BARC NEWSLETTER

No. 239
December
2003

परमाणु ऊर्जा विभाग - स्वर्ण जयंती वर्ष
अगस्त २००३ - अगस्त २००४
Department of Atomic Energy
Golden Jubilee Year
August 2003 - August 2004

New Year Message from Director, BARC

Dear Colleagues,

It gives me great pleasure to welcome you all to the New Year 2004. I take this opportunity to express my happiness for the advances made in BARC during the year goneby in various fields of nuclear science and technology because of your unstinted cooperation and professional contributions in our pursuit for excellence in basic and applied sciences. My compliments to each one of you not only for your individual as well as collective contributions to our all-round advances but also for the efforts you have taken to reach the benefits of the same to the common people.

The year 2003 has been particularly the year of great professional satisfaction because of our achievements in the field of nuclear power, agriculture and food preservation, health care,

Contents

desalination and industry as well as for the appreciation of the same by the people at large. All the facilities recently commissioned, viz., Research Reactor CIRUS and WIP at Trombay, Medical Cyclotron – PET facility at RMC, SHRI at Vadodara, KRUSHAK at Lasalgaon, Desalination Plant at Kalpakkam, Bio-gas Plant (NISARGRUNA), etc., have been performing well. It is also heartening to see that the mixed carbide fuel supplied by BARC for FBTR at Kalpakkam has performed extremely well (by logging more than 1,20,000 MWd/Te of burn-up without any failure). Dedication to the nation by the Hon'ble President of India on October 10, 2003 at Sankara Netralaya, Chennai, of our I-125 based miniature brachy therapy source for treatment of ocular cancer and indigenous development of state-of-the-art Co-60 based Teletherapy unit have been special landmarks in our contributions towards health care of the society. Equally commendable has been our progress in realization of yet another technology (viz., Ceramic Joul Melter) for vitrification of high level waste. Our development work on Advanced Heavy Water Reactor is nearing completion. We have also progressed considerably in our development efforts for some of the important technologies for the future (viz., Compact High Temperature Reactor, Accelerator Driven Sub-critical System etc.). The various other programmes which we have been pursuing in the X Plan are the steps in the direction for building an economically strong India by utilizing nuclear science and technology for its long term energy security along with equally important contributions in the fields of health care and food security.

Friends, I am confident that with your sustained cooperation, hard work, total commitment and complete dedication, BARC would relentlessly pursue as a well orchestrated team to achieve our goal of placing India amongst the giants in the field of nuclear science and technology.

Finally, let me also take this opportunity to convey my Season's Greetings and Best Wishes for the New Year to all my colleagues from BARC and the members of their families.

(B. Bhattacharjee)

निदेशक, भाभा परमाणु अनुसंधान केंद्र, का नव वर्ष संदेश

प्रिय साथियों ,

आप सभी को नव वर्ष 2004 की बधाई देते हुये मुझे अत्यंत हर्ष हो रहा है । इस अवसर पर मैं भापअ केंद्र द्वारा पिछले वर्ष के दौरान नाभिकीय विज्ञान एवं तकनीकी के क्षेत्र में की गयी उन्नति के बारे में बताते हुये आप के साथ अपनी खुशियां बांटना चाहता हूँ । इस उन्नति के लाभों को जनसामान्य तक पहुंचाने में आपके सहयोग एवं सर्वांगीण प्रयास के लिए मैं सभी को हार्दिक बधाई देता हूँ ।

वर्ष 2003 बड़ा ही संतोषजनक वर्ष रहा क्योंकि इस वर्ष के दौरान परमाणु विद्युत, कृषि एवं खाद्य परिरक्षण, स्वास्थ्य देखभाल, निर्लवणीकरण और उद्योग के क्षेत्रों में प्रशंसनीय उपलब्धि प्राप्त हुयी है । हाल ही में कमीशन की गई सुविधाएं जैसे , अनुसंधान रिएक्टर साइरस एवं डब्ल्यूआइपी ट्रांबे, चिकित्सीय साइक्लोट्रॉन - आरएमसी में पीईटी सुविधा , वडोदरा में श्री, लासलगांव में कृषक, कलपक्कम में निर्लवणीकरण संयंत्र, बायोगैस संयंत्र (निसर्गरुणा), आदि सुचारु रूप से कार्यरत रहे । यह भी खुशी की बात है कि भापअ केंद्र द्वारा कलपक्कम के फास्ट ब्रीडर टैस्ट रिएक्टर के लिए आपूर्ति की गई मिश्रित कार्बाइड ईंधन ने अत्यंत संतोषजनक कार्यनिष्पादन किया (बिना कोई रुकावट के 1,20,000 MWd/Te से भी अधिक बर्न अप) । माननीय राष्ट्रपति के द्वारा दिनांक 10 अक्तूबर, 2003 को शंकरा नेत्रालया, चेन्नई में नेत्र संबंधी कैंसर के उपचार के लिए I -125 आधारित लघु ब्रैकी थेरेपि स्रोत उपलब्ध करवाना और अत्याधुनिक कोबाल्ट 60 आधारित टेलिथेरेपि इकाई समाज के स्वास्थ्य देखभाल के प्रति हमारे महत्वपूर्ण योगदान रहे । उच्च स्तरीय अपशिष्ट के कांचीकरण के लिए सेरेमिक जूल मेल्टर प्रौद्योगिकी का विकास एक और सराहनीय उपलब्धि है । प्रगत भारी पानी रिएक्टर पर विकास कार्य पूरा होने वाला है । संहत उच्च तापमान रिएक्टर , त्वरक चालित उपक्रांतिक प्रणाली आदि जैसे महत्वपूर्ण प्रौद्योगिकियों के विकास में भी अच्छी प्रगति हुई है । दसवीं योजना के अंतर्गत भारत को आर्थिक रूप से एक मजबूत देश बनाने के लिए नाभिकीय विज्ञान एवं तकनीकी का उचित प्रयोग कर दीर्घकालीन ऊर्जा सुरक्षा के साथ-साथ स्वास्थ्य देखभाल एवं खाद्य सुरक्षा के क्षेत्रों में भी महत्वपूर्ण योगदान देना होगा ।

मित्रों, मुझे विश्वास है कि आप सभी के सहकार्य, कठिन परिश्रम और परिपूर्ण समर्पण से भापअ केंद्र एक सफल संगठन के रूप में कार्य करेगा और अपना देश नाभिकीय विज्ञान एवं तकनीकी के क्षेत्र में कुछ महाशक्तियों में से एक कहलाएगा ।

अंततः, मैं इस अवसर पर भापअ केंद्र के मेरे साथियों और उनके परिवार के सदस्यों को नव वर्ष की शुभकामनाएं देता हूँ ।

(बी. भट्टाचार्जी)

POLYMETALLIC OCEAN NODULES – A POTENTIAL SOURCE OF NICKEL AND COBALT

S.K. Tangri and A.K. Suri
Materials Processing Division

Solvent extraction (SX) plays a key role for separation of nickel and cobalt from the complex leach liquor of polymetallic nodules (PMN) where the presence of a host of impurities makes it difficult to recover the metals of interest in a pure form. Materials Processing Division (MPD), BARC, has good expertise in separation and recovery of metals by solvent extraction for a number of metals like molybdenum, tungsten, vanadium, copper, nickel, cobalt and silver from variety of secondary resources. MPD, has recently provided know how for the separation of nickel and cobalt to the Department of Ocean Development (DOD) for India's first PMN pilot plant for processing 500kg of dry ocean nodules per day. The pilot plant set up by DOD at Hindsutan Zinc Ltd. (HZL), Udaipur, is already producing copper, nickel and cobalt. MPD has been associated with the down stream processing of leach liquor (60 l/h) in mixer settlers for removal of impurities and separation of nickel and cobalt using the extractants namely di-2-ethyl hexyl phosphoric acid (D2EHPA) and 2-ethyl hexyl phosphonic acid mono 2-ethyl hexyl ester (PC88A)to recover pure nickel and cobalt bearing solution for electrowinning of respective metals. It may be pertinent to mention here that BARC already has the know how for making both these organic extractants. At present, D2EHPA is being regularly produced at facilities located at Heavy Water Plant, Talcher.

Nickel and cobalt have important industrial and strategic applications. Cobalt finds use in making wear resistant and hard facing alloys, permanent magnets, catalysts, corrosion resistant alloys, super alloys and body implants. It is especially useful in missiles and jet engines. Co^{60} is used as radioactive source in radiography and sterilization of food and surgical equipments. The major use of nickel is in the making of stainless steels. It is also used for making catalysts, magnetic alloys, super alloys and corrosion resistant alloys.

Resources of Nickel and Cobalt

Terrestrial deposits of nickel occur mainly either as oxide ores also termed laterites or as sulphide ores. Major desposits of laterites are found in New Caledonia, Canada and Australia. In India, low grade lateritic nickel (~0.5 – 1.0% Ni) is found in Sukinda region of Orissa. It is also available as over burden on the deposits of chromite ore but so far these have not been commerically exploited. Cobalt is associated with copper in oxide ores found in Zaire and Zambia. It is also associated with nickel ores of Canada and Australia. The growing demand of nickel and cobalt coupled with non availability of any good land based primary source of these metals in India has prompted the search for alternate secondary sources for recovering these metals. The important secondary/ alternate sources of nickel and cobalt are given in Table 1 and Table 2 respectively.

MPD, BARC, has an active programme on SX processing of some of these sources namely Alnico scrap and spent ammonia cracker catalyst (generated by Heavy Water Plants) in addition to ocean nodules.

Processing of Ocean Nodules

Ocean nodules have become a focus of global attention for extraction of non-ferrous metals like Ni, Co, Cu, Zn, Mn, Pt, Ag, Au and Mo. This is mainly because land based resources of these metals are rapidly depleting and vast reserves of these nodules are available at the ocean bed.

Table 1: Sources of Ni in India

Resources	Ni %	Remarks
Low grade lateritic nickel from Sukinda region of Orissa and nickelferrous over-burden from mining of chromite ore	0.5 – 1.0%	Over burden of chromite ore mining (1.5 M T/yr)
Nickel Copper sulphide concentrates of Jaduguda	~ 8%	By product of U, 1200 T/yr
Hydrogenation catalyst	~ 8%	Variable quantity
Alnico Scrap from magnet industry	~ 8.5%	Variable quantity
Nickel bearing pickling sludge	1.2 – 2.4%	Variable quantity
Ocean Nodules	~ 1%	About 750MT in Indian Ocean's prime location.

Table 2 : Sources of Co in India

Resources	Co %	Remarks
Converter slag from Copper indstry	0.4 – 0.8	About 15T/yr generated by Hindsutan Copper Ltd at Ghatshilla
Spent catalyst from ammonia cracker plant	~ 20	~1 T/yr
Alnico scrap from magnet industry	~ 11	Variable quantity
Beta cake from zinc industry	6.3	About 1800 T/yr
Cemented carbide tool scrap	3.2	Variable quantity
Spent catalyst from hydro processing plant	2.0	Variable quantity
Ocean nodules	0.1	~750 MT in Indian Ocean's prime location

Table 3: Composition of Indian Ocean nodules

Constituent	Weight %
Ni	1.1
Co	0.1
Cu	1.2
Fe	6.8
Mn	22.5
Zn	0.2
Al	1.7
SiO_2	13.5
H_2O	12.0

Fig.1 Indian Ocean nodules

India became the registered pioneer investor in 1987 with the mine site allocated in Central Indian Ocean basin at water depths of 4-6kms. India's prime site is estimated to have about 750 million tonnes of nodules with nickel content to the tune of 7.5 million tonnes and cobalt roughly 0.7million tonnes. Fig. 1 shows the photograph of the Indian Ocean nodules and Table 3 gives their average composition.

All the developments related to survey, exploration, technology development for mining, metallurgy and environmental impact analysis are coordinated by the Department of Ocean Development with active scientific collaboration from several national laboratories and institutes. The work related to metallurgical processing of ocean nodules was initiated in late eighties by the three national institutions – National Metallurgical Laboratory, Jamshedpur (NML), Regional Research Laboratory, Bhubaneshwar (RRL) and Hindsutan Zinc Ltd., Udaipur (HZL) Each of the institutes investigated different processing schemes and then tested one of these most promising one on extended scale. Based on these extended scale tests and the technical evaluation by the engineering consultants, one of the processing schemes based on ammoniacal sulphur dioxide leaching developed by RRL, Bhubaneshwar, was selected for setting up a continuously operating pilot plant. At this stage, on a specific request from Department of Ocean Development, a programme was initiated at MPD, BARC, to process the down stream leach liquor by SX for recovery and separation of pure nickel and cobalt. The flowsheet for processing the ocean nodules to recover copper and generate nickel and cobalt bearing sulphide leach liquor is shown in Fig.2.

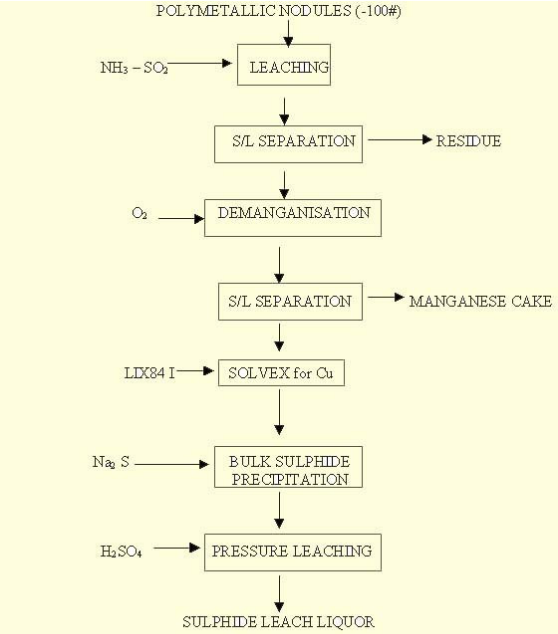


Fig.2 Schematic flowsheet for leaching of ocean nodules

A typical composition of the leach liquor which acts as a feed for the separation and recovery of nickel and cobalt is shown in Table 4.

Table 4: Typical composition of ocean nodules leach liquor

Metal	Concentration
Zn	1.05g/l
Cu	0.66g/l
Ni	22.80g/l
Co	1.64g/l
Mn	11ppm
SO_4^{2-}	0.6M
Fe	180ppm

Process Development Work at BARC

Experimental work initially started with synthetic leach liquor corresponding to the typical composition expected to be generated in the plant. Basic studies were conducted to establish the equilibrium isotherms of metals of interest with and without the presence of other associations and determine the number of stages necessary for carrying out the actual separation experiments. Based on these results, experiments were conducted in minimixer settlers set up of 150ml mixer capacity (Fig.3) initially with synthetic and then with actual leach liquor generated during bench scale trials at Regional Research Laboratory, Bhubaneshwar. A three step process flow sheet has been developed which is shown in Fig. 4.

An integrated processing scheme with all the three steps including electrowinning of nickel was tested in the laboratory at MPD using minimixer settlers and demonstrated to the participating agencies of this programme. Subsequently, the process for separation of nickel and cobalt was tested in our laboratory with synthetic leach liquor on the same scale as that of the pilot plant (i.e. 60 litre/hr flow rate of leach liquor) using 2.5 litres mixer capacity mixer settlers (Fig.5)

Based on the experimental data generated at RRL (B) and MPD, BARC, a pilot plant has been set up by the Department of Ocean Development at the premises of HZL, Udaipur, to process 500kg of ocean nodules per day. A photograph of the SX section of the pilot plant is shown in Fig-6. The leach liquor at a flow rate of 60 l/hr is continuously processed in mixer-settlers to separate both nickel and cobalt with ~99% recovery and ~99.9% purity.

Fig.3 Laboratory setup of mini-mixer settlers

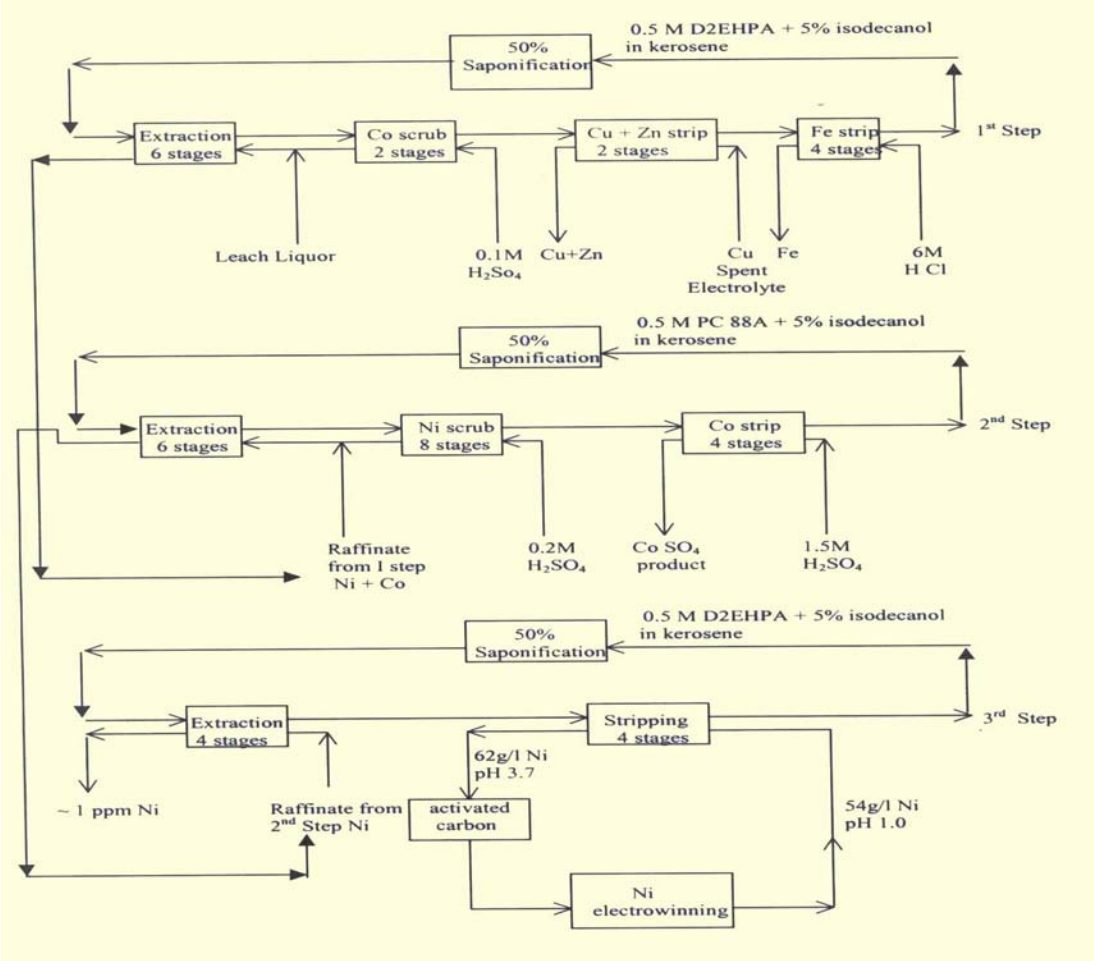


Fig.4. Three Step Solvent Extraction Process

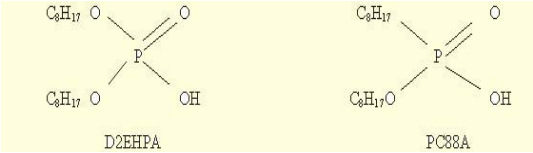
Fig.5 Acrylic mixer-settlers of 2.5 litres mixer capacity

In the first step of extraction, impurity elements in the leach liquor such as Cu, Zn, Fe and Mn are removed by extraction with 50% saponified 0.5M D2EHPA with 5% isodecanol in kerosene. The second step of extraction separates pure Ni and Co from the raffinate of 1st step by using 50% saponified 0.5M PC88 A with 5% isodecanol in kerosene. The third step comprises of integrated solvent extraction – electrowinning (SX-EW) circuit where nickel from the raffinate of 2nd step extraction are extracted and then stripped using the spent electrolyte from the electrowinning cell to make the pregnant nickel solution suitable for recycling to the electrowinning cell. Once again 50% saponified 0.5M D2EHPA with 5% isodecanol in kerosene is used for extraction of nickel in the third step.

Fig.6 SX section of the PMN pilot plants at HZL, Udaipur

Solvent Extraction

Organophosphoric acids namely D2EHPA and PC88A are very useful extractants for processing of sulphate solutions. The chemical structure of these extractants are shown below :



Extraction Mechanism

The extraction of a metal ion M^{2+} by the extractant RH takes place by ion exchange mechanism as shown below:

$$M^{2+}_{(aq)} + 2(RH)_{2\,(org)} \Leftrightarrow MR_2\,(RH)_{2\,(org)} + 2H^+_{(aq)}$$

From the above it is clear that extraction of metal ions proceeds with generation of acid which reduces further extraction. This problem has been overcome by using partially saponified solvent which generates Na^+ ions on metal extraction as shown below:

$$2\,NaR_{(org)} + M^{2+}_{(aq)} \Leftrightarrow R_2M_{(org)} + 2Na^+_{(aq)}$$

Saponification of solvent also helps in keeping good control of pH across extraction cum scrubbing stages which inturn helps in separation of metals. The extraction order of metals varies as Fe>Zn>Mn>Cu>Co>Ni>Na. In the first step, impurities up to Cu are seperated from Co & Ni. D2EPHA was found to be good for the 1st step of solvent extraction as it gives high separation factor between Cu and Co. In the second step, PC88A was selected as an organic extractant because it gives high separation factor between Co-Ni. D2EHPA has also been chosen for the 3rd step as it has higher distribution coefficient, (Kd) for Ni than PC88A.

Conclusion

The solvent extraction expertise of BARC has been used in non-nuclear areas for recovery of metals like nickel and cobalt of strategic and industrial importance. The pilot plant set up at Hindustan Zinc Ltd. is based on R&D work on leaching of ocean nodules by RRL(B) and down stream solvent extraction processing of leach liquor by BARC. It is the result of active collaboration among the participating institutions with Engineers India Ltd, as consultants. The work was carried out at BARC under MoU with DOD through which BARC earned a revenue of Rs.36.15 lakhs.

References

1. Tangri S.K. and Suri A.K., Solvent Extraction of Metals from Ocean Nodule Leach Liquor Metals, Materials and Processes, V 01.11, No.2, pp 145-150, 1999.
2. Bhattacharya K, Fonseca M.F, Sadanandam R, Tangri S.K. and Suri A.K, Studies on the Removal of Impurities from Ocean Nodules Leach Liquor by Solvent Extraction. Proceedings of the Third Ocean Mining Symposium, Goa, India, pp 260-264 November 8- 10, 1999.
3. Rane M.V, Srikanth K, Menon N.K, Sadanandam R, Tangri S.K. and Suri A.K., Simultaneous Spectrophotometric Estimation of Iron, Copper, Cobalt and Nickel in Ocean Nodule Leach Liquor. Proceedings of the Third Ocean Mining Symposium, Goa, India, pp 265 -267, November 3 -10, 1999.
4. Rane M. V, Sadanandam R, Tangri S.K and Sufi A.K., Mahasagar Granthikaon Men Se Cobalt Ki Prapti. Symposium on Bharat Men Vigyan Ke Badalte Charan, Goa, October 9-10, 2000.
5. Tangri S.K, Sadanandam R, Fonseca M.F and Suri A.K.,Solvent Extraction Process for Recovery of Nickel and Cobalt from Ocean Nodules LeachLiquor. Proceeding of Fourth Ocean Mining Symposium, Poland, pp.180-185, 23-27 September, 2001.
6. Tangri S.K and Suri A.K ., Production of High Purity Cobalt by Solvent Extraction, International Symposium on Solvent Extraction, RRL, Bhubhaneshwar, 26-27 September, 2002.

A NEW RADIATION PROCESSED HYDROGEL DRESSING FOR BURN AND WOUND HEALING

Lalit Varshney
ISOMED, Radiation Technology Development Section

A new hydrogel wound dressing has been developed as a spin-off of basic research being pursued in Chemistry & Isotope Group, BARC, in the fields of Radiation Chemistry and Radiation Technology(1-2). It has been observed to be highly effective in healing almost all types of external wounds. Known as Hydrogel Dressings, it is now available commercially. Extensive clinical studies have established its safety and shown that it is not only an excellent first aid for burns but also cures other difficult to heal wounds like diabetic foot ulcers, leprosy ulcers, animal bites, etc. It is expected that with its growing awareness, more applications would add to the existing list. The use of such dressings is well established abroad but so far their local use was restricted due to very high cost of imported dressings. Radiation processing technology developed at BARC, produces high quality hydrogel dressings at fraction of the market cost of imported material.

Use of hydrogel dressings is known and has several applications in medical field. Drug delivery devices, contact lenses, wound dressing, artificial cartilage's or membranes, vascular prosthesis, gel coated catheters, etc., are some of the examples(3). Due to the direct relevance to human health, scientists have been continuously exploring these systems. Generally, hydro(water) gels contain 30 -90% of water entrapped in a three dimensional network structure of a hydrophilic polymer. The large water content makes them highly bio-compatible and therefore preferred for use as biomaterials. Some of the

hydrophilic polymers used in these applications include poly (vinyl pyrrolidone), poly(ethylene oxide), poly (vinyl alcohol) and poly(acrylic acid). Presence of acidic, basic or both groups in the constituent polymers of hydrogels make them pH sensitive. Hydrogels made using polymers having lower critical solution temperature (LCST) like Poly (N-isopropyl acrylamide) and poly (vinyl methyl ether) make the gel thermosensitive. These hydrogels belong to stimuli responsive gels and show variable swelling and deswelling characteristics with change in pH and temperature. Such hydrogels are used in drug delivery devices. Depending upon the nature of application, the size of these hydrogel can vary from nanometers (nanogels, injectable hydrogels) to centimeters to meters (wound dressing, fire blankets, drug delivery devices and implants).

The basic property which is required to be incorporated in a polymer to produce a usable hydrogel is to form cross links between different polymers chains, resulting in a three dimensional network structure. One of the most convenient ways to produce cross links is to irradiate aqueous solution of the polymers by gamma rays or electron beam. This method allows to control the degree and nature of cross links, the parameter which influences swelling capacity, mechanical properties and pore size. On irradiating dilute polymer solution the major fraction of the radiation energy is absorbed by water forming radicals and molecular products as shown :-

$H_2O \longrightarrow H, .OH, e^-(aq.), H_2O_2, H_2, H^+$

The species responsible for producing crosslink are OH and H radicals (G (OH)= 2.7 x 10^{-7}mol $.J^{-1}$,G(H)= 0.55 x 10^{-7} mol . J^{-1}) where again OH plays the major role to form crosslinks (bimolecular rate constant of the order of 10^9 dm^3 mol^{-1} s^{-1}). Radicals (OH,H) abstract hydrogen atoms and produce carbon centred radicals on polymer chains. The radicals on the polymer chains further decay by forming intermolecular crosslinking, which gives rise to increase in molecular weight and finally a hydrogel, intramolecular crosslinking (crosslinking within the same chain, loop formation) and disproportionation reactions. While the proportion between recombination and disproportionation reactions is set by the nature of the radicals, the relative proportions of inter and intramolecular crosslinking can be controlled. High dose rate (electron beam) and lower concentration favours intramolecular crosslinking where as higher concentration and lower dose rate (gamma rays) favours intermolecular crosslinking. The former method could be used for making micro or nanongels the later is useful for making biomaterials like wound dressing. The mechanism of these fast reactions occurring during irradiation can be studied using pulse radiolysis technique. Another added advantage in using radiation processing is that it can sterilize the product in a sealed packet with high degree of sterility assurance level Thus, radiation processing technology provides an excellent tool for making hydrogel biomaterials and to sterilize them. The methodology, approach and applications of the new wound dressing developed at BARC are described below.

Natural skin is the best functional cover to the wound but its use is not practical. So, the second best dressings have to be used. Among the economical dressings cotton gauze, Sofra tulle, Inadine, potato and banana peels are currently in use, while the list of expensive dressings includes Collagen, Amniotic membranes, Elastogel, Omniderm, Burn free, etc. Depending on wound conditions, medicated as well as non-medicated dressings are used.

A dressing should ideally have following desirable characteristics:-

Characteristics of Ideal Dressing

- Maintains moist environment at the wound - dressing interface
- Possible to use on infected wounds
- Low or non-adherent and mechanically strong
- Transparent and flexible

- Provides mechanical protection and cushioning effect.
- Should not require frequent changing
- Comfortable and contour forming
- Safe to use
- Good absorption characteristics
- Impermeable to microorganism
- Sterile
- Available in required sizes
- Possibility of delivering drugs without removing dressing
- Cost effective

Normally, three to four different types of dressings would be required to meet all these criteria. The new dressing developed by BARC meets almost all requirements and hence is an ideal wound dressing. Unique advantages of radiation processing technology is that it packs most of the enlisted characteristics in single stage manufacturing process. The technology is environment friendly as it leaves no residue or pollutant in the environment.

The fact that pure aqueous PVA solution when irradiated forms a soft gel has been known for a long time (4). Earlier attempts to make hydrogel dressing using this knowledge were largely unsuccessful in developing a commercially viable process for hydrogel dressings of desirable qualities. The other known PVA hydrogel dressings made by chemical methods and irradiation(3,5) invariably require purification and sterilization before it could be used. Many of these hydrogel dressings contain plasticizers to bring flexibility, anti-microbial agents to avoid microbiological contamination and mechanical support to impart strength to the hydrogel. The added chemicals are known to interfere with wound healing as well as unsuitable to sensitive patients.

In the present process, one of the most biocompatible polymers, polyvinyl alcohol (PVA), and a mixture of naturally occurring polysaccharides like agar and carrageenan are mixed together. The hot aqueous solution of this mixture is poured in disposable plastic trays and sealed in polythene bags. These bags/pouches are then sent to ISOMED for radiation sterilization resulting in ready to use hydrogel dressing.

As described earlier, the present process utilizes two unique properties of gamma radiation in single step to produce ready to use dressing. These are

(1) Radiation sterilization, and
(2) Radiation crosslinking.

Hydrogel products as such are difficult to sterilize by other known methods using heat and gases like ethylene oxide (EtO) without adversely affecting their properties. That is why many manufacturers use anti-microbial agents and preservatives in such products, whereas ionizing radiation such as gamma rays from Cobalt-60 are known to inactivate micro-organisms in a sealed packet with high degree of reliability.

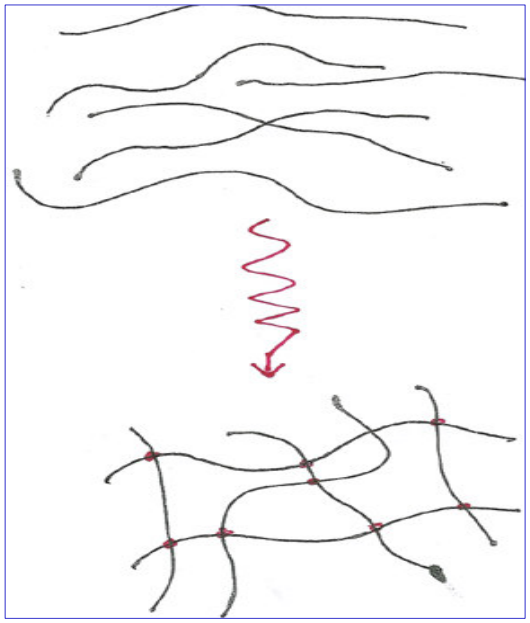


Fig. 1 Formation of network structure (cross-linking) by exposing polymer chains to gamma radiation

PVA polymer chains in aqueous solution are first immobilized by polysaccharides. On exposing to gamma radiation, the hydroxyl radicals, generated by radioly sis of water present in the solution abstract hydrogen atoms from the polymer chains and form radicals. Several such

radicals combine among one another through covalent bonds and form a sort of woven, porous, three dimensional network structure(Fig.1). This resultant structure is a transparent, flexible and mechanically strong hydrogel dressing. The hydrogel dressing is insoluble in water even under autoclave conditions (121^0C, 15 PSI).

In the present process (1-2), both the steps, cross-linking and sterilization, were achieved in a single step process using gamma radiation. The process does not involve use of initiators, plasticizers, antimicrobials, mechanical support, etc. There is practically no non-cross-linked (water soluble) PVA remaining in the Hydrogel (gel fraction > 98%). Therefore, no further purification of the gel is required. This obviates post radiation processing step, which is the norm in this type of preparations. The dressing thus produced is free from chemical contaminants and bio-compatible.

Polysaccharides present in the formulation impart extremely desirable properties such as strength and flexibility to the gel dressings, which are not possible when PVA aqueous solution (sans polysaccharides) are used. Employing a combination of natural polysaccharides in place of single polysaccharide also has added advantage of eliminating use of plasticizers and humectants. Because of high molecular weight and branched structure, these polysaccharides remain entrapped in the gel network structure and become part of the dressing.

The present dressing contains about 90 % water, yet has the capacity to absorb further water, almost equal to its weight. On application on wound, it could reduce the skin temperature by 8-10^0C and maintain this differential for very long time. This property is very useful in reducing the depth of burning and restricting the burn damage to the body surface. Hydrogel dressings reduce pain by cooling and covering the open nerve endings and thus are very useful on donor areas in plastic surgery. The present dressing is elastic in nature and has high compression strength. It provides a good cushioning effect and thus could be used in treating bedsores. Dry wounds can be best treated with hydrogels. Hydrogel dressings hydrate the desiccated wounds which is essential for healing. Absorption and hydration properties of the dressing softens the slough wound (wound containing pus) and sucks out the slough, makes the wound clean which helps in early healing.

The exact mechanism of healing by Hydrogel dressings is not very clearly understood. Some of the opinions are that, hydrogel dressings reduce depth of burning by cooling the wound, reduce pain, provide humid environment (moist wound healing), form layer of growth promoting biochemical, retain new skin (non adherent), induce formation of new blood vessels and granulation tissues, which promote early and clean healing.

Fig. 2 Normal and Iodine (coloured) hydrogel dressing

Most hydrogel dressings available in the international market are not suitable for use on infected wounds. BARC dressing, on the other hand, if desired, can be converted into Iodine-hydrogel (antimicrobial Hydrogel) by the user himself (Fig. 2), thus getting best properties of germicidal Iodine and that of Hydrogel. This antimicrobial Hydrogel could be prepared by simply dipping the dressing for a few seconds in a Iodine solution . Available from any chemist shop, Tincture of Iodine (USP) or Lugol solution (diluted 1 part in 4 parts of distilled water) could be used as Iodine source. The transparent gel changes into coloured gel, absorbing about 1000 PPM of Iodine. The absorbed Iodine is trapped in inter helical spaces of PVA.

On applying to the wound, an equilibrium is established between Iodine and wound fluid. Iodine in the gel is released slowly depending on protein matter present in the wound. Iodine has tendency of reacting much faster with bacterial proteins as compared to human proteins and thus inactivate micro-organism preferentially. Complete consumption of Iodine is indicated by the gel reverting back to its original colour. In the same way, other water soluble drugs can first be absorbed and transported across to the wound. This allows ample freedom to a practitioner to try different medications for treatment.

Although self adhesive, it is preferred that a secondary bandage is used to secure the hydrogel dressing. The size of the dressing should be larger than the wound perimeter. If dried on the wound, hydrogel dressing should be rehydrated by first wetting the dressing, using boiled cooled / distilled water for 10-15 minutes to ensure painless removal of the dressing. For exuding wounds, three to four parallel cuts on the gel could be made using surgical knife before application. The excess exudate could then be absorbed into the secondary bandage such as absorbing cotton.

Fig. 3 A kerosene stove burn case from rural area treated by hydrogel dressing for 15 days, dressing on every third day.

Fig. 4 Leprosy patient ulcer on foot not healing for 10 years(Top) wound size 3cm x 2 cm x 1 cm (LxWXD), after treatment with Iodine Hydrogel dressing (Bottom), wound size 0.5 cm x 0.2 cm (LxW), alternate day dressing, 15 dressings.

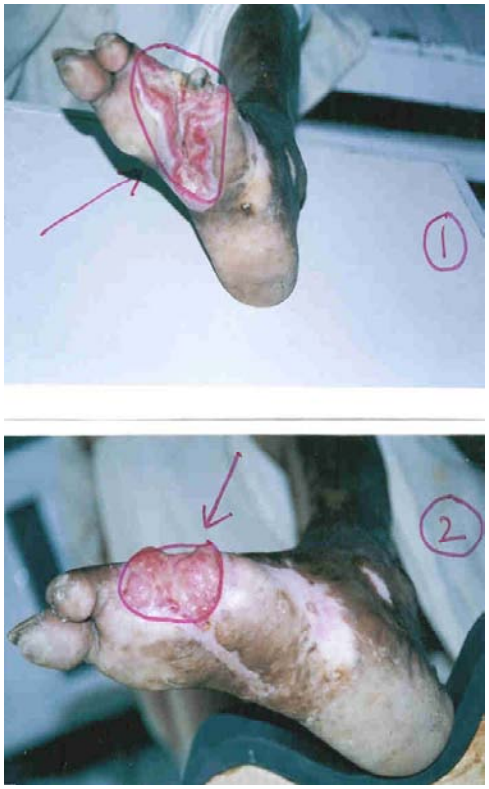


Fig. 5 Leprosy patient ulcer (Top) wound size 8cm x3cm x 1 cm (LxWXD), after treatment with Iodine Hydrogel dressing (Bottom), wound size 3 cm x 2 cm (LxW), alternate day dressing, 15 dressings.

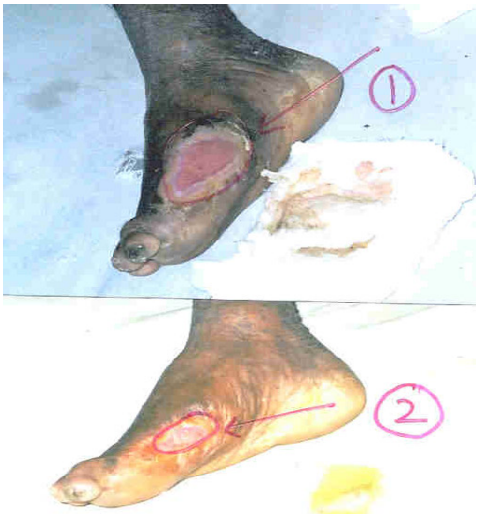


Fig. 6. Non-healing Diabetic foot ulcer before and after hydrogel dressing treatment for 15 days, dressing after every 24 hrs.

Depending upon the wound condition, the dressing could be used for one to three days. Once removed from the packet, it should be used immediately. The dressing is not reusable and once opened should not be stored for later use. The dressing could be stored under normal conditions in cool and dry places. In hot climate, the dressing should be preferably stored in refrigerator.

BARC hydrogel dressings have been so far used for treating burns, leprosy ulcers, animal bites(6), diabetic foot ulcers, herpes, fresh scars, bullet injuries, boils, pimples, sun burns, abrasion, etc with excellent results. Its application and some of the examples are shown in the pictures (Fig 3-6).

Recently, the technology has been transferred to M/S ABS Medicare Pvt Ltd, Vadodara for commercial production of the Dressing.

The technology development work on this project was carried out in collaboration with Radiation Chemistry and Chemical Dynamics Division, (RC&CD), BARC.

References

1. L. Varshney and A.A. Majmudar, “A process for manufacturing hydrogel wound dressing”, Indian Patent Application No. 731/Bom/1999.
2. L. Varshney and A.A. Majmudar, A process for manufacture of hydrogels for burn and injury treatment, WO0130407, PCT application published on 3/5/2001.
3. J.M.Rosiak et. al, "Radiation formation of hydrogels for biomedical purposes: some remarks and comments", Radiat.Phys. Chem, vol. 46, no.2,161-168,1995
4. Radiation Chemistry of Polymeric System, A. Chapiro, Vol XV, Interscience Publisher, p. 589, 1962.
5. C.Gopinathan, T.P. Balan, A.A. Majmudar, B.J. Shankar and L. Varshney, “A method of preparing a mechanically strong hydrophillic polyvinyl alcohol hydrogel", Indian Patent No. BOM/456/98, 15/7/98
6. "BARC drug is 'bear necessity ' for Gadchiroli Tribals,” Indian Express, Monday, September 16,2002.

BARC SIGNS MoUs FOR MANUFACTURE OF THREE-PIECE MANIPULATORS

In the quest for indigenisation of equipment and tools essential for remote-operation in hazardous environment specially those which face international sanctions, Nuclear Recycle Group (NRG), BARC, embarked upon a programme of collaborative efforts some time back so that reputed manufacturers in the country could be persuaded to develop these equipment. In one such programme, BARC was able to draft the services of M/s Hindustan Machine Tools Limited, Bangalore, and M/s Kerala Hitech Industries Limited, Trivandrum, and utilise their design teams and precision tool room facilities for the development of Three-Piece Manipulators. Encouraged by the satisfactory performance of the prototypes developed by both these

Mr B.D. Jain, Group General Manager, HMTL, signing the MoU with Mr B. Bhattacharjee, Director, BARC

companies, Back End Technology Development Division decided to involve them in manufacturing another 20 pairs of TPMs for the hot cells of various projects of NRG. Memoranda of Understanding were signed on May 08, 2003 between BARC and these two PSUs.

Mr Johnson Peter, Managing Director, Kerala Hitech Industries Ltd., signing the MOU with Mr B. Bhattacharjee, Director, BARC

Mr B. Bhattacharjee, Director, BARC, was the signatory on behalf of BARC, for both MoUs which were signed by Mr B.D.Jain, Group General Manager, on behalf of HMT and Mr Johnson Peter, Managing Director on behalf of Kerala Hitech Industries. Speaking on this occasion, Director, BARC, expressed his satisfaction that an item of immense importance to remote operation has been indigenised. He lauded the technical excellence achieved by both the PSUs. Both Mr Jain and Mr Johnson agreed with Director, BARC, and assured him that the TPMs manufactured hence-forth will match international workmanship.

Senior BARC officials present on the occasion included Dr R. B. Grover, Associate Director, Technical Coordination & International Relations Group, BARC, Mr H. S. Kamath, Director, Nuclear Fuels Group, BARC, Dr G. D. Pungle, IFA, BARC, Mr N. K. Bansal, Associate Director (Operations), Nuclear Recycle Group, BARC, Mr V. P. Balakrishnan, Associate Director (Projects), Nuclear Recycle Group, BARC, Mr K. C. Sahoo, Head, Post Irradiation Examination Division, BARC, Mr A. M. Patankar, Head, Technology Transfer & Collaboration Division, BARC, Mr K. K. Prasad, Head, Back End Technology Development Division, BARC, and Mr Kanwar Raj, Head, Waste Management Division, BARC.

BARC TRANSFERS TECHNOLOGY TO PRIVATE SECTOR

The technology of "Electrolysing of reactor channel sealing plug jaws" has been developed by Centre for Design and Manufacturing, BARC. It is a thin dense chrome plating process and gives a consistent hardness value of RC 70 - 72 on a plating thickness of 7-12 microns. Tolerance limit of ± 0.6 microns on deposit thickness up to 6

Photograph after signing the agreement with M/s Avasarala Automation Ltd., Bangalore. Seen from left to right are Mr V.K. Upadhyay, TT&CD, BARC, Dr J. Krishnan, Head, Manufacturing Section, CDM, BARC, Mr T.T. Mani, Managing Director & CEO., M/s Avasarala Automation Ltd., Bangalore, Mr A. Manjunatha, Head, CDM, Mr A.M. Patankar, Head, TT&CD, BARC and Mr Khaleel Ahmed, CDM, BARC

microns and ± 1.2 microns on thickness from 6 to 12 microns are typically obtained. With electrolysing, no grinding is necessary after plating because the process lends itself to flat even distribution all over the part. Electrolysing provides high hardness with less coating thickness, low co-efficient of friction, uniform coating (no need to further machining and no need to bake). The bath has excellent levelling properties and flat-even deposition is achieved on edges and recesses.

This process is extensively used for electrolysing (hard chrome plating) the reactor channel sealing plug jaws for 235 MWe and 500 MWe nuclear reactors.

The know-how of “Electrolysing of reactor channel sealing plug jaws” was transferred to M/s Avasarala Automation Ltd., Bangalore, on May 23, 2003.

Technology Transfer and Collaboration Division coordinated all activities related to the transfer of this technology.

सुरक्षा एवं संरक्षा पर गोष्ठी

राजभाषा कार्यान्वयन समिति, भाभा परमाणु अनुसंधान केंद्र, तारापुर के तत्वाधान में दिनांक 07 मार्च 2003 को "सुरक्षा एवं संरक्षा" विषय पर एक संगोष्ठी का आयोजन किया । इस संगोष्ठी में सभी संयत्रों के लगभग 125 प्रतिभागियोंने भाग लिया । संगोष्ठी के उद्घाटन सत्र में उपस्थित वरिष्ठ अधिकारीगणों ने वागदेवी मॉ सरस्वती के चित्र पर माल्यार्पण करके दीप प्रज्वलित किया ओर संगोष्ठी का विधिवत उदधाटन किया । इसके बाद राजभाषा कार्यन्वयन समिति, भाभा परमाणु अनुसंधान केंद्र, तारापुर, के अध्यक्ष श्री राजेन्द्रसिंह येवतीकर ने अपने अध्यक्षीय भाषण में सभी का स्वागत किया एवं संगोष्ठी के विषय-वस्तु का परिचय दिया । तत्पश्चात श्री एस.डी. भारंबे एवं सभी वकताओं ने सुरक्षा एवं संरक्षा विषय पर संगोष्ठी ररवने पर राजभाषा कार्यान्वयन समिति, की सराहना की । इस गोष्ठी में कुल छ: वार्ताए प्रस्तुत की गईं इन वार्ताओं के शीर्षक व वार्ताकार क्रमश: निम्न थे ।

संगोष्ठी के उद्घाटन समारोह के अवसर पर अध्यक्षीय भाषण करते हुये श्री राजेन्द्रसिंह येवतीकर, और मंच पर आसीन बायें से दायें - श्री आर.डी. चांगरानी, डा. जोस पनक्कल, श्री एस. कुंभरवार एवं श्री कौशल कुमार श्रीवास्तव

पर्यावरण संरक्षा (डा व्ही.के. शुक्ला)
वास्तु निर्माण संरक्षा (श्री ए.ए. सिद्दीकी एवं
श्री ए.के. दास)
नाभिकीय संस्थानो की सुरक्षा (श्री आर. डी. राय)
नाभिकीय संरक्षा (श्री राजेन्द्रसिंह येवतीकर)
आग के कारणों एवं उसकी रोकथाम (श्री एस. के.
श्रीवास्तव)
कार्यक्रम का संचालन श्री कौशल कुमार श्रीवास्तव ने किया और धन्यवाद ज्ञापन श्री रामहरख रा. सिंह ने किया ।

DIRECTOR, BARC, VISITS KRUSHAK AT LASALGAON

Mr B. Bhattacharjee, Director, BARC, visited KRUSHAK (KRUSHI UTPADAN SANRAKSHAN KENDRA), a low dose food irradiation facility at Lasalgaon, near Nashik, on August 9, 2003. He formally inaugurated the commencement of operations by giving the source raise command on the computer screen of the PLC in the control room of the irradiator for irradiation of a 20 tonnes consignment of onion for a private company. Dr K.B. Sainis, Associate Director, Biosciences Group, BARC, Mr P.B. Kulkarni, Director, Engineering Services Group, BARC, Mr J.K. Ghosh, Deputy Chief Executive, Board of Radiation and Isotope Technology (BRIT), Dr A.K. Sharma, Head, Food Technology Division, BARC and Project Manager, Dr A.K. Kohli, Senior General Manager, BRIT, the project engineering team including Mr. R.K. Modi, and Mr M.G. Radke of the Division of Remote Handling and Robotics, BARC, Mr K.B. Mehra of Architecture & Civil Engineering Division, BARC, Mr N.S. Gabhane, Head, Technical Services Division, BARC and Dr A.G. Behere, Head, Co-ordination and Operation, KRUSHAK, were present among others including the staff of KRUSHAK, members of the local Agricultural Produce Marketing Committee, members of the electronic and print media and other invitees. Director, BARC, inspected and discussed the various aspects of plant operation with the staff and also answered queries from the media persons. KRUSHAK is a technology demonstration unit, set up by BARC, to demonstrate low dose applications of gamma radiation for preservation of agricultural commodities. The facility can process onion, garlic, ginger, and potato for sprout control, cereals, pulses and their products for insect disinfestation, and exportable agricultural and horticultural products for meeting international quarantine requirements.

Mr B. Bhattacharjee, Director, BARC, inaugurating the commencement of operations at the KRUSHAK at Lasalgaon

INTERNATIONAL TRAINING COURSE ON "SECURITY FOR NUCLEAR INSTALLATIONS"

BARC-DAE, India, and the International Atomic Energy Agency (IAEA) held the resident Training Course for the first time in India on 'Security for Nuclear Installations' during May 11-20, 2003 at Hotel Sun-n-Sand, Mumbai.

Inaugural session of the Course

This course was arranged at par with Agency's international courses. The topics were suitably selected to give a wider over-view of the elements involved in the security for nuclear installations. The course consisted of 15 lecture sessions, 2 workshop sessions, 1 plenary session (participants' views) and a field visit to Kakrapar Atomic Power Station, apart from the opening and the concluding sessions. The course was inaugurated by Mr V.K. Chaturvedi, CMD, NPCIL and concluded by Dr D.K. Sankaran, Additional Secretary, DAE.

There were total of twenty one participants; two each from Bangladesh, Indonesia, Korea, Malaysia, Thailand; and eleven from DAE India. IAEA arranged seven faculty members from abroad to talk on various subjects and six faculty members contributed from India. One IAEA representative was present throughout as IAEA training specialist. In line with similar courses arranged by the Agency, financial assistance was received from the Agency.

The overall objectives of the training course were to:

1. increase security awareness and plan security arrangements at nuclear installations.
2. create and foster characteristics and attitudes in organizations and individuals that physical protection issues receive attention warranted by their significance.
3. establish an awareness of the need for an integrated system of physical protection for nuclear facilities that is effective against the threat of radiological sabotage and theft of nuclear and other radioactive material.
4. familiarize professionals involved in the establishment of a state system of physical protection with current concepts and techniques.
5. provide understanding of international aspects of physical protection.
6. provide understanding of States individual responsibility for nuclear security.

Participants in attention during a lecture session

Dr Shankaran, Additional Secretary, DAE, distributing certificates to participants

Considering the success of this course, a few topics listed below were identified as independent courses to be dealt with in future:

- Design, evaluation and facility characterization
- Security technologies – evaluation and application
- Security culture - human and engineered approach
- Design basis threat
- Control of radioactive sources

Detailed lecture notes were provided to all the participants in two volumes. Course materials were also provided in CD to all the participants.

NATIONAL SYMPOSIUM ON ENVIRONMENT

The 12th National Symposium on Environment (NSE-12) was held at the H.N. Bahuguna Garhwal University (HNBGU), Badshahi Thaul Campus, Tehri Garhwal, Uttaranchal, during June 5-7, 2003. The event was organised by the Department of Physics, H.N. Bahuguna Garhwal University, and the Health, Safety and Environment Group of BARC, in collaboration with the Narora Atomic Power Station. This is the twelfth meet on Environment organised by the Health, Safety and Environment Group, BARC, and sponsored by Board of Research and Nuclear Sciences, DAE. These National level symposia are being organised annually since 1992, with institutional involvement from various regions in the country, with the aim of fostering scientific and technical exchange among the scientists, academicians and students in the field of environmental sciences. The focal theme for NSE-12 was selected as, "Environmental Protection Strategies for Sustainable Development", matching with the environmental and ecological issues of Tehri, Garhwal region. This year also, the event was held coinciding with the World Environment Day, i.e., June 5, 2003.

Since many of the current projects of DAE are planned in the ecologically sensitive areas, the Symposium gave a good opportunity on the various modalities and scientific approaches required for Environmental Impact studies for the new ventures.

The three day symposium was inaugurated by Dr Anil Kakodkar, Chairman, AEC and Secretary, Government of India, Department of Atomic Energy. In his address, Dr Kakodkar stressed that safety, health and preservation of the environment are given the highest priority in all the units of DAE. While strongly advocating the concept of zero-based impacts which is the damage caused to the ecosystem, in the absence of any technological intervention, due to natural growth factors such as population pressure, he suggested that R&D studies on environmental aspects should take into account the local parameters. He expressed confidence

Dr Anil Kakodkar, Chairman, AEC, inaugurating the 12th National Symposium on Environment

that technology can provide solutions to the problems at hand and can help India to become a developed country by the year 2020 which is environmentally sound. He stressed the need for tapping the resources for maximum benefit, while ensuring that no irreversible damage to the environment takes place. The proceedings containing invited lectures, oral and poster presentations was released by the Chairman, AEC.

Dr V. Venkat Raj, Director, Health, Safety and Environment Group, BARC and Co-convener of the National Advisory Committee of the Symposium, focused on the genesis of the National Symposia on Environment through BRNS, DAE, support. He said that the DAE lays a very strong emphasis on safety and environmental protection. As part of this activity, pre-operational environmental surveys of DAE project sites are conducted, with the involvement of the local Universities. The mandatory requirements specified by the Atomic Energy Regulatory Board are being achieved by the Environmental Survey Laboratories (ESLs) of BARC functioning at the various DAE facilities, he added.

There were 45 oral and 35 poster presentations, covered by the 10 technical sessions scheduled over three days. Each session had an invited talk by a lead expert in the chosen topic of the session. While delivering his invited talk on "Electricity Generation in a Sustainable Development Perspective", Dr Venkat Raj compared the environmental impacts from different energy scenarios at the regional and at the global levels. He emphasized the important role nuclear energy can play in the sustainable development perspective considering the various aspects such as resources, safety, radiological protection, cost externalities and environmental impact. This is pertinent particularly in view of the global concern about green house gas emissions from fossil fuel based power generation units and the efforts being made for their reduction as per the various international protocols. He outlined the steps taken by the Indian Nuclear Programme involving both R&D and the power sector, to ensure minimum impact on the environment.

The environmental impacts of natural hazards in parts of Tehri district, supported by case studies, were highlighted by Prof D.S. Bagri from HNBGU with their mitigative efforts and concurrent needs. In the session on Environment, Ecology and Awareness, Dr. P.S. Rawat, Principal and Director, HNBGU, Tehri campus, in his invited talk, stressed the need for close interaction between society and the environment to attain sustainable development.

Delivering the invited lecture in the session on Environmental Radioactivity, Dr H.S. Virk, Prof Emeritus, Gurunanak Dev University, Amritsar reviewed on the natural radioactivity Status in the country. The various aspects of the dose received by the public due to the omnipresent natural radiation environment was discussed. Dr H. Hayakawa from Environmental Radiation Research and Monitoring Centre, Japan presented the details of radioactivity monitoring program around nuclear power plants in Japan. He informed that the data so collected is made available to the public for better transparency and acceptance of nuclear energy as a major source of power by the people. The use of Rn^{222} as a tracer in watershed management of different aquifers was presented by Dr A. Kies from Centre Universitaire de Luxembourg.

In his invited talk on industrial pollution perspectives, the issues related to petroleum industry, along with the current technological solutions to reduce the overall impacts, were detailed by Dr Sudhir Singhal, Director, Indian Institute of Petroleum, Dehradun. The various approaches to waste water management from specific industry sectors, the rich operational experience of Common Effiuent Treatment Plant (CETP) from the TTCIA, Navi Mumbai, were also discussed. Mr R.P. Gurg, formerly Head, Environmental Studies Section of Health Physics Division, BARC, presented the monitoring strategies as adopted in the Indian nuclear power plants for various environmental matrices including their parametric importance.

The current perspectives on environmental quality monitoring for conventional pollutant parameters in different matrices and their QA/QC needs were presented by Dr T.N. Mahadevan, Environmental Assessment Division, BARC. The various contributed papers in the session on AQM included speciation, volatile organic chemicals, black carbon, aerosol size distribution and their source apportionment. The bio-engineering methods as an eco-friendly, cost effective approach for sustainable development was dealt in details by Dr L.M.S. Palni of G.B. Pant Institute of Himalayan Environment & Development, Uttaranchal. He also discussed the various stress factors like population growth, deforestation, natural calamities etc. and emphasized on the adoption of green concepts for recharging of aquifers.

A section of students of H.N. Bahuguna Garhwal Unversity

The poster presentation which was organised as a separate session for half-a-day was an interactive one and was widely appreciated by all participants both from the quality of papers and the organizational efforts.

In the concluding session, the highlights of the three-day meeting were presented with suggestions on newer areas of research, emphasizing an holistic approach to the various environmental issues to be carried out with inter-institutional interactions. Participants strongly pleaded for the continuance of the NSE program which gives them good opportunities to understand the current perspectives on environmental sciences through interactive sessions with various experts at the national level.

In order to facilitate the universities to avail of the BRNS project funding by way of projects of mutual interest, Mr S.G. Markandeya, on behalf of the BRNS, explained the modalities involved in the submission and selection of project proposals. This meeting was specifically convened for the benefit of the senior faculty members from various universities, who were attending the symposium.

As part of the Public Awareness Programme, Mr V.D. Puranik, Head, Environmental Assessment Division, BARC, and Mr R.K. Sharma, Head, Media Relations, BARC, delivered lectures followed by interactive sessions with the post graduate students of the HNBG University. The topics covered included natural radioactivity and the associated impacts, beneficial uses of atomic energy with special reference to the contributions made and technologies provided by the department in the fields of medicine, industry, agriculture, etc.

A visit to Tehri Dam site was arranged as part of the scientific programme to understand the ecological, environmental and engineering intricacies of the hydro power generation unit. Dr Anil Kakodkar also visited the site and had very useful discussions with the Dam Authority at the site.

FORTHCOMING SYMPOSIA

- Electronics & Instrumentation programme of Department of Atomic Energy (DAE) has been mainly fuelled by the need in areas like Reactor & Accelerator Instrumentation, Physics Experimentation and various Process Control Instrumentation requirements. Nuclear Instrument design has undergone rapid changes in the last few years with extensive usage of Hybrid Micro Circuits (HMC), ASICs and FPGAs, with many foundries in India offering VLSI fabrication facilities. Indigenous development of ASICs and HMCs is imperative for self-reliance, for keeping pace with the technological advances and also in overcoming problems like obsolescence. BARC and IGCAR have taken an initiative in designing ASICs, HMCs and FPGAs for meeting the requirements of DAE.

ASICs and hybrids for applications like Gamma Ray Telescope, Silicon Strip Detectors for CERN and PIN diodes for Dosimetry and other radiation monitoring instruments, RF Systems & Amplifiers for LINAC at TIFR and standardized functional boards based on FPGA devices, HMC based control instrumentation for PFBR & 500MWe PHWR reactors, etc. are some of the developments pursued at BARC & IGCAR with active participation of public sector. The new generation of instruments incorporate multiple interfaces for connectivity like Ethernet, RS485, USB and I^2C, etc. Some of the radiation monitoring systems will be based on standard protocols like RADNET. Embedded Systems & Wireless Technologies are other application areas for the new generation instruments.

In order to provide a forum for exchange of ideas relevant to all these developments and to focus on these new technological issues on

development activities in Nuclear Instruments, it is proposed to organise a GOLDEN JUBILEE DAE-BRNS National Symposium on "Nuclear Instrumentation - 2004" (NSNI-2004) under the auspices of BRNS, during February 17-20, 2004 at IGCAR, Kalpakkam, Tamilnadu. This event aims to include a number of invited talks by experts in topics of current interest in the field, presentation of contributed papers from scientists and engineers involved in the development and usage of Nuclear Instruments. It is also proposed to supplement the proceedings of symposium with exhibition of related products by industries and research institutions.

For more details, contact : Mr T.S. Anantha-krishn an, Secretary, NSNI-2004, Electronics Division, Bhabha Atomic Research Centre, Mumbai 400 085; Tel.No. 91-22-25593806, Fax : 91-22-5505151/5519613; Email:anant@apasara.barc.ernet.in, or Mr B. Krishna Kumar, Jt. Secretary, NSNI-2004, Electronics Division, IGCAR, Kalpakkam, Tamilnadu – 603102; Tel.No. 91-4114-280302, Fax : 91-4114-280228; Email: bkk@igcar.ernet.in

भा.प.अ. केंद्र के वैज्ञानिकों को सम्मान / BARC SCIENTISTS HONOURED

• डॉ. जे. वी. यखमी, अध्यक्ष, तकनीकी भौतिकी एवं प्रोटोटाइप इंजीनियरी प्रभाग, भापअ केंद्र को नोवोसिर्बिस्क (रूस) में दिनांक 2-6 जून, 2003 के दौरान आयोजित एशिया पैसिफिक अकैडमी ऑफ मटेरिएल (APAM) की बैठक में APAM सदस्य के रूप में चुना गया।

Dr J.V. Yakhmi, Head, Technical Physics & Prototype Engineering Division, BARC, has been elected to the membership of the Asia Pacific Academy of Materials (APAM) during the meeting of APAM held at Novosibirsk (Russia), during June 2-6, 2003.

• श्री बी.एन. पाण्डेय, विकिरण जैविकी एवं स्वास्थ्य विज्ञान प्रभाग, को दिनांक 10-12 फरवरी 2003 के दौरान छत्रपति साहूजी महाराज आर्युविज्ञान विश्वविद्यालय (अपग्रेडेड किंग जार्ज मेडिकल कॉलेज) लखनऊ में "रोल ऑफ फ्री रेडिकल्स एण्ड एंटीऑक्सडेंटस् इन हैल्थ एंड डिसीज" पर आयोजित अंतरराष्ट्रीय सम्मेलन तथा सोसायटी फॉर फ्री मेडिकल रिसर्च इंडिया के द्वितीय वार्षिक सम्मेलन में बैस्ट ओरल प्रजेन्टेशन पुरस्कार दिया गया । इसमें नकद पुरस्कार एवं मानद् चिन्ह होते हैं । श्री बी.एन. पाण्डेय एवं श्री के.पी. मिश्रा द्वारा लिखित लेख "रोल ऑफ मेम्ब्रेन ऑक्सिडेटिव इमेज एण्ड रिएक्टिव आक्सिजन स्पीशीज इन रेडियेशन इंडयूसड् अपोप्टोटिक डैथ इन माउस थायमोसाइटस्" के लिए यह पुरस्कार उन्हें प्रदान किया गया ।

Mr B.N. Pandey of Radiation Biology and Health Sciences Division, BARC, has been honoured with the “Best Oral Presentation Award” at International Conference on Role of Free Radicals and Antioxidants in Health and Disease, and 2nd Annual Conference of Society for Free Radical Research-India held at Chatrapati Sahuji Maharaj Medical University (upgraded King George’s Medical College), Lucknow, during February 10-12, 2003. This carries a cash award and a citation. The award was conferred on him for his paper titled, “Role of membrane oxidative damage and reactive oxygen species in radiation induced apoptotic death in mouse thymocytes”, authored by B.N. Pandey and K.P. Mishra.

Edited and published by Dr Vijai Kumar, Head, Library & Information Services Division, Bhabha Atomic Research Centre, Trombay, Mumbai 400 085.

Editorial Management : T.C. Balan, Computer graphics & layout : P.A.S. Warrier

BARC Newsletter is also available at URL:http://www.barc.ernet.in (for private circulation only