Utilization of Accelerators at EBC

Accelerator for Food Irradiation

▪ No chemical residues	▪ Reliable & safe
▪ Inherent characteristics & properties preserved as no heat is generated	▪ Precise and reproducible treatment process
▪ Product can be treated after packaging	▪ Proven use for 30 years
▪ Non-toxic	▪ Environment friendly

JOURNAL OF RADIATION RESEARCH AND APPLIED SCIENCES
2019, VOL. 12, NO. 1, 245–259
https://doi.org/10.1080/16878507.2019.1650223

Comparison of gamma and electron beam irradiation for using phyto-sanitary treatment and improving physico-chemical quality of dried apricot and quince

Sarver A. Rather[a], Peerzada R. Hussain[a], Prashant P. Suradkar[a], Omeera Ayob[b], Bhaskar Sanyal[c], Abhijit Tillu[d], Nishant Chaudhary[d], R. B. Chavan[d] and Sunil K. Ghosh[c]

[a]Astrophysical Sciences Division, Nuclear Research Laboratory, Bhabha Atomic Research Centre, Srinagar, India; [b]Department of Food Technology, Faculty of Engineering and Interdisciplinary Sciences, Jamia Hamdard (Hamdard University), New Delhi, India; [c]Food Technology Division, Bhabha Atomic Research Centre, Mumbai, India; [d]Electron Beam Centre, Accelerator and Pulse Power Division, Bhabha Atomic Research Centre, Mumbai, India

Conclusion

Based on the results of the present study, it is concluded that electron beam irradiation could prove beneficial compared to gamma irradiation

Indian Journal of Pure & Applied Physics
Vol. 50, November 2012, pp. 870-873

Alanine-EPR dosimetry in 10 MeV electron beam to optimize process parameters for food irradiation

Bhaskar Sanyal[1]*, Sanjeev Kumar[1], Mukesh Kumar[2], K C Mittal[2] & Arun Sharma[1]
[1]Food Technology Division, Bhabha Atomic Research Centre, Mumbai, India
[2]Accelerator & Pulse Power Division, Bhabha Atomic Research Centre, Mumbai, India
*E-mail: sanyal@barc.gov.in

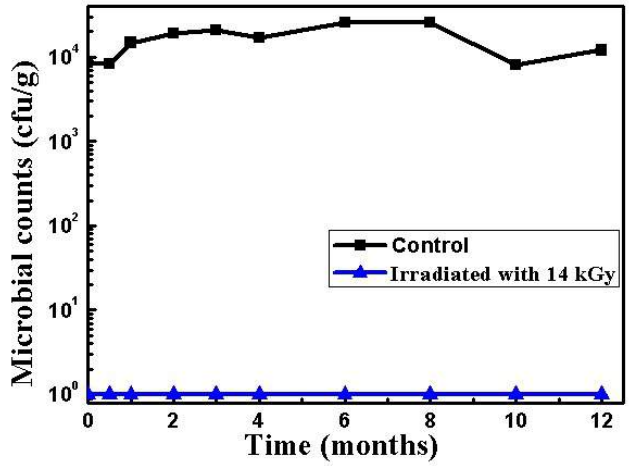
Conclusion

10MeV Facility is suitable for large scale Food irradiation

Accelerator for Food Irradiation


Coriander Powder Irradiation in 10 MeV Linac at EBC.

Coriander powder irradiated with 14 kGy dose can be stored safely for 1 year span of food production cycle.



Results of microbial analysis by dilution methods

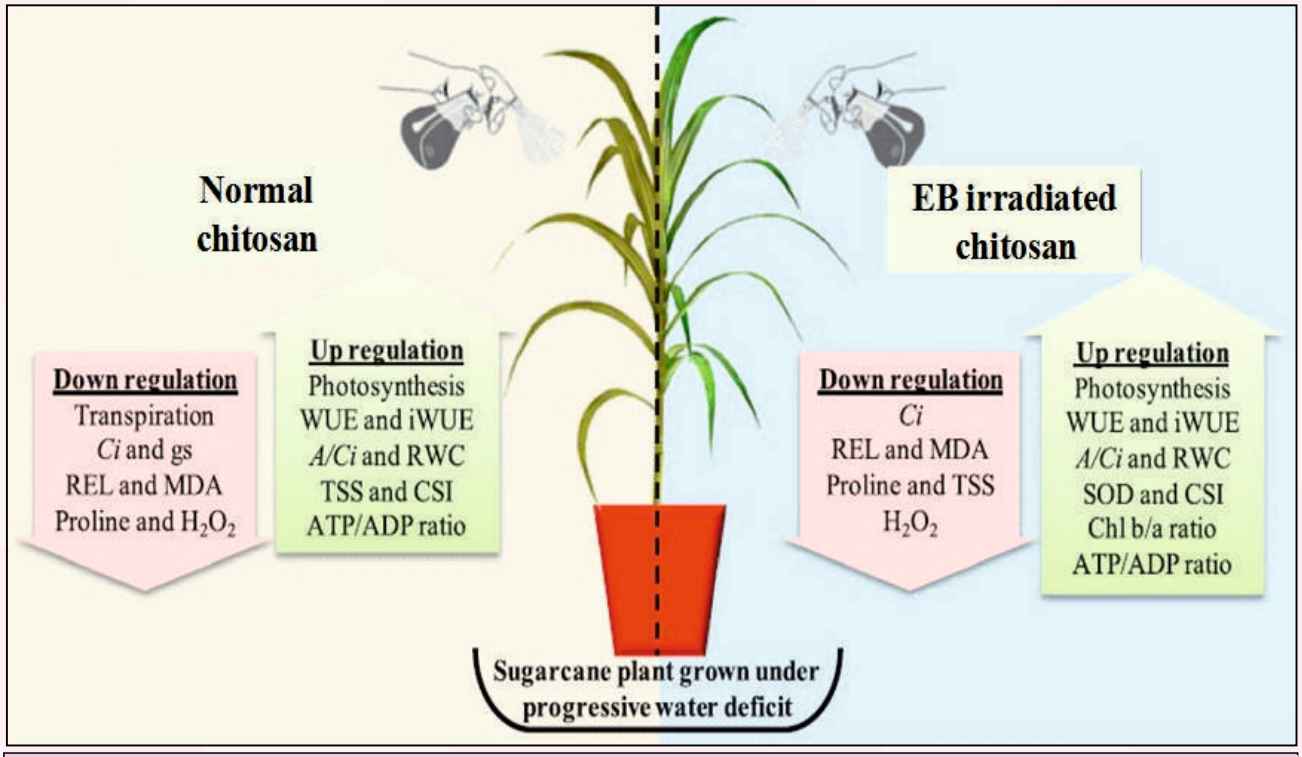
Microbial counts for un-irradiated and irradiated coriander powder 12 month

Food Products Irradiated with 10 MeV at EBC
Target Dose Range : 0.25 kGy - 14 kGy

▪ Potato	(0.4-1kGy)
▪ Mango	(0.4-1kGy)
▪ Rawa	(0.25-1kGy)
▪ Litti	(1- 4kGy)
▪ Dried Apricot	(1- 4kGy)
▪ Dried Quince	(1- 4kGy)
▪ Coriander Power	(10- 14kGy)

Accelerator for Agriculture

Chitosan Irradiation at EBC for VSI, Pune. Target dose = 50 kGy
Production enhancement by 1.3 times using EB treated chitosan



Electron beam treated chitosan provides better germination, proper tillering of plant and regulate photosynthesis

Technology fits for slogan given by Vasantdada Sugar Institute, Pune, as
स्वच्छ भारत , समृद्ध भारत

Accelerator for Agriculture


Irradiation of chitosan (biopolymer) at EBC on large scale for 100Acres of plantation


Chitosan (biopolymer) Loading on Conveyor


Papaya : Non Treated


Papaya: EB Treated


Papaya : Non Treated


Papaya: EB Treated

EB treated CHITOSAN for papaya cultivation: Future prospects

Accelerator for Agriculture

Letter of Appreciation from Vasantdada Sugar Institute

VASANTDADA SUGAR INSTITUTE

संशोधनेन संवृद्धिः

ISO 9001:2015

Phone : (020) 26902100
Direct : (020) 26902211
Fax : (020) 26902244
Web-mail : sc.deshmukh@vsisugar.org.in
E-mail : dgvsipune@gmail.com
Web-site : www.vsisugar.com

Manjari (Bk.), Tal. - Haveli, Dist. - Pune : 412 307
Maharashtra, India.

Shivajirao Deshmukh IAS (Retd.)
DIRECTOR GENERAL

VSI/DG/Biostimulator/ 2615 /2020

Date- 21.10.2020

Dear Sir,

This is to convey our deep appreciation to the staff of Electron Beam Center, BARC, Kharghar, who have extended all help to Vasantdada Sugar Insitute, Pune for EB irradiation of chitosan to obtain low molecular weight chitosan- 'irradiated' chitosan. The staff participated with us in irradiating chitosan in different forms with different irradiation doses to obtain Low Molecular Weight Chitosan on large scale. This institute has utilized the material for testing its efficacy as bio-stimulator for managing biotic and abiotic stresses in sugarcane and allied crops. The irradiated material is found significantly superior over non irradiated chitosan. Its multi-location evaluation trials along with Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri have shown 22.8 t/ha cane and 4 t/ha sugar yield improvement in sugarcane. The "irradiated chitosan" has been recommended by the Joint Research Committee of Agriculture Universities in Maharashtra State- JOINT AGRESCO 2018. In addition, the irradiated chitosan has shown promising results in several vegetable, grain, flower, fruit crops etc. for sustainable yield improvement.

The work was carried out under VSI-BARC joint collaborative program with a BRNS project, and present MOU with NABTD for the development of irradiated chitosan. This institute would like to acknowledge the help and cooperation of EBC, NABTD, BARC (DAE) for the program on developing "irradiated chitosan" as a biostimulator in improving plant productivity sustainably. We hope for a strong and continued collaborative programme with BARC.

With regards

Yours faithfully,

21.10.20

(Shivajirao Deshmukh)

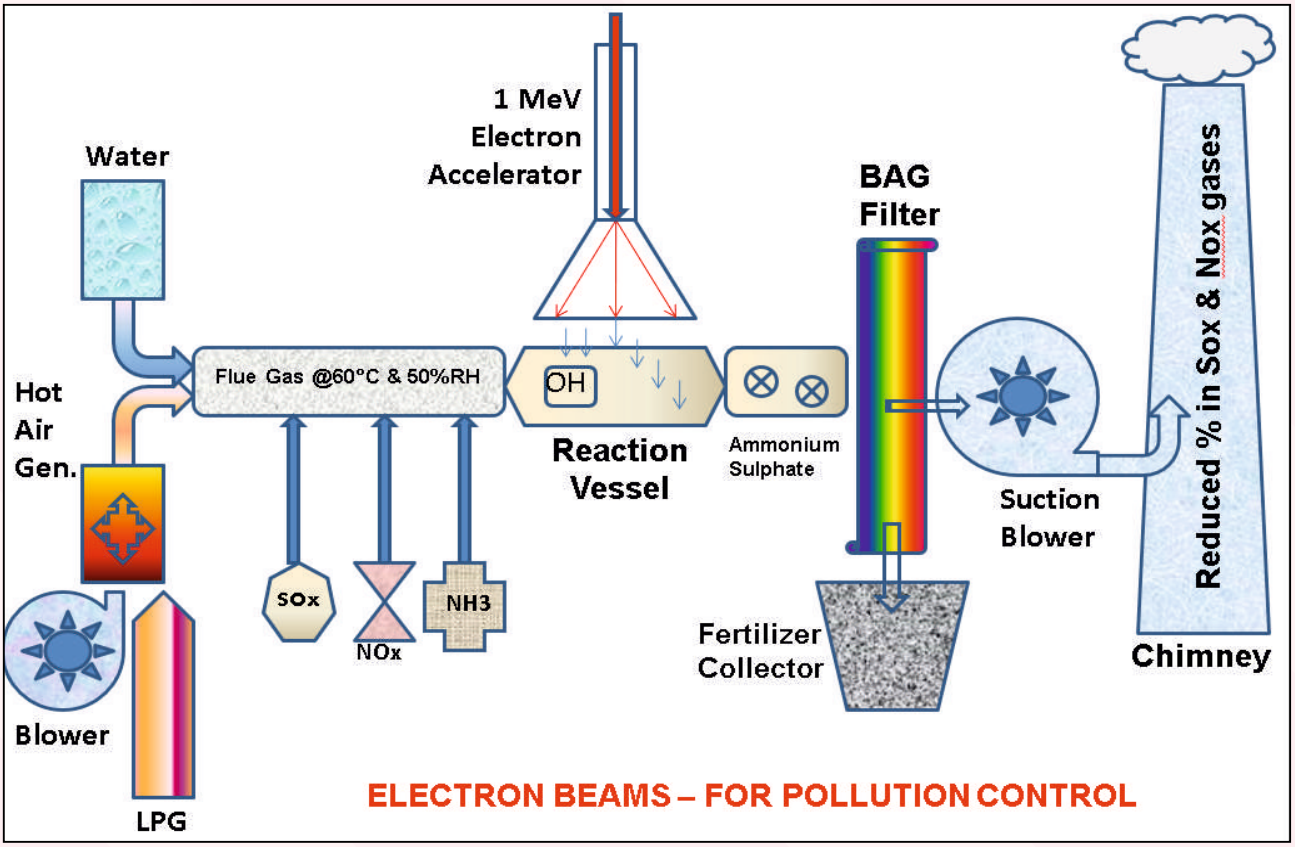
To,

The Director,
Bhabha Atomic Research Center,
Anushaktinagar, Trombay,
Mumbai 400 085

Accelerator for Environmental Applications

Elecron Beam Flue Gas Treatment (EBFGT)

- Flue Gas is a mixture of gases emitted from thermal power plants by burning fossil fuels like coal, diesel and natural gas etc. It contains particulate matter and oxides of sulphur and nitrogen (usually known as SOx and NOx). It is responsible for acid rains and air pollution.
- Electron beam interacts with moisture and produces of highly oxidizing OH free radicals, which react with the flue gas components to produce sulphuric acid and nitric acids. The acids are neutralized by ammonia in the moist environment to produce useful fertilizers, ammonium sulphate and ammonium nitrate.
- The optimized dose is 15kGy to achieve highly efficient removal of SO_2 and NO_2. The demonstration experiment was done in collaboration with BHEL Ranipet.

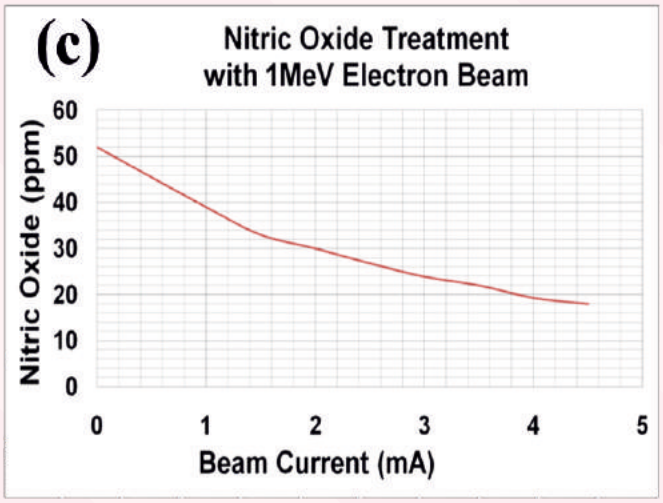


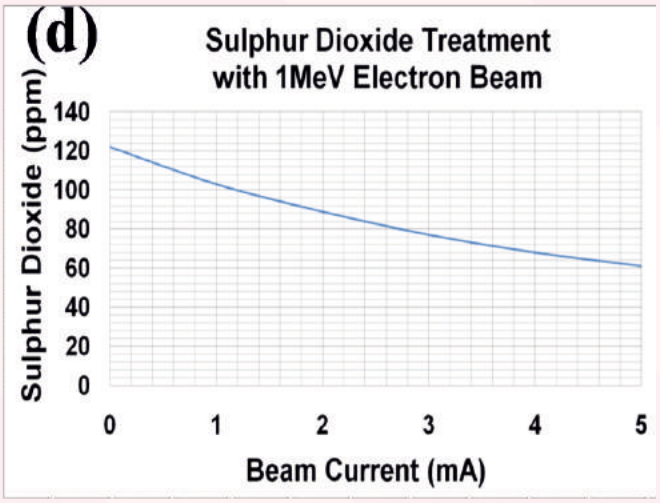
Concept of Electron Beam Flue Gas Treatment Facility

Accelerator for Environmental Applications

Experimental set up for EBFGT at EBC

Fertilizers collected after experiments





Results of EBFGT experiments, showing decrease in SOx and NOx levels

The whole of science is nothing more than refinement of everyday thinking.

-Albert Einstein

Accelerator for Environmental Applications

Electron Beam Waste Water Treatment (EBWWT)

RSC Advances

PAPER

View Article Online
View Journal | View Issue

CrossMark click for updates

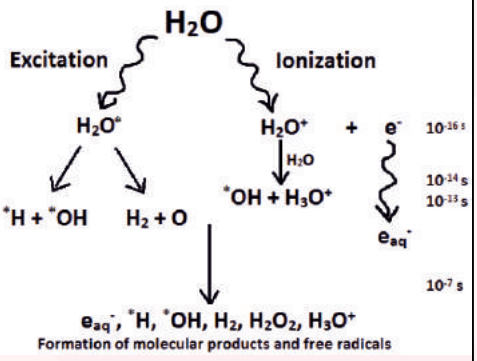
Cite this: *RSC Adv.*, 2014, 4, 53921

Evaluation of efficiencies of radiolysis, photocatalysis and ozonolysis of modified simulated textile dye waste-water

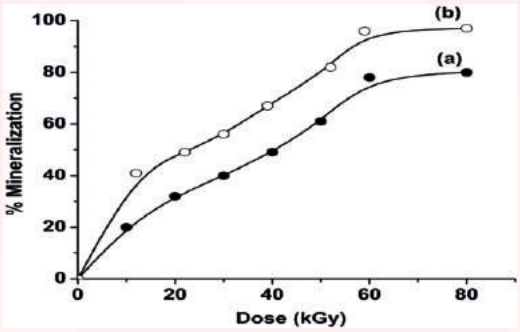
Jhimli Paul Guin,*[a] Y. K. Bhardwaj,[a] D. B. Naik[b] and Lalit Varshney[a]

[a]*Radiation Technology Development Division, Bhabha Atomic Research Centre, Trombay, Mumbai-400 085, India. E-mail: paul.jhimli@gmail.com; Fax: +91-22-2550-5151; Tel: +91-22-2559-0175*

[b]*Radiation and Photochemistry Division, Bhabha Atomic Research Centre, Trombay, Mumbai-400 085, India*



Radiolysis of water



Mineralization of WW in the presence of 4×10^{-2} mol dm^{-3} $K_2S_2O_8$ during (a) gamma radiolysis, and (b) EB radiolysis

Contents lists available at SciVerse ScienceDirect

Radiation Measurements

journal homepage: www.elsevier.com/locate/radmeas

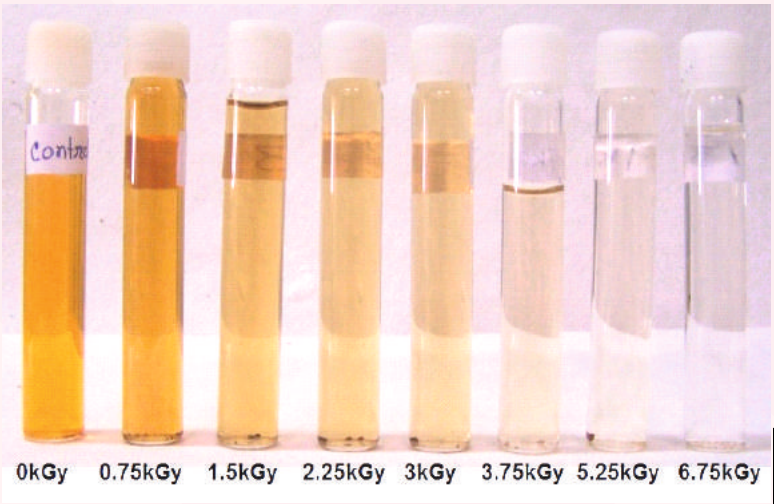
ELSEVIER

Dosimetric evaluation of an indigenously developed 10 MeV industrial electron beam irradiator

R.H. Chilkulwar[a], S.D. Sharma[a,*], N. Chaudhary[b], S. Acharya[b], Y.S. Mayya[a], K.C. Mittal[b], L.M. Gantayet[b]

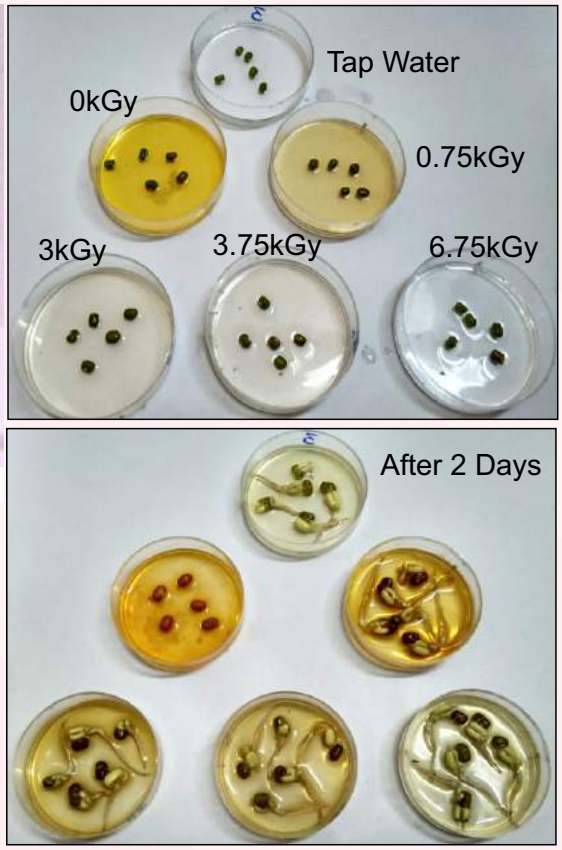
[a] *Radiological Physics & Advisory Division, Bhabha Atomic Research Center, CT&CRS, Anushaktinagar, Mumbai 400094, India*
[b] *Accelerator & Pulse Power Division, Bhabha Atomic Research Center, Trombay, Mumbai 400085, India*

Experimental Set Up for Waste Water Treatment



Decolouration of dye with dose

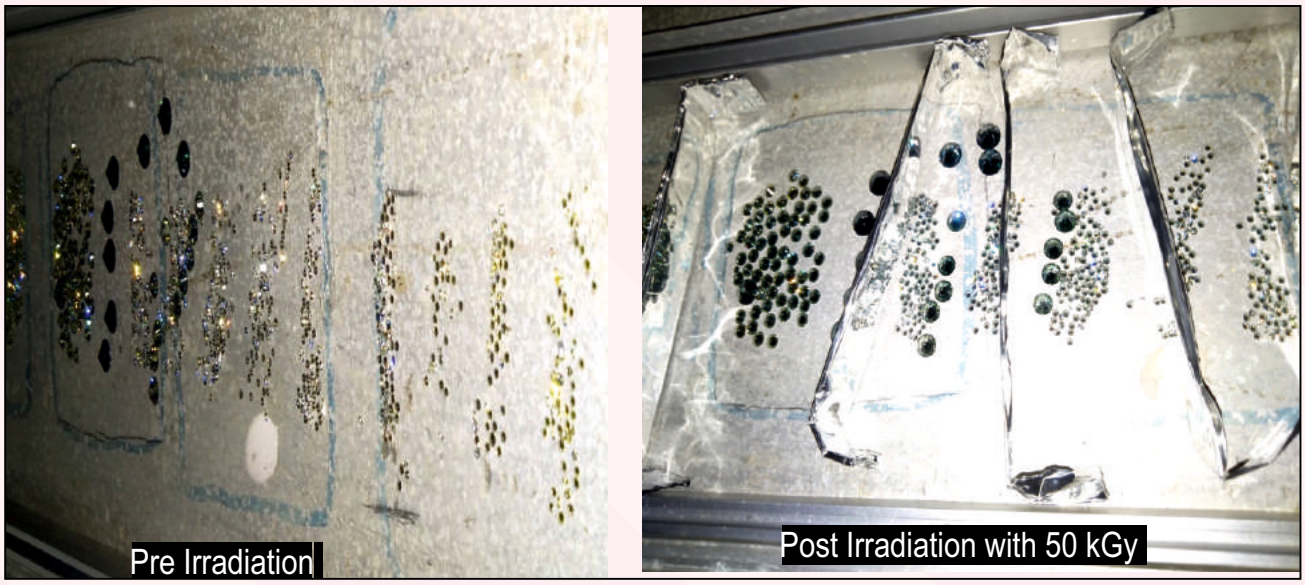
At EBC Kharghar, 1 MeV, 100 kW Electron Beam Waste Water Treatment (EBWWT) an industrial demonstration system is being developed for reducing COD/BOD levels of effluents and dye water on industrial scale to treat 1-2MLD of water.



Moong seed germination test on the unirradiated and irradiated dye solution

Accelerator for Industry

Colour Enhancement GEM STONES



Different types of gemstones like topaz, tourmaline, quartz crystals etc. have been irradiated with 10 MeV electron beam (EB) at EBC, Kharghar. The accumulated dose delivered was around 10 MGy

Polyethene O-Ring Gasket Irradiation

The polyethene O-Ring Gaskets were irradiated using 10MeV RF Linac. The dose imparted was 300 kGy. These O-rings are used for various industrial applications.

O-Ring Irradiation at 10MeV facility at EBC. Softening Temp.: 70˚C (pre irradiated), 280˚C (post irradiation)

Surface Modifications and Radiation Damage Studies

Indigenously developed 500 keV DC Accelerator at BRIT, Vashi has been used for imparting new properties to fabric and cotton. Bombay textile Research Association (BTRA) has conducted experiments on treatment of cotton, nylon & silk fabric samples to improve tensile strength, UV protection and anti-microbial properties.

Electro-conductive cotton fabric prepared by electron beam induced graft polymerization and electroless deposition technology

Contents lists available at ScienceDirect

Radiation Physics and Chemistry

journal homepage: www.elsevier.com/locate/radphyschem

Multifunctional finishing of cotton fabric by electron beam radiation synthesized silver nanoparticles

Amol G. Thite[a,*], Kumar Krishnanand[a,1], D.K. Sharma[b], Anjan.K. Mukhopadhyay[a]

[a] The Bombay Textile Research Association, Ghatkopar (W), Mumbai 400086, India
[b] Bhabha Atomic Research Centre, Trombay, Mumbai 400085, India

2.1. In-situ synthesis of silver nanoparticles by EB radiation

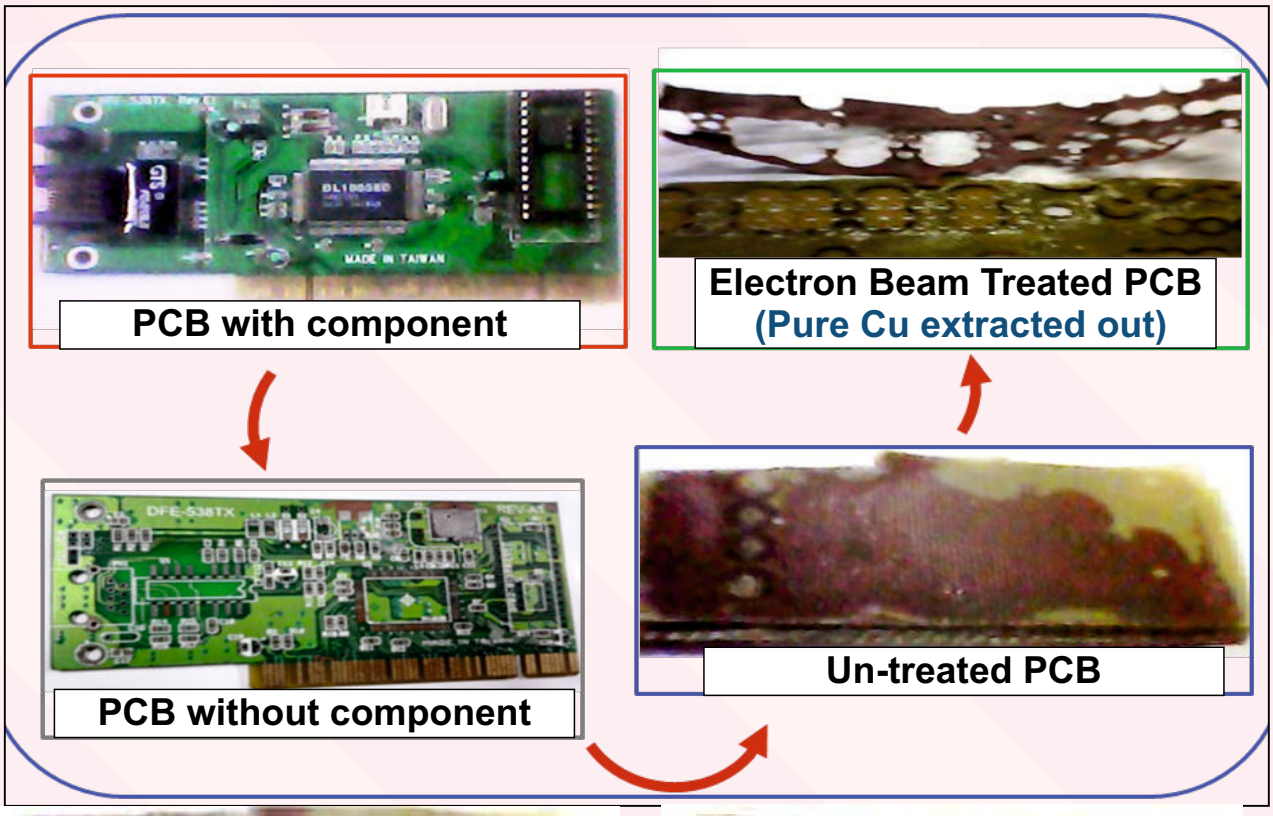
The cotton fabric samples were first padded with an aqueous alcoholic $AgNO_3$ solution. The aqueous alcoholic solution was prepared with different silver nitrate concentrations like 0.01%, 0.1% and 1.0% (wt./vol.) in deionised water along with 1.5 mM isopropanol. The cotton fabrics were padded by padding mangle (Mathis, Switzerland) with 2–dip–2–nip system, 0.4 bar squeezing nip roller pressure and 1 m/min roller surface speed. The padded fabric gained almost 90% constant wet pick up. These padded fabric samples were later kept in zip lock polyethene bags in nitrogen atmosphere for further EB radiation exposure.

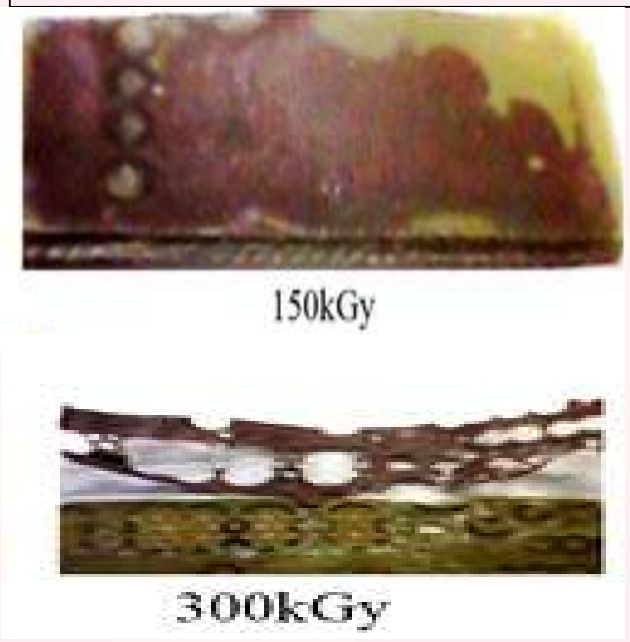
These padded fabric samples were irradiated using 500 keV electron beam system at Bhabha Atomic Research Centre (BARC), Mumbai. Specifications for electron beam irradiation were: electrons beam energy, 300 keV and conveyor speed, 0.42 m/min. Samples were irradiated with three different EB doses such as 10, 25 and 50 kGy. After irradiation, samples were kept in zip lock bag for 3 h and then washed with water to remove residual un-reacted chemicals. These were finally dried in air. Treated samples were investigated by different analytical techniques.

4. Conclusions

Electron beam radiation has been successfully used for the *in-situ* synthesis of silver particles in the cotton fabric. From SEM images, these were observed as uniformly dispersed on the fibre surface and their dimensions fall in nano range. Their amount on percent weight of cotton sample was measured quantitatively by ICP–OES spectroscopy technique and shown higher content in sample padded with higher concentration silver nitrate solution. The effect of concentration change was found more powerful than the EB doses as the variation range in concentration was larger than the latter. Reflectance spectra provide another support that particles were in nano range as treated samples reflected less in the 400–450 nm wavelength regions. Deposition of silver particles also conferred the fabric having UV-blocking, colour change and antibacterial properties. The values of ultra-violet light protection factor could be altered by varying the solution concentration and to a less extent by EB dose. UPF and antibacterial characteristics were durable even after ten standard washing cycles. Such finishing treatment did not appreciably alter the physical properties of fabrics like air permeability and bending length, however, a positive desirable change of increased total recovery angle was observed. Thus, the radiation induced synthesis of silver nanoparticles was found to impart multifunctional finishing to the cotton fabric.

Accelerator for Electronic Waste Disposal





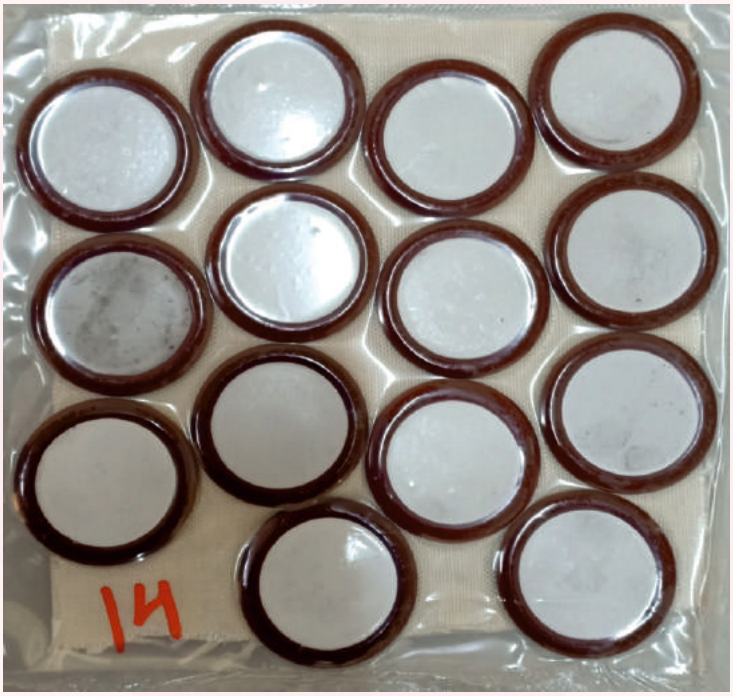
EB irradiated sample of PCB

- The irradiation was done with 10 MeV up to dose of 350kGy,the copper can be pulled off from PCB which is 99.9 % pure and fully reusable
- Post copper removal the PCB becomes easily degradable.
- Process can be carried out in actual atmospheric condition without use of any chemical catalysts

Accelerator for Semiconductor industry

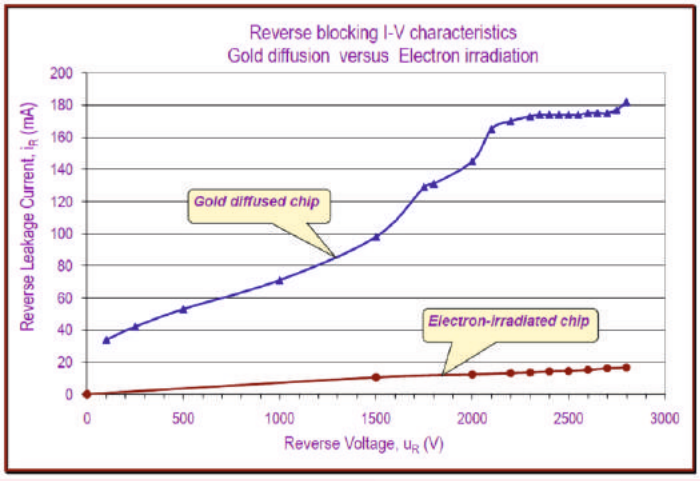
Power diode irradiation for Reverse recovery Time Reduction

The irradiation of power diode rated 2.6 kV, 700 A, used as switching device in turbo generators of Bharat Heavy Electricals Limited (BHEL), has been done in 10 MeV. The reverse recovery time (trr) was reduced from 15 µs to 6 µs after delivering 4 kGy optimized dose. In addition leakage current is around 20 mA and forward voltage drop is 2.0 V in comparison to 150 mA and 2.3 V achieved through gold doping. This is the first time an EB accelerator is used for control of semiconductor device parameters in India. With this facility, the required exposure time is found to be much shorter (~ 25 s) to complete one batch processing containing around 200 diode chips.

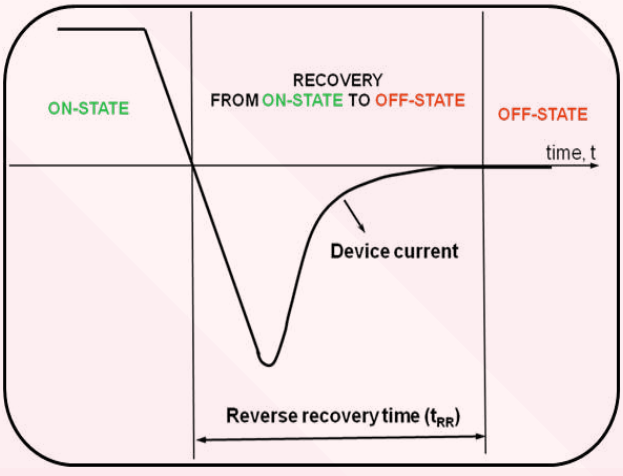


EB treatments ultimately leads to improved manufacturing yield, enhanced turnover, extension of product range, import substitution and customer satisfaction

- Better current carrying capacity for semiconductor based devices like solar cells etc
- Improved radiation resistance especially for space applications
- Surface finishing of metals



Comparison of Gold diffusion and irradiated Diode



Reverse recovery process in a diode

Accelerator for Semiconductor industry
Letter of Appreciation from BHEL

ಭಾರತ್ ಹೆವಿ ಎಲೆಕ್ಟ್ರಿಕಲ್ಸ್ ಲಿಮಿಟೆಡ್
भारत हेवी इलेक्ट्रिकल्स लिमिटेड
Bharat Heavy Electricals Limited
(A Government of India Undertaking)
ELECTRONICS DIVISION
P.B. No. 2606, Mysore Road, Bangalore - 560 026
An ISO 9001, ISO 14001 & OHSAS 18001 Company

Gram : BHARATELEC
Fax : 080-26740137
PHONE : 2888[illegible]
(EPABX NO))

Ref: SCPV// DEVENG/ IRRDN-BARC
Date: 13.06.2012

Dear Dr. K.C. Mittal
Project Manager,, Electron Beam Center
BARC, Khargar,, Navi Mumbai- 400614

Dear Sir,,
BHEL uses fast recovery silicon diodes in high speed Turbo Generator sets in power plants. The specified reverse recovery time (trr) of each diode is achieved by high energy electron irradiation (Typ 8-10 MeV) on diode chips.

In this context, we have used the electron beam facility (10 MeV, LINAC) at BARC on silicon diode chips that were developed at BHEL's Semiconductor manufacturing centre at Bangalore. After initial trials under the guidance of BARC scientific staff, we have been able to achieve the targeted trr values within the Ut- trr design window of these chips. The diode test results have been encouraging.

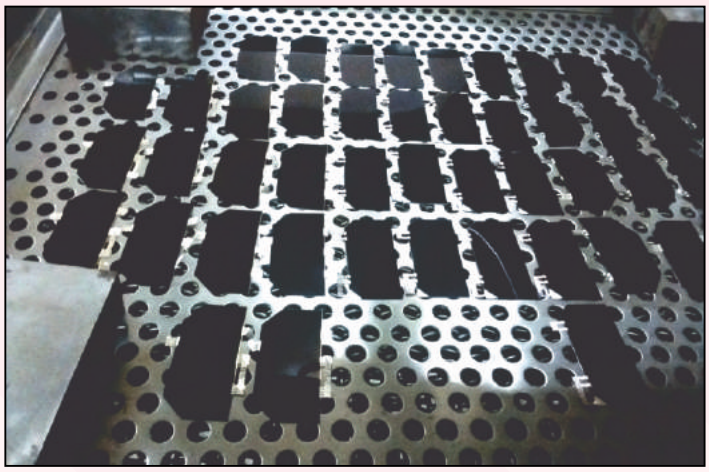
Consequently,, there has arisen an urgent bulk requirement of these diodes from our sister unit, namely BHEL,, Haridwar. These diodes will be deployed in the rotating exciter machines of 660/ 800 MW TG sets. Accordingly,, we request you to provide us a time slot for irradiating 600 nos. diode chips on priority..

Thanking you & with warm regards,,

Saji Salkalachen
Dr. Saji Salkalachen
Addl. GM / Head - SC&PV-Engg.
BHEL, Electronics Division,
Mysore Road, Bangalore- 560026

ಡಾ. ಸಾಜಿ ಸಲ್ಕಲಾಚೆನ್, ಅ.ಮ.ಪ/(ಎಸ್.ಸಿ. ಎಂಡ್ ಪಿ.ಎ.) ಇಂಜಿ
डॉ. साजी सल्कलाचेन, अ.म.प/(एस.सी. एंड पी.ए.) इंजी
DR. SAJI SALKALACHEN, AGM / (SC&PV)-ENGG
BHEL, EDN, MYSORE ROAD, BANGALORE - 560 026

Accelerator for ISRO Solar Cell Irradiation



Multi-junction InGaP/GaAs/Ge (2.5 V, 1A) solar cell, study up to integral fluence 10^{15} for 15 year life time of satellite,
Efficiency degrades from 28% to 18%

Beam Energy: 1MeV, Beam Current: 100μA, Dose: 20-250kGy

GaAs (2.5 V, 1A) for radiation hardening analysis up to integral fluence 10^{15} for 15 years satellite life.

भारत सरकार
अंतरिक्ष विभाग
इसरो उपग्रह केन्द्र
पोस्ट बॉक्स नं. 1795, हवाई पत्तन मार्ग
विमानपुरा डाक घर, बेंगलूरु - 560 017. भारत
दूरभाष : +91-80-5268361, 5265989

सत्यमेव जयते

Government of India
Department of Space
ISRO Satellite Centre
Post Box. No. 1795, Airport Road, Vimanapura Post
Bangalore - 560 017. India
Telephone : +91-80-5268361, 5265989

M Sankaran
Group Director,
Power Systems Group

Ph : 080-25083772
Fax : 080-25083520
email: msankar@isac.gov.in

PSG/E/06/15

23rd June 2015

Dear Dr. Kamlesh Dasgupta,

We at the Power Systems Group of the ISRO Satellite Center, Bangalore are engaged in the design development and realization of the Power System for all ISRO spacecraft missions, including solar panels for power generation. As you may know, the spacecraft solar arrays experience the worst of the space environment including the electrons and protons trapped by the Earth's magnetic field in addition to the energetic solar flare protons. In our quest for a better understanding of the radiation effects on photovoltaic solar cells, our engineers approached your team at the EBC, Kharghar. The idea was to explore the possibility of using the electron beams available at the EBC for these studies.

In continuation to this, our engineer visited EBC on 28th May 2015. During her visit, total 24 sample solar cells were irradiated for 1MeV electron at different fluences. The test was very fruitful and satisfactory and we are accessing the effect of radiation on solar cell.

I wish to put on record, our appreciation and acknowledgement of the co-operation and help extended by your team at the EBC, during the visit. We intend to stay in touch with you and your team for carrying forward this work.

With best regards

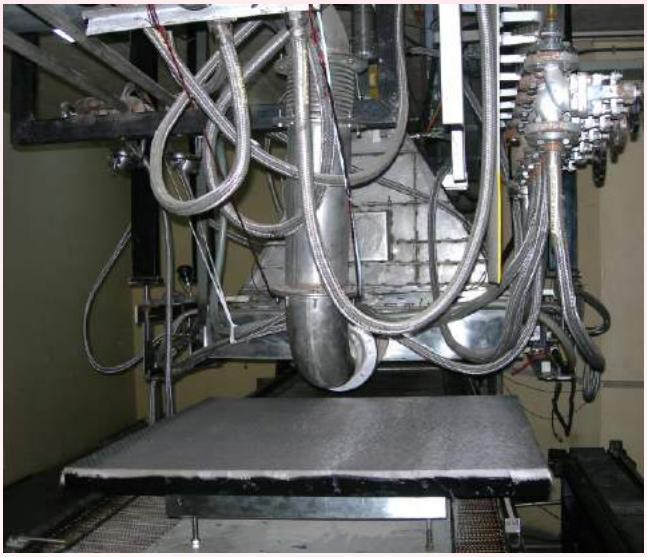
Yours sincerely,

(M Sankaran)

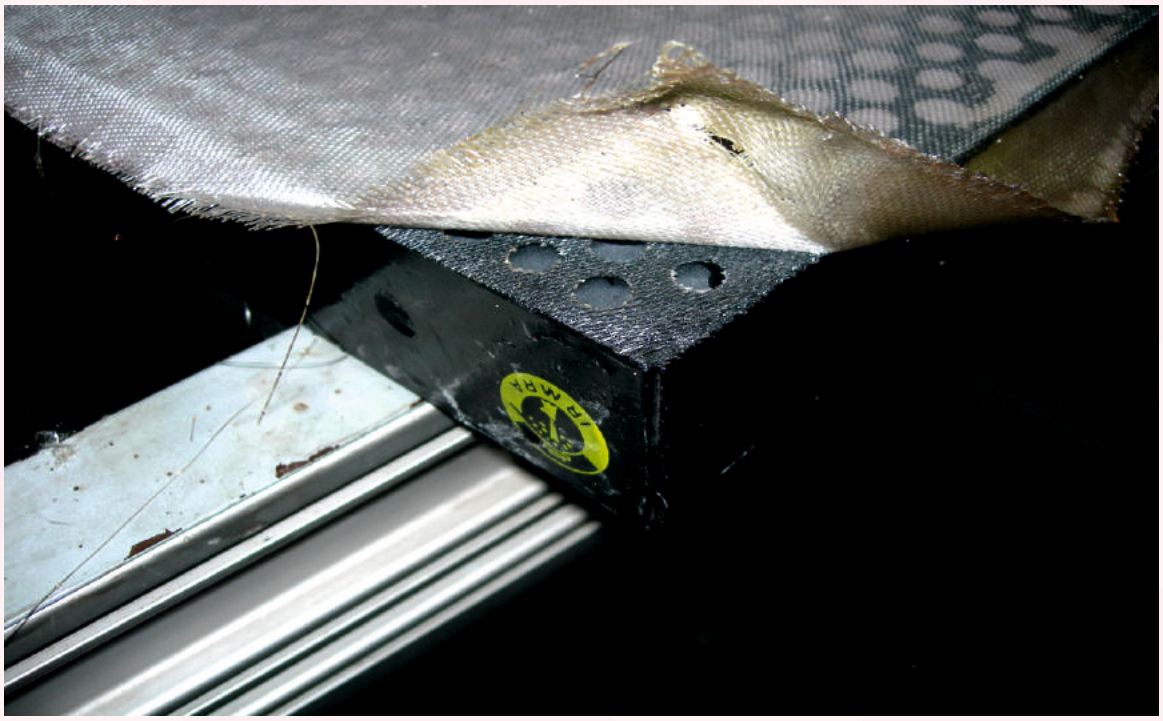
To

Dr.Kamlesh Dasgupta
Associate Director, BTDG, BARC
BARC
Mumbai

Accelerator for Irradiation of SBC Rubber Tiles



Beam Energy: 750-800keV DC, Beam Current: 3mA and 5mA



Post Irradiation: Cohesion of polyester resin to the surface of rubber tile

To adhere the rubber tiles to the hull outer surface reliably, mounting surface of tile, after application of polyester resin, Ship Building Centre, Vizag imparts radiochemical treatment to the tiles from an imported 700keV electron accelerator. Accelerated electrons originate a steady compound between polyester resin and raw rubber, providing reliable cohesion of polyester resin, cured with electron impact, with rubber plate surface. Such experiments have been conducted successfully using the DC accelerator at EBC, Kharghar

Accelerator for Research and Development

Irradiation of Natural & Synthetic Fluorspar (CaF2) for MSD, BARC

Pre Irradiation

Representative image for yellow sample

Post Irradiation (above 5 MGy): dark purple colored powder

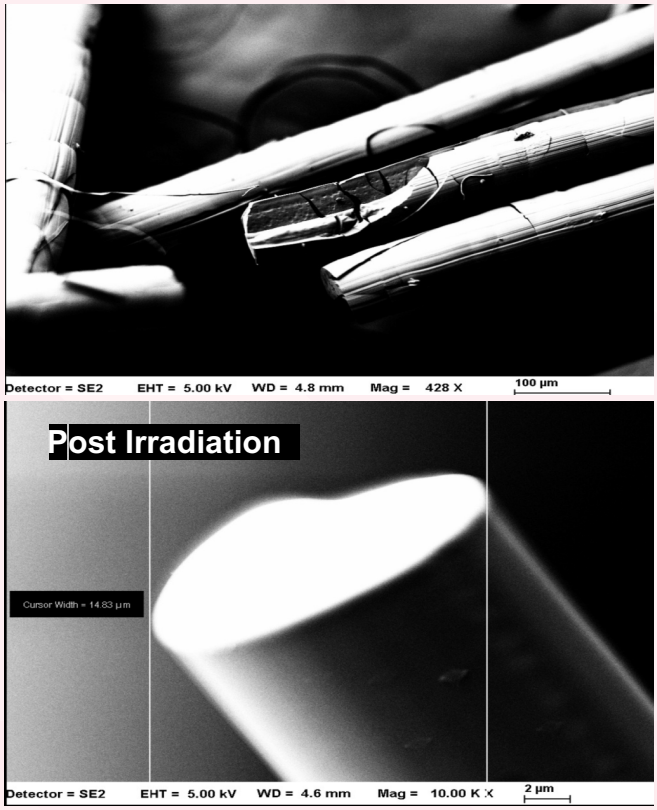
Conclusion

Same type of color centre production in all the specimens irrespective of the rare-earth content. TEM investigations results in considerable change in the microstructure.

Irradiation of Ceramic Powder and Fibre for GAMD, BARC

Pre Irradiation

Crosslinking Density Increases in Powder form up to 6 MGy followed by Saturation

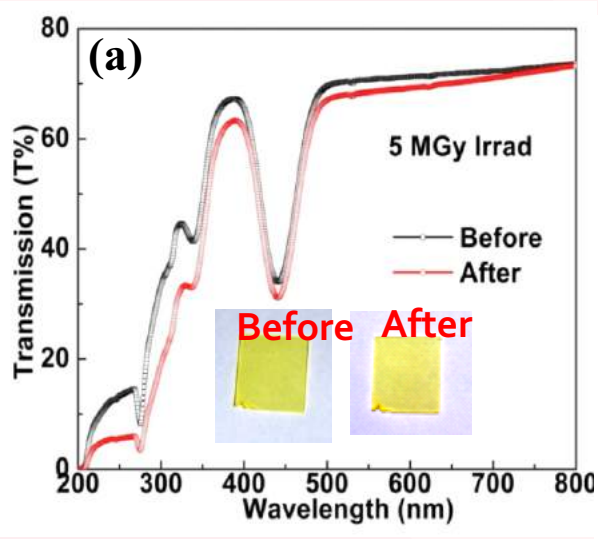


Accelerator for Research and Development

Corrosion Analysis for Zirconium Alloy

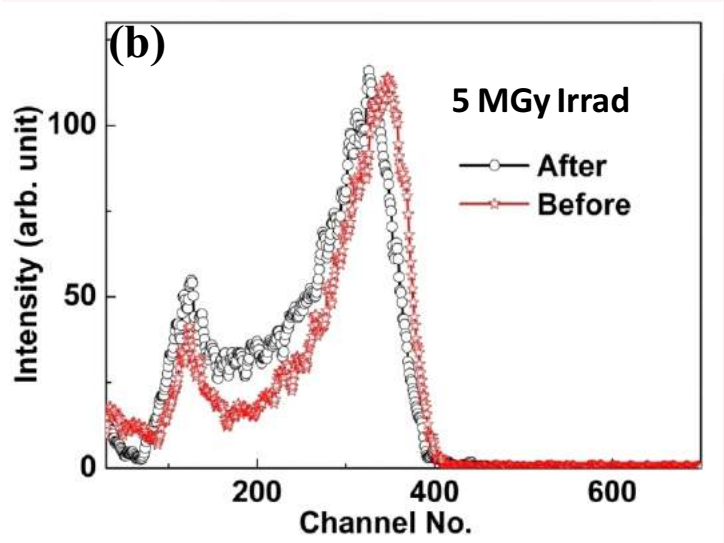
Zirconium (97.5%) and niobium (2.5%) alloy is used as pressure tube in pressurized heavy water nuclear reactors to hold fuel bundles and carry the heavy water in CO2 environment. The oxidation of this metal alloy, in presence of high radiation field and in simulated reactor conditions, has been analyzed using 10 MeV. The accumulated dose delivered to the sample is around 350 MGy at rate of 1.0 MGy/h. The signature of oxidation in alloy was observed after imparting dose of 150 MGy. This study has been carried out in collaboration with RED, BARC and ChD, BARC.

Irradiation of Ce doped GGAG Scintillators Crystal for NRG/TPD, BARC



Optical transmission spectra

Transmission decreases by 3%
No change in Ce3+ characteristics absorption bands (~ 445 nm)



Light output spectra measured with Am-Pu α- source

Scintillation light output of shows a slight decrease ~5%

1.5 mCi β- source (E~ 1.6 MeV) in 15 yrs ~ 5 MGy

Organic Film based Irradiation Studies

10 MeV accelerator was utilized to tailor the electrical and mechanical characteristics of organic films as insulating (BOPET) and semiconducting like molecular semiconductor (zinc phthalocyanine, ZnPc) & conducting polymers (PANI, PEDOT), with emphasis to deploy the modified films for device applications such as gas sensors and radiation dosimeters. The enhancement in mechanical properties of BOPET with 8 kGy dose has been achieved that makes it better packaging materials for food & medical product radiation sterilization

Accelerator for Research and Development

Failure study of Pressure Tubes of PHWR units at Kakrapar

10MeV RF Linac was utilized for failure analysis of Pressure tubes used in PHWR of Kakrapar for simulating required radiation environment and studying the effect of it.

Government of India
BHABHA ATOMIC RESEARCH CENTRE
Reactor Engineering Division

Engg. Hall No.-7,
Trombay,
Mumbai-400 085

Ref: RED/SKS/EBC/ 134807 /19

July 16, 2019

Sub: Utilization Certificate for10 MeV RF Linac at EBC, CBD Belpaur

10MeV RF Linac at EBC CBD Belapur is being used presently to carry out experiments to understand the mechanism of failure of pressure tubes in the two PHWR units at Kakrapar. Type of failures as observed in these units was hitherto unknown to subject experts both within the country and elsewhere. It was suspected that contaminated Carbon dioxide gas used in the annulus gas monitoring system had led to these failures. Confirmation of this aspect was needed and 10MeV RF Linac at EBC CBD Belapur was identified as the source of radiation for simulating in-reactor environment.

Preliminary trial experiments were conducted first to confirm the effect of simulated radiation environment and the reactants on the surface condition of the specimens. Finding the results encouraging, experiment has been scaled up to simulate the geometry and environment. Also the experimental set-up has been instrumented to monitor the various parameters. This scaled-up experiment has so far been conducted for 150 hrs in an intermittent manner against the targeted period of 500 hrs.

Further, it is being envisaged to use 10 MeV Linac for identifying the constituent(s) in the gas used in the annulus gas monitoring system of Indian PHWR which can have some adverse effect on the protective oxide layer on the outer surface. For this, a permanent test loop for characterization of gases for reactor application is proposed to be set-up at EBC Kharghar which can be aligned with Linac as and when need arises.

I am really thankful to the officers and staff at EBC who have extended all possible help during the course of these experiments. I am extremely thankful to Shri R.K. Rajawat, AD, BTDG and Head, APPD for this support and encouragement and wish to get continued support in future as well.

16/07/2019

(S. K Sinha)
Head, RED

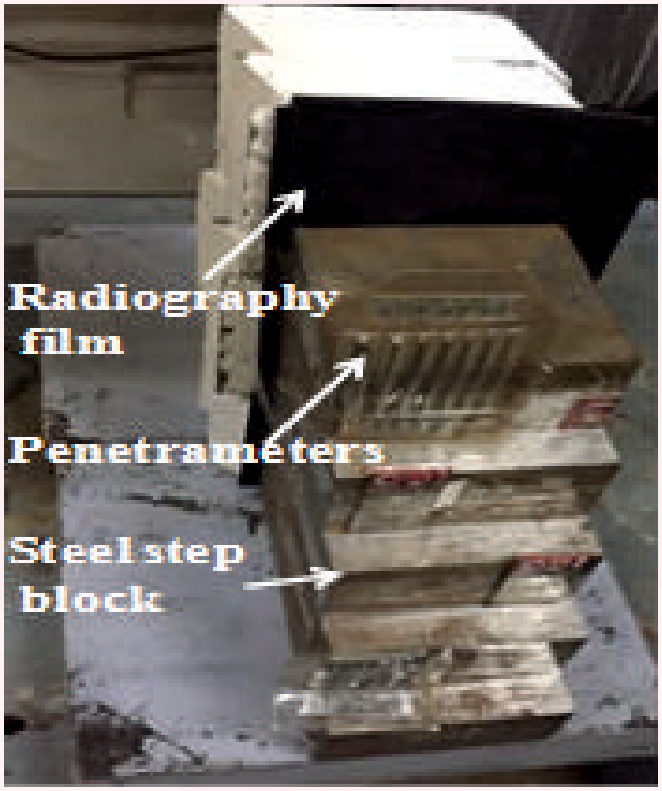
एस. के. सिन्हा
S. K. SINHA
अध्यक्ष/Head
रिएक्टर इंजीनियरी प्रभाग
Reactor Engineering Division
आर.ई.डी., भा.प.अ.केंद्र/R.E.D., BARC
इंजीनियरी हॉल नं. 7/Engineering Hall No. 7
ट्रॉम्बे, मुंबई-85./Trombay, Mumbai-400 085.

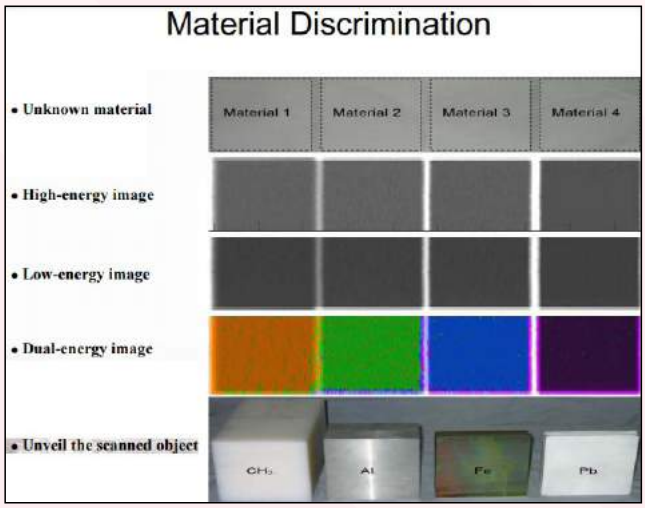
Shri. R. K. Rajawat
AD, BTDG & Head, APPD
B.A.R.C.

Accelerator for Research and Development

Accelerator for Industrial Radiography

Radiography experiments were carried out using 6 MeV Linac with a steel step block having thickness 100 mm to 200 mm with 25 mm step thickness. The radiography parameters such as thickness range, sensitivity and focal spot size have been evaluated by means of both wire type (ASTM E 747) and hole type (ASTM E 1025) penetrameters. The achieved sensitivity is 2 % and the focal spot size is ~ 1 mm. It was concluded that the 6 MeV Linac (developed by APPD in house) is suitable for radiography of materials having thickness up to 200 mm steel equivalent. The experiment has been done in collaboration with QAD and IRAD, BARC.





Material discrimination using Dual Energy Linac

" My success will not depend on what A or B thinks of me. My success will be what I make of my work"

-Homi Jehangir Bhabha

Accelerator for Security Applications

Accelerator as Cargo Scanner

Cargo scanning systems are employed to interrogate cargos at ports or borders to prevent the transport of banned or undeclared objects like weapons, drugs, smuggling items, human trafficking etc. The interrogation is done by an x-ray beam produced by high energy electron accelerator. It consists of an accelerator, a set of collimating units and an imaging detector-array. The interior picture of cargo can be generated on the computer screen after reading the pixels of the detector-array.

Imaging of Cargo at Gamma Field, BARC using 6 MeV System