and their derivatives. Several innovative analytical methods for the off-site identification of CWAs and their markers have been developed. These procedures have been published in the international journals of high repute, and are being followed by the OPCW and other laboratories. These techniques were highlighted in the temporary working group meetings on sampling and analysis held at the OPCW as well as discussed in the OPCW Scientific Advisory Board meetings.

Because of consistent excellent performance, the Noble Peace Prize 2013 winner OPCW has recognised DRDE as the sample preparation laboratory for the 32nd official proficiency test conducted in October-November 2012. In this test, Vertox Lab DRDE challenged the 28 laboratories from 22 countries from all over the globe to detect and identify the CWAs and their marker chemicals at low concentrations of parts per million in the environmental matrices.

Vertox Lab of DRDE has obtained the NABL accreditation for analysis of chemical warfare agents and their markers under ISO/IEC Guide 17025. The status of NABL accreditation is maintained by the Vertox since last 10 years.

## Animal Facility

Experimental animals play pivot role in life-sciences stream. DRDE has Animal Facility Division with all the necessary arrangements for breeding, rearing and maintenance of commonly used small laboratory animals such as Swiss and BALB/c strains of Albino Mice (*Mus musculus*), Wistar Rats (*Rattus norvegicus*), English Guinea Pigs (*Cavia porcellus*) and New Zealand White Rabbits (*Oryctolagus cuniculus*). The animals are being reared under standard animal husbandry conditions since more than four decades. The total strength of laboratory animals are around 6000-7000 at any given time. The facility produces and maintains quality animals for research and development of technologies, systems, antidotes, drugs, products, etc. of defence interest related to life-sciences and as a spin-off to the civil populace.

DRDE is registered with Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA)—a statutory committee, since 1999, under the Prevention of Cruelty to the Animals Act, 1960 (Chapter 4, Sec. 15-1). The establishment has a CPCSEA approved standing Institutional



New Zealand White Rabbits (*Oryctolagus cuniculus*) Room





**Swiss Albino Mice (*Mus musculus*) Room**

Animals Ethics Committee (IAEC) which closely monitors the use of animals for experimental purposes. The IAEC meetings are convened regularly as per guidelines of CPCSEA and all the animal demands under each study protocol are examined critically to ensure judicious utilisation before approval. Further, the used or old rabbits are also rehabilitated with humane care.

### **Bioprocess Scale-up Facility**

The Bioprocess Scale-up Facility (BSF) is involved in process development for bulk production and purification of biomolecules such as recombinant proteins and antibodies to be used either for diagnostic application as well as vaccine candidates. The facility spreads over 1220 m<sup>2</sup> area and has clean rooms ranging from class 100,000 to class 100 particle counts with pressure difference of 30 to 60 Pa. It is housing many instruments including fermentors (5,20,100 L capacity), filtration systems (Prostak, Pellicon spl, Pellicon mini, Proflux) and chromatography systems (Akta purifier, Akta explorer and Akta pilot) for laboratory as well as pilot scale production and purification of biomolecules. This



**Bioprocess Scale-up Facility**

facility is well equipped with HVAC systems, purified water plant, steam generation plant and WFI plant. The BSF facility is maintained as per WHO Current Good Manufacturing Practices (cGMP).

Over the period, the recombinant proteins of bacterial agents, viz. Bacillus anthracis (Anthrax), Brucella, Staphylococcal enterotoxin B (SEB), malaria and viral agents, viz. dengue, chikungunya, JE, west Nile, etc. have been successfully produced using this facility. These recombinant proteins are being used for development of ELISA/Flow Through/ICT based diagnostic kits. This facility is approved by Drug Controller General of India (DCGI) for production of biomolecules of diagnostic and therapeutic importance. In addition, the facility has been used under GOCO (concept for bulk production of yeast expressed human insulin precursor in 100 L fermentor) by M/S Bigtec, Bengaluru.

### **High Containment Facility**

High Containment Facility (HCF) is biosafety level-3 facility meant for handling the highly pathogenic microorganisms, usually known as the risk group-3 (RG-3) pathogens. This facility has been in use at DRDE since past many years. HCF is maintained at a gradient of negative pressure and more contaminated areas are under higher negative pressure. The HCF has five components, viz. laboratories, animal house, effluent treatment plant, HVAC system and utility services. The facility has



High Containment Facility

three tier construction with ground floor comprising of animal house and laboratories, the basement has effluent treatment plant and the top floor houses air treatment system and its disposal without endangering the environment. The utility building provides essential support services and specialised facility (electric supply, standby power supply, chiller, boiler, air conditioning, DM water plant, compressed air, etc.).

The entry to HCF is restricted to the trained personnel. Users are required to wear a dedicated laboratory dress in the facility. A mandatory shower is taken on exit from the facility. The research pertaining to RG-3 bacteria and viruses is conducted in HCF. The animal wing is used for carrying out the studies related to pathogenesis, immunity, etc. of various pathogens or their components. The facility is also used for carrying out the animals challenge studies of putative vaccine candidates.

## R&D Infrastructure and Test Facilities

DRDE has high end instruments and facilities for carrying out research and development work pertaining to detection, protection and decontamination of chemical and biological agents. The laboratory is well equipped with instruments like NMR Spectrometer (600 MHz), Gas-Chromatograph Fourier Transform Infrared Spectrometer, Ultra High Performance Liquid Chromatography Coupled with Quadruple Time-of-Flight Mass Spectrometer (UHPLC-QTOF), LC-MS/MS, Atomic Absorption Spectrophotometer and Gas Chromatography-Mass Spectrometer (GC-MS), etc.

The laboratory is also equipped with state-of-the-art instruments like MALDI TOF based BioTyper



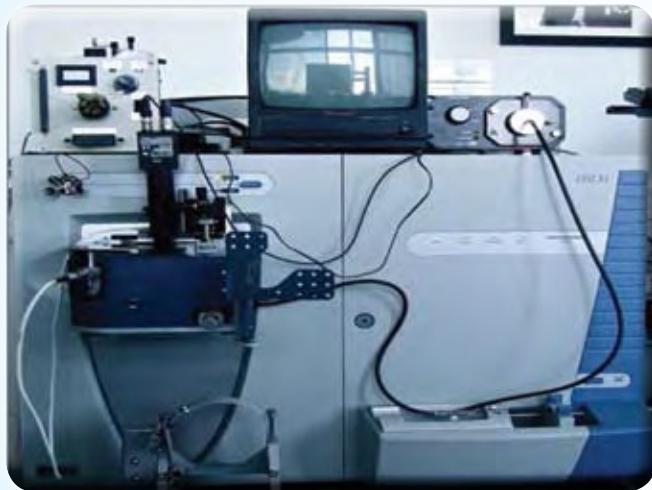
NMR Spectrometer (600 MHz)



Gas Chromatograph Fourier Transform Infrared Spectrometer



**Ultra High Performance Liquid Chromatography Coupled with Quadruple Time-of-Flight Mass Spectrometer**



**LC-MS/MS**



**MALDI TOF based BioTyper for Bacterial Identification**

for Bacterial Identification, MALDI-TOF-TOF 4800, Automated DNA Sequencer, UV Visible Double Beam Spectrophotometer and Real Time PCR, etc.

Besides these, DRDE also has a central instrumentation facility equipped with instruments like Scanning Electron Microscope Quanta 400 ESEM-EDAX with conductive coating units and Renishaw Invia Raman Microscope.

### Social Missions

DRDO, besides developing detection, protection and decontamination technologies for biological and chemical agents participate and contribute significantly in various social missions during disease outbreaks, natural calamities or disasters.

#### DRDO Tsunami Relief Mission

During the DRDO Tsunami Relief Mission in Tamilnadu in December 2004, a team of scientists from DRDE camped the affected areas in Nagapattinam, Tamilnadu. The team visited the various relief camps and did the surveillance for diseases like cholera, malaria, typhoid, dengue and distributed insect repellents to the victims.

#### Mumbai Flood Relief Mission

DRDE team visited Mumbai in 2006 and examined the clinical and environmental samples for presence of various pathogens.

#### Investigations of Disease Outbreaks

##### Cholera

DRDE scientists investigated various cholera outbreaks in different parts of country. The epidemiological studies were performed on the collected samples from various outbreaks. In 2004, potable water samples collected from the cholera affected areas of Bhind district and analysed for the presence of *V. cholerae*.

In 2004, a cholera outbreak was reported in Chennai and a total of 512 persons were affected



between November 1 to 17, 2004. The clinical samples were found to have toxigenic *V. cholerae* 01. The epidemiological studies were performed using ERIC PCR, Box PCR, RAPD and RFLP to find out the relatedness among isolates.

In 2007, clinical samples of cholera were collected from the cholera outbreak in Kalahandi, Koraput and Rayagada. A novel mutation in *Vibrio cholerae* isolate in Orissa outbreak was reported for the first time. The same mutation was found in the cholera isolates from Haiti epidemic, where millions of people were affected.

In 2010 DRDE team investigated the cholera outbreak in Orissa. Besides, DRDE investigated the cholera outbreaks in Gwalior in 2006, Hyderabad in 2008 and Solapur in 2009.

## Anthrax

Anthrax is a disease of biodefence importance. Being a zoonotic disease, it spreads from animals to human in natural conditions. It has three clinical manifestations, pulmonary anthrax, gastro-intestinal anthrax and cutaneous anthrax. The cutaneous anthrax is endemic in several parts of India. DRDE team investigated cutaneous anthrax outbreak cases in Madhya Pradesh, Andhra Pradesh and Orissa.

## Staph Enterotoxin

*Staphylococcal aureus* is the common cause of food poisoning and causes severe vomiting and diarrhea. The clinical cases have been investigated from the local outbreaks and the enterotoxin type has been investigated.



DRDE Team During Tsunami Relief Mission at Nagapattinam

## Feedback Form for *Technology Focus*

**Technology Focus** requests its esteemed readers to send their feedback about the quality of content and coverage in the **Technology Focus**. Your feedback is important to us as it gives scope for improvement and serve in a better way.

How do you rate the DRDO **Technology Focus** as a medium to adequately present DRDO developments ?

- Excellent     
  Good     
  Satisfactory

Is **Technology Focus** highlighting developments of DRDO appropriately ? If no, kindly suggest ?

- Yes     
  No

how do you rate the quality of photographs in the **Technology Focus** ?

- Excellent     
  Good     
  Satisfactory

Optimal number of pages you would like for the **Technology Focus** ?

- 16 Pages     
  20 Pages     
  24 Pages     
  28 Pages

In which format do you prefers **Technology Focus** ?

- Print     
  Online Pdf     
  E-pub     
  Video Magazine

when do you receive printed copy of **Technology Focus** ?

- Previous Month     
  Same Month     
  Next Month

what should be the frequency of **Technology Focus** ?

- Bimonthly     
  Quaterly     
  Half Yearly

For online notification of the latest issue of **Technology Focus**, Kindly provide your E-mail id ?

E- mail :

Suggestions, to further improve the technical content of the **Technology Focus** ?

-----  
 -----

Signature

Name :

Estt :

Your feedback is valuable for us. Kindly fill the feedback form and send it to

**Director  
Defence Scientific Information & Documentation Centre (DESIDOC)  
DRDO, Ministry of Defence  
Metcalfe House  
Delhi - 110 054**

**Telephone: 011-23902403, 23902472**

**Fax: 011-23819151; 011-23813465**

**E-mail: [director@desidoc.drdo.in](mailto:director@desidoc.drdo.in); [techfocus@desidoc.drdo.in](mailto:techfocus@desidoc.drdo.in);  
[technologyfocus@desidoc.deldom](mailto:technologyfocus@desidoc.deldom)**

## Other Technologies Developed by DRDO

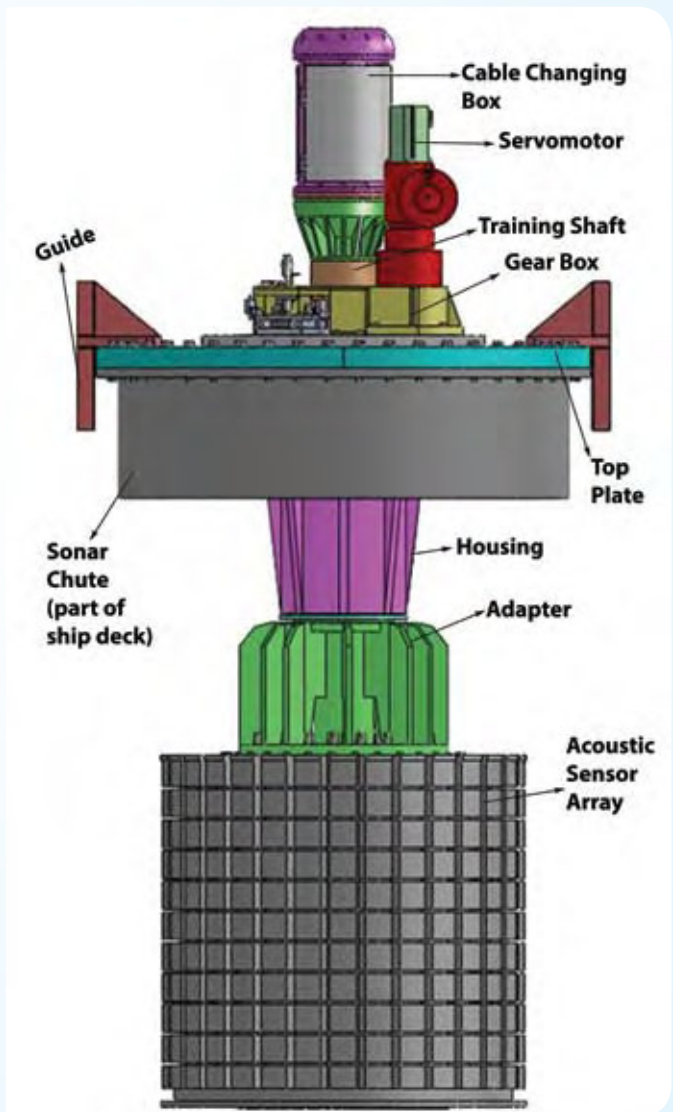
### Indigenous Training Gear for Ship Borne Hull Mounted Sonar System

In a ship borne hull mounted sonar system, the cylindrical acoustic sensor array is usually fitted to the ship deck through a training gear. The training gear, also known as Directing Gear (DG) is an electrically driven rotating mechanism that supports the 4 Ton sensor array and acts as an interface to the ship's deck structure. The main purpose of the DG is to rotate the sensor array at a controlled slow speed and index to a specified angle for in-situ calibration and health monitoring using a near-field acoustic projector array. Till recently, the DG for all Indian naval ships were imported from UK and Germany. In the year 2014, an indigenous DG was successfully developed through a collaborative effort between NPOL, Kochi, BEL, Bengaluru and HMT Kalamassery. NPOL provided the design support, HMT was the DG manufacturer and BEL was the sonar system integrator and supplier.

The main design challenges were to realise a compact structural design to suit the requirements of different types of ships/installations, obtaining high natural frequency for a suspended mass of 4.5 Ton array, high reliability in intermittent use against high sea state marine conditions, avoiding stick slip condition during slow speed rotation of heavy mass, dynamic hydrostatic sealing, user friendly HMI and precise closed loop positioning mechanism avoiding hunting. Also it was required to design a suitable lifting and guiding mechanism for the 7 Ton DG-acoustic array assembly to facilitate maintenance of the system within the ship compartment.

These challenges were overcome through a detailed survey through onsite study of different classes of ships, FEA based design, closed loop servomotor drive system and suitable material selection for structure, seals and bearings. The major subsystems of DG are the top plate, housing, adapter, guide, servomotor drive, planetary gear box and control system. While the subassemblies such as top plate, housing, etc. directly connected to

the ship's structure are made of ASTM A131 Grade EH36 high strength steel, the inner rotating structure separated through bearings and seals are made of Al Silicon Bronze alloy. The bush bearing is reinforced PTFE to suit marine environment and to avoid stick slip condition under slow speed rotation of heavy mass. It also has allied subsystems such as a winch



Major Parts of Directing Gear Assembly



# Technology

टेक्नोलॉजी फोकस



operated pulley lifting mechanism and a guiding mechanism during lifting. The control system has the options of local control, remote control and sonar-console control. The design of the DG is compact and generic in nature that facilitates fitment into different classes of ships with both hull mounted and bow mounted versions. Also the FE based structural design ensures capability to support the complete range of sensor arrays of different sizes and weights in adverse environmental conditions. In addition, the single flange mounting design of the DG minimises the mechanical interface with the ship structure and consequent structural changes in the ship while replacing existing foreign DG with the new indigenous one. With the aid of FEA tools, natural frequencies above 90 Hz could be obtained while keeping the mass of the system low. The design was also verified for shock resistance and inertial loads up to sea state 8. The major advantages of the Indigenous DG over foreign makes are servo-controlled drive system for precise position control, higher natural frequency for improved sonar performance integration of sonar

operation and training gear operation at sonar console, multiple sonar home positions that facilitates reconfiguring of sonar processing to compensate for emergency situations at sea, three level overshoot safety mechanism that involves software lock, sensor lock and mechanical lock and above all customisation depending on individual platform requirements. The design, manufacturing and FATs of the first unit of directing gear was completed in September 2014.

The first unit was exported to Myanmar as part of HUMSA X integrated ship sonar system and successfully installed onboard the Myanmar Navy's lead Aung Zeya-class guided missile frigate in October 2014. The assembly also involved levelling of the system with respect to the ship's datum reference and alignment with the fore-aft axis of the ship. The ship was launched after successfully clearing hydrostatic pressure tests of the DG system and its sealing interface with the ship at the mounting flange. Subsequently two more units were supplied to Myanmar. The fourth unit was installed onboard INS Brahmaputra.

*Technology Focus* focuses on the technological developments in the organisation covering the products, processes and technologies.

**मुख्य सम्पादक**  
गोपाल भूषण

**सह-मुख्य सम्पादक**  
अशोक कुमार

**सम्पादक**  
दीप्ति अरोरा

**मुद्रण**  
एस के गुप्ता  
हंस कुमार

**विपणन**  
राजीव विज  
आर पी सिंह

**Editor-in-Chief**  
Gopal Bhushan

**Assoc. Editor-in-Chief**  
Ashok Kumar

**Editor**  
Dipti Arora

**Printing**  
SK Gupta  
Hans Kumar

**Marketing**  
Rajiv Vij  
RP Singh

टेक्नोलॉजी फोकस के पाठक अपने सुझाव संपादक, टेक्नोलॉजी फोकस, डेसीडॉक, मेटकॉफ हाउस, दिल्ली-110 054 को भेज सकते हैं।

दूरभाष: 011-23902403, 23902472

फैक्स: 011-23819151; 011-23813465

ई-मेल: [director@desidoc.drdo.in](mailto:director@desidoc.drdo.in); [techfocus@desidoc.drdo.in](mailto:techfocus@desidoc.drdo.in); [technologyfocus@desidoc.deldom](mailto:technologyfocus@desidoc.deldom)

इंटरनेट: [www.drdo.gov.in/drdo/English/index.jsp?pg=techfocus.jsp](http://www.drdo.gov.in/drdo/English/index.jsp?pg=techfocus.jsp)

Readers of *Technology Focus* may send their suggestions to the Editor, *Technology Focus* DESIDOC, Metcalfe House Delhi - 110 054

Telephone: 011-23902403, 23902472

Fax: 011-23819151; 011-23813465

E-mail: [director@desidoc.drdo.in](mailto:director@desidoc.drdo.in); [techfocus@desidoc.drdo.in](mailto:techfocus@desidoc.drdo.in); [technologyfocus@desidoc.deldom](mailto:technologyfocus@desidoc.deldom)

Internet: [www.drdo.gov.in/drdo/English/index.jsp?pg=techfocus.jsp](http://www.drdo.gov.in/drdo/English/index.jsp?pg=techfocus.jsp)

डेसीडॉक द्वारा प्रकाशित

Published by DESIDOC

RNI No. 55787/93