

*A newsletter of the Society of Polymer Science, India, Thiruvananthapuram Chapter*

## Dr. Vasant Ranchhod Gowariker

25-03-1933 – 02-01-2015

*Polymer News pays tributes to this great human being, wonderful mentor and pioneer in the fields of polymers and high energy materials, Dr. Vasant Ranchhod Gowariker who left for heavenly abode on 2<sup>nd</sup> January 2015. We dedicate this issue to the memories of that great personality*



### News at a glance

- Dr.S.S Bhagawan, Professor, Amrita Vishwa Vidyapeetham and SPSI life member. expired on 03-09-2014
- Dr. Vasant R. Gowariker, former Director, VSSC and former Scientific Advisor to Prime Minister, expired on 02-01-2015
- SPSI AGM on 16th January 2015. Formation Day Lecture will be delivered by Prof. Bruno AMEDURI Macromolecular Engineering and Architecture Institute, France.

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### Editors

Dr. C. P Reghunadhan Nair, VSSC  
Dr. C Gouri, VSSC  
Dr. R. S Rajeev, VSSC

### From the President's Desk...

Dear Readers and Colleagues

At the outset let me wish you a happy and prosperous 2015.

2014 passed in no time and 2015 reached us with lots of hope and expectations. Many things had happened during 2014 which made us very proud. For example, The Mangalyan and the peace Nobel to Kailash Satyarthi made all Indians proud. Bharat Ratna to Professor CNR Rao was a moment of joy to all Indian scientists. However, the act of brutal terrorism, killing innocent school children in Pakistan and vanishing of aircrafts with people on board have created large wounds and pain to all of us. Nevertheless, humanity is marching towards progress in all walks of life with the intervention of science and technology. With new government taking over, the Indian scientific community is hoping for a better time in science and technology. To cater the needs of more than 800 million people of India who live at the bottom of the economic pyramid, science and technology should further improve by creating new knowledge

and wealth. Scientific societies have a greater role to play in strengthening the scientific brain power of the country.

During the past year, The SPSI, Thiruvananthapuram Chapter could initiate a new programme to motivate the young researchers of the region by organizing a special seminar, in addition to the other ongoing activities. Several experts were invited to give lectures on specific topics which were well attended by the members of the society and by the student community. Several of the members of the SPSI-T brought laurels to the society in the form of national and international recognitions. I congratulate them for their hard work and excellence. The executive committee and members of the SPSI-T put their best efforts in organizing seminars, workshop and conferences. I thank all of them for their contributions.

It was very unfortunate that we recently lost one of the stalwarts of the Indian space activities and one

of the most accomplished polymer scientists, Dr. Vasant Gowariker. Equally saddening was the untimely demise of Dr.S.S. Bhagwan, a noted polymers researcher and a hard core polymer science practitioner and an important resource person of SPSI. I join all members of SPSI-TVM in expressing our deep sorrow to the families and friends of Dr. Gowariker and Dr Bhagwan and pray that their souls rest in peace.

Last but not the least, I take this opportunity in thanking the editorial team and all those have contributed to the latest volume of the SPSI-TVM Polymer News. I urge continued support of all members of SPSI-T to take the society to further heights. Your criticism, comments and suggestions for the improvement of the SPSI-T are most welcome.

I am extremely happy to present this new volume of the Polymer News to you.

With warm regards  
A. Ajayaghosh.

## Milestones of Dr. Gowariker

Dr. Vasanth Ranchhod Gowariker known as 'Father of Solid Propulsion in India', made valuable contributions to the fields of space research, weather and population. Above all he was a true gentleman, a perfect human being and a great leader.



On the success of SLV-3

*Today SHAR Centre consists of 10,000 people of ISRO who are either spiritually or physically here. The first rocket from Thumba weighed 10 kg and went to 4.5 km altitude. Today Shri Kalam has been successful in sending up 17 ton vehicle to place Rohini in orbit. I am sure, under Prof. Dhawan's leadership, ISRO will acquire capabilities to launch 4 tonne payloads in near future*

Courtesy: VSSC Documentation Group and VSSC Library



Dr. Gowariker with the then Prime Minister Smt. Indira Gandhi

Courtesy: VSSC Documentation Group and VSSC Library

- Born in Pune on 25 March 1933
- Obtained M. Sc. And Ph.D in Chemical Engineering from the University of Birmingham, UK
- Collaborated with Dr. F.H. Garner to create Garner-Gowariker theory, a novel analysis of heat and mass transfer between solids and fluid .
- Joined the current Indian Space Research Organization in 1967.
- Served as Director, VSSC 1979 to 1985 – Successful launch of SLV-3 during his tenure
- Scientific Advisor of Prime Minister P V Narasimha Rao from 1991 to 1993. Also been the Secretary of Department of Science and Technology
- Vice-Chancellor, Pune University and Chairman of the Marathi Vidnyan Parishad between 1994 and 2000
- Compiled The Fertilizer Encyclopedia (2008) that featured 4,500 entries detailing the chemical composition of fertilizers
- Awarded Padma Shri in 1984 and Padma Bhushan in 2008
- Received the Fie Foundation Award
- Expired on 2 January 2015Pune

Courtesy: VSSC Library



Dr. Gowariker being welcomed at Trivandrum Airport after the successful launch of SLV-3

Courtesy: VSSC Documentation Group



A meeting of Kerala Cabinet with Prof. Satheesh Dhawan, Dr. V. R. Gowariker and Shri A.P.J Abdul Kalam to congratulate ISRO on the success of SLV-3

Courtesy: VSSC Documentation Group

## Early life of Dr. Gowariker

Dr. Gowariker showed keen interest in mechanics and mechanical engineering at an early age. When he was 11, he made an automatic thread winding machine for the Charka. He got appreciation from Mahatma Gandhi's Secretary for this invention.

Dr. Gowariker did his schooling and graduation from Kolhapur,

Maharashtra. After obtaining Master's Degree, he joined University of Birmingham, UK for his PhD. He got his PhD degree in just two years!

When Dr. Vikram Sarabhai and Dr. Gowariker were working together at Tata Institute of Fundamental Research, Dr. Gowariker got interested in Polymer Chemistry. He joined the

current ISRO in 1967, thanks to Dr. Sarabhai who personally invited Dr. Gowariker to Thumba to work on solid propellants. The success of ISRO today is the testimony to the contributions of the two visionaries.

Excerpts from <https://www.manase.org/en/maharashtra.php?mid=68&smid=23&pmid=6&id=845>

## A Tribute to My Great Guru, Dr. Gowariker

Dr. K.N. Ninan, former Outstanding Scientist, VSSC & Emeritus Professor, IIST

*It was with profound grief that we heard about the sad demise of my Great Guru Dr. Gowariker under whom I started my long career in PED/ISRO and who was my PhD joint supervisor. He was a great visionary, a fine human being and a dignified person with firm commitment to whatever job he had undertaken. He loved all around him, who in turn adored and respected him. He laid strong foundations for the propellants and chemicals activities of ISRO, nay the entire Country. He was a great patriot who believed that the Indian youth can realize his dreams through indigenous technologies. He will live in our memories forever. We express our heartfelt condolences to the bereaved family and pray that his soul rest in the everlasting peace. On this occasion with a mixed feeling of sorrow and gratitude, I take a stroll down memory lane of my days in PED/C&M Group and share a few old photographs with Dr. Gowariker.*

### Early Years of PED and Vision of Dr. Gowariker

The real beginning of PED was in 1967, when Dr. Vikram Sarabhai recruited Dr. Vasanth R Gowariker from UK to lead the propellant R & D activities for Indian space programmes. Dr. Gowariker proved



Dr. Gowariker with Dr. Sarabhai & the then Prime Minister Smt. Indira Gandhi (Feb.2, 1968).

himself as an inspiring leader with great vision and foresight and established PED as the cradle of composite solid propellant research in India. By the time I joined PED in August, 1968, Dr. Gowariker had already established the essential rudimentary facilities for making a small '00' motors with a propellant mass of approx. 350 g for testing the propellants being developed. When Prime Minister Smt. Indira Gandhi visited TERLS on Feb 2, 1968 for its dedication to the UN, she was shown the processing operations of raw materials preparation, mixing, casting and curing to make the 00 motor.

I remember the warmth with which Dr. Gowariker, a handsome, tall and polished gentleman, the then Head, PED received me, a 22 year old 'lad', when I joined PED in August, 1968. He introduced me to all, without exception whether they were Engineers (currently designated as Sci/ Engrs), Tech-

nical Assistants or Lab Assistants; there were only a few at the time.

Dr. Gowariker was a great visionary who realized that India can be self reliant in the critical rocket propellant technology only with a strong research base for the in-house development of the required chemicals and by having the necessary infrastructure to produce them in quantities sufficient for the future rockets and satellite launch vehicles. He was not keen to acquire foreign technologies (if at all they were available) because of the strings attached to them or to use imported raw materials for developing the propellants because an embargo on such items could halt the entire program. Therefore, in addition to the R & D for developing propellants, he

*"Dr. Gowariker was a great visionary who realized that India can be self reliant in the critical rocket propellant technology only with a strong research base for the in-house development of the required chemicals ..."*

planned a Polymer Complex, having the R & D labs for developing the polymeric fuel binder and other polymers and special chemicals



The then PED building which currently houses the motor assembly hall and burning rate lab

and also the testing labs with sophisticated equipment to characterize them. The polymers developed at Polymer Complex were to be scaled up and produced, for which he planned a Propellant Fuel Complex (PFC). Similarly, he had dreams about in-house production facilities for ammonium perchlorate and the propellant itself.

The Engineers in PED started making the blue prints of various facilities as per the vision of Dr. Gowariker. Our working hours started at 8 AM and ended up at 10.30 PM on almost



Inauguration of PTL by Dr. Sarabhai (Dr. Gowariker behind Dr. Sarabhai)

all days. New labs and facilities started coming up and they were inaugurated by Dr. Sarabhai during his visits to Trivandrum. Thus, the Chemical Analysis Lab was inaugurated by Dr. Sarabhai in 1969 and the Propellant Testing Lab (PTL) in 1970.

An experimental electrochemical cell procured from CERI was scaled up at PED, and the Ammonium Perchlorate Experimental Plant (APEP) at Alwaye was set up by the PED Engi-

neers. The pilot plant facility for scaling up the resins developed in PED was established in a rented building at Karamana. This eventually culminated in

*"The design and engineering drawings of India's first and the then largest composite solid propellant plant, SPROB, were made by PED in its city cell at Marikar Building ..."*

PFC. The design and engineering drawings of India's first and the then largest composite

**Chemical Lab. for Thumba Space Centre**

FROM OUR CORRESPONDENT

TRIVANDRUM, April 25. The Space Research Project at Thumba has been brought a step nearer to its full operational level with the starting of a chemical laboratory as part of a propellant complex. The complex is coming up in the Space Science and Technology Centre (SSTC) on Veli Hill in the neighbourhood of Thumba.

Both conventional and sophisticated equipment is being got for the laboratory to help meet the needs of all the units of the Indian National Committee for Space Research (INCOSPAR) situated at Thumba/Veli. The laboratory will carry out such work as chemical analysis and group identification.

Dr. Vikram Sarabhai, Chairman, Atomic Energy Commission and INCOSPAR, who recently inaugurated the laboratory, said the laboratory would be a very useful facility for the work connected with propellant research etc. The head of the Propellant Engineering Division of SSTC is Dr. Vasant R. Gowariker.

Manned by a team of young chemists, the laboratory is working on a two-shift basis to meet the increasing demand of analytical work.

The Hindu, April 25, 1969

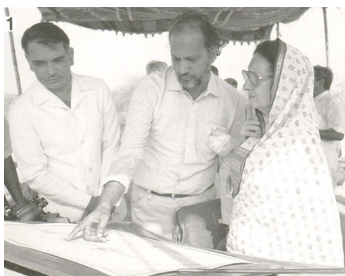
solid propellant plant, SPROB, were made by PED in its city cell at Marikar Building near Statue Junction and the plant at Sriharikotta was established by the PED engineers. SPROB

Contd. in Page 4

## A Tribute to My Great Guru, Dr. Gowariker .....(contd. from Page 3)

with its indigenous machinery was a dream project of Dr. Gowariker.

After the sad demise of Dr. Sarabhai on December 31, 1971, Prof. Satish Dhawan took over Chairman, ISRO and Dr. Brahm Prakash the Director of



*Dr. Gowariker explaining his dream projects to Prime Minister Smt. Indira Gandhi and Minister Mr. Sivaraj Patil*

Vikram Sarabhai Space Centre (VSSC), named after the visionary founder father of ISRO. PED with a strength of over 300 became too large to be retained as a Division, as in the case of other Divisions of VSSC. Thus, VSSC was reorganized in January, 1976 and in the first reorganization, PED got elevated as Chemicals and Materials Group (C & M Group) with Dr. Gowariker as its Director. In 1979, when Dr. Gowariker became Director, VSSC, Mr. M. R. Kurup, succeeded him as Director, C & M Group.

### Propellants and Chemical Systems for ISRO

Information and open literature on making composite propellants were scanty, the raw materials and machineries were not available; but we had the benefit of being guided and motivated by a great visionary leader, Dr. Gowariker as Head, PED and the undying enthusiasm and hard work of all in PED under his leadership. The initial attempts at PED to develop solid propellants with whatever available raw materials led to the development of

a polyester propellant which was successfully flight tested in a 'Dynamic Test Vehicle' (DTV) of RH-75 size on Feb.21, 1969. It was a red letter day in the Country's history of accomplishing self reliance in the critical technology of composite solid propellants. Thereafter, Feb.21 was celebrated as the 'PED day'.

True to his faith in the indigenous capability, Dr. Gowariker followed the path of 100% in-house developed propellants for the SLV-3 Programme. Thus, the ISRO polyol based solid propellant developed at PED was chosen as the propellant for the 10 T monolithic motor to be made at SPROB whose formal inauguration was planned with its static test. The static test was not successful; but Dr. Gowariker faced it with great courage and determination and he told us go ahead with our forward march. This led to the high energy fuel based HEF-20 (1) propellant successfully used in the SLV-3 upper stages and



*The maiden flight of DTV on Feb. 21, 1969*

later in ASLV also. A spin-off of the polyol technology is the polyurethane foam. It is used for the production of artificial limb or "Jaipur Foot" which benefits a large number of handicapped people.

The development, scale up, production and characterisation of HTPB resin and the propellant with it is perhaps the biggest and the most challenging R & D endeavour undertaken by PCM Group. Today India is on par with the space faring nations in the critical solid propellant technology, thanks to the visionary leaders like Dr. Gowariker who motivated us while groping in the path of the development. The credit for taking the decision to choose HTPB propellant for PSLV goes to Dr. Gowariker who was the Director, VSSC at that time. This momentous decision has put the country on top of the

*"True to his faith in the indigenous capability, Dr. Gowariker followed the path of 100% in-house developed propellants for the SLV-3 Programme."*

world map in solid propellant technology and today we are proud of our world class solid motors like S-139 & S-200, the third largest solid motor in the world.

Dr. Gowariker and his team have contributed substantially to the Indian space endeavours by developing a large number of chemicals, polymers and polymer based systems, in addition to the polymeric fuel binder and other subsystems of solid propellants and I do not venture to describe all of them here. Chemical related issues anywhere in ISRO, nay in the Country, were referred to him to find elegant solutions.

### Publications & Professional Societies.

Dr. Gowariker encouraged his scientists to do research, publish papers in quality journals and to improve their qualifications which empowered them with better capability for data generation and interpretation. His book



*Publications shown to Prof. Dhawan*

on Polymers is a standard text book for thousands of students in the country and abroad and his Encyclopedia on Fertilizers is a unique one.

The C & M Group has nurtured the growth of professional societies in the fields of propellants and polymers in this part of the



*Inauguration of HEMSI-TVM Chapter by Dr. Gowariker*

Country. The Trivandrum chapters of High Energy Materials Society of India and Society for Polymer Science, India were inaugurated by Dr. Gowariker. These two local chapters are perhaps the most active and the largest local chapters in the country.

### Management Style of Dr. Gowariker

The management style of Dr. Gowariker was something worth emulating. He called every one by the first name and we referred to him as "Guruji" with great respect. He encouraged every person and every new idea. He believed that every body in PED was capable of doing big and he motivated us to think big. Failures never demoralized him. Thus, even when 'OO' motors were exploding on the static test stand (which was a common sight in those days), he was

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## A Tribute to My Great Guru, Dr. Gowariker .....(contd. from Page 4)

thinking about a propellant plant to make big solid boosters. The PED motto "to strive to seek to find and not to yield" was reflected in all his actions. The motto was displayed prominently everywhere in PED. He used to say "Do like nobody can do better".

Dr. Gowariker's manpower planning, transparency and consultations in decision making, advance action for future and his concepts of multi-tasking and sharing of responsibilities by all, laid the foundations for the well-known 'ISRO Culture'

*"He (Dr. Gowariker) used to say- Do like nobody can do better"*

of working for a common goal and finding out collective solutions for the problems. The 'brain-storming sessions' of Dr. Gowariker were usually held beyond normal working hours and on many days at the residence of Dr. Gowariker in late hours. The fond memories of the tea and snacks served by Mrs. Gowarier for such meetings

are still green in our minds.

Dr. Gowariker pioneered in introducing the "PED Duty Officer (DO) System" which gave birth to the



PED Team who won the All Kerala Safety Drama Competition sharing the moments with Dr. Gowariker

DO system in VSSC. Another innovation he introduced was the 'PED Benevolent Fund' to be used for needy colleagues in their hardship like hospitalization. This scheme developed as 'VSSC Staff Benevolent Fund' currently being managed by elected representatives in VSSC. We celebrated 'PED day' with great enthusiasm, every year on 21st February to commemorate the launch of the first Indian rocket with the indigenous composite propellant developed by PED. It was an occasion for family get-together in which all could express their artistic skills. The following photograph was

taken with Dr. Gowariker the Director, VSSC, when the PED team won all Kerala Safety drama competition.

### Bio-hydrocarbon or Space Crude

In the late 1970s, a project called "Space Crude Project" was initiated by Dr. Gowariker in PED to make petroleum crude from non edible vegetable oils. He was convinced that PED had a bigger role to play in the context the spiraling increase in the cost of petroleum crude, leading to depletion in foreign exchange reserve of the country. In an endeavor to find an alternate fuel, the project started with an attempt to make hydrogen by splitting water with solar energy, using

catalysts. Later research work was initiated on direct catalytic decarboxylation of non-edible vegetable oils to prepare hydrocarbon fuel with no oxygenated products in it. I remember the demonstration of the space

crude pilot plant to the Space Commission Members; an ambassador car driven on the space crude was an item of the demonstration. A US patent was filed for the process of making biohydrocarbon (US Patent

No.4,102,938).

At the fag-end of his illustrious life, he was heading a project on space crude at University of Pune with funding from ISRO. He was a great patriot and a great scientist who believed that science can solve the problems of our country and the country has sufficient potentials to accomplish it.

Though a late entrant, India is today one among most well respected nations in the area of space technology, and we owe a lot to Dr. Gowariker for bringing us to that level.

My salutations to the Great Guru, Dr. Vasanth R Gowariker.

## Tributes to Dr. Gowariker by Thiruvananthapuram Chapters of HEMSI and SPSI

The Thiruvananthapuram Chapters of HEMSI and SPSI jointly condoled the sad demise of Dr. V. R Gowariker, the doyen of solid propulsion technology in India. In a meeting held on 5th January 2015, many close associates as well as those who admired him from a distance paid tributes to the great leader and human being.

The quality of Dr. Gowariker as a great human being was told by Mr. M.J. Varghese of VSSC (Rtd.) when he narrated an incident where a thief who stole articles from his house, when caught

by police, was released without registering a case on the request of Dr. Gowariker. Not only that, all the stolen items were given to the thief by him! It was narrated that even militant head-load workers refused to accept money from Dr. Gowariker for the job they had done for him.

As a tribute, Dr. K. N. Ninan released an article on Dr. Gowariker. Dr. C.P. Reghunadhan Nair told that it might take another 1000 years for the rebirth of such a personality and we cannot wait till then. Shri V.P. Balangadharan narrated an

incident where Dr. Gowariker was anxious to know from where the flowers he had presented to him were purchased as he was exigent that one should support footpath vendors rather than big shop owners—a classical example of his human touch. Dr. S. Aravamudan could feel the spirit and enthusiasm even at his old age when he met him to discuss the biofuel related project, which Dr. Gowariker was undertaking at University of Pune. He was so passionate about the project, which, according to him, would save a lot of foreign exchange and encouraged ISRO communi-

ty to undertake the project.

Dr. V.N. Krishnamoorthy, Shri K.S. Sastri, Shri C.B. Kartha, Shri S. Alwan, Shri V.J. Varkey, Dr. Manorajnah Rao, Dr.Rm. Muthiah, Shri V. Srinivasan, Dr.A. Ajayaghosh and Shri C. Sreekumar Nair were also shared their memories and adored the contributions of Dr. Gowariker. Many who spoke on the occasion adored his vision and research ideas which were far sighted, making India self reliant in many fields including energy and space.

## Gowariker: Always a Step Ahead

To pay tributes to Dr. V. R. Gowariker, a condolence meeting was held in Thiruvananthapuram under aegis of Thiruvananthapuram Chapters of SPSI and HEMSI. Many of Dr. Gowariker's associates shared their memories on that occasion. We reproduce with permission an article on Dr. Gowariker published by Shri V.P. Balagangadhran, Group Head (Rtd.), VSSC, in his website, [www.balagangadhran.com](http://www.balagangadhran.com)

It was a deluge of anecdotes and memories at the condolence meeting held on 05-01-2015 to remember Dr. Vasant Gowariker. A wonderful human being, a wonderful mentor, and a great leader – that's what he was for the people who had the fortune of working with Dr. VRG. For others like the guy who broke into his house in Trivandrum in early seventies, he was a life changer. He was adored by all even outside office and a story had gone around that the militant headload workers

*"Though a fatherly figure to many, he treated his mentees as equals and called them by their first names. . ."*

refused to accept wages from him, which he had to thrust into their pockets.

A true nationalist who believed in indigenous technology, and the man who's rightfully called as the father of India's solid propellant technology, Dr. Gowariker breathed his last in Pune on January 2, 2015. He was 81.

His mentees who thronged the meeting shared vivid memories of the early days of Propellant Engineering Division (PED) and VSSC. As someone mentioned at the meeting, such men are born only once in a thousand years. Though a fatherly figure to many, he treated his mentees as equals and called them by their first names. The boss who spoke with his arms on our shoulders, the boss who treated us to coffee at his home, the boss who spent money from his own pocket to reward us for our professional successes, the boss for whom we would work long hours without cribbing – Dr. VRG was a boss that anyone would dream of hav-

ing. The PED Fund which grew into the VSSC Benevolent Fund, Countdown – VSSC's in-house



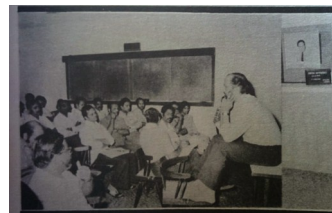
The author hands over a conference kit to Dr. Gowariker

magazine which still chronicles the successes and failures of the Center, the tree-lined avenues at VSSC – Dr. VRG's legacy lives through these and many more. When the Civil Engineering Division raised a flag to his idea of planting avenue trees, indicating the presence of underground power cables, he wrote on the file: "Cables can be replaced". Even his 8am-5:30pm PED Shift was accepted without a murmur. That was his charm. He did not hesitate in offering a lift, even to bunking employees. Of course, they stopped bunking after that.

At times he found pleasure in addressing duty officer meetings, sitting on a table with his foot on a chair, even as Director, VSSC – something that would have got VSSC "cool workplace" brownies had it been today. "Brainstorming Room", read the signboard outside his cabin. It indeed was. He was a step ahead of others – back in the seventies he started working on green energy, and trying to convert oils from non-edible seeds into biofuel. He called it space crude. Even after four decades, he believed that biofuels can reduce petroleum imports. Back in the 1970s, much before the advent of fuel cell technology, he initiated a programme for split-

ting of water into hydrogen and oxygen.

Dr. Gowariker was a protege of Dr. Vikram Sarabhai, who recruited him from the UK. Dr. VRG started propellant engineering and pyrotechnic research in the then Space Science and Technology Centre (SSTC). He pioneered the development of solid propellants in the country and created an illustrious band of scientists and technologists for India's rocket related programmes. But for his solid propellants, ISRO would not have been what it is today. He started propellant research from scratch starting with cordite. After numerous experiments with various composite propellant formulations, the final recipe using Hydroxyl Terminated



Dr. Gowariker addresses the VSSC community

Polybutadiene (HTPB) was chosen as the benchmark. HTPB-propellant provides energy for ISRO's huge solid motors including the S-200 motor used in GSLV-Mk-III CARE mission. To make resin in-house, he created the Propellant Fuel Complex. He established the Ammonium Perchlorate Experimental Plant (APEP) at Aluva to produce the much needed oxidiser. He founded the Polymer Complex to research on the fine chemicals needed for space research. Dr. VRG made ISRO self sufficient in chemicals and materials.

Under him, the Propellant Engineering Division (PED), in his own words, "was just a cub". He envisioned the cub growing into

a lion in a video shown at the inauguration of SPROB (Solid Propellant Rocket Booster Plant). True to his dream, the PED has now grown into a 'lion'.

He succeeded Dr. Brahm Prakash as the second Director of VSSC. Dr. Satish Dhawan, a close associate and a tall senior colleague of Dr. Gowariker, was then the Chairman of ISRO. After leaving VSSC, he had a short stint at the Stanford University, on deputation from ISRO. Later he served as the Secretary, Department of Science and Technology, Scientific Adviser to the Prime Minister PV Narasimha Rao, and the Vice Chancellor of Pune University. Even after retirement, he had a lot of energy and out of the box thoughts. He created the Fertilizer Encyclopedia and the Pesticide Encyclopedia.

No one who has known Gowariker can ever think or say anything but praise for the great handsome-gentleman-scientist-administrator. He was a rare blend of technology, science, management and humility. He was the man behind the country's first monsoon forecast model, and was famously known as the 'Father of Indian Monsoon Model'. He started the National Science Day celebrations which have come to stay. He was one step ahead of all. He kept that precedence even in his death. He died on January 2, one day ahead of the death anniversaries of Dr. Brahm Prakash and Dr. Satish Dhawan, two of his great associates, who died on January 3, though in different years.

May his great soul rest in peace.

## Dr. Vasanth Ranchhod Gowariker : bonnes mémoires

Dr. C. Reghunadhan Nair, Group Director, VSSC

On this occasion, with a mixed feeling of sorrow, and gratitude to the departed soul, I, on behalf of the chemical community of ISRO pay immense homage to Dr. Vasanth Ranchhod Gowariker who left us on 2nd January 2015 for heavenly abode. By the passing away of Dr VRG, the country lost the doyen of solid propulsion, a great leader and an unparalleled visionary. The chemical community's existence and its significance in ISRO were made felt by this great chemical and propellant engineer. He was a great visionary, a fine human being and a dignified person with firm commitment to whatever job he had undertaken. Though, I did not have the fortune to get myself associated with him and thus get benefited, I have heard a lot about him from the erstwhile PED colleagues for whom he was a god seen, a god that wished their welfare. Bosses are seldom remembered, revered, but VRG made an exception to that belief. I have seen people urging to declare themselves as close associates of VRG even after a quarter century of his leaving VSSC!

A wonderful human being, a wonderful mentor, and a great leader - that's what Dr VRG was for the people who had the fortune of working with him. For others like

the thief ( no more a thief after) who broke into his house in Trivandrum in early seventies, he was a life changer. He was adored by all even outside office and a story had gone around that the militant head load workers refused to accept wages from him, which he had to thrust into their pockets.

A true nationalist who believed in indigenous technology and

the man who is rightfully called the father of India's solid propellant technology, Dr.

Gowariker was the role model for the PED chaps some of whom mimics his voice even now. Though a fatherly figure to many, he treated his mentees as equals and called them by their first names. The boss who spoke with his arms on their shoulders, the boss who treated them to coffee at his home, the boss who spent money from his own pocket to reward them for their professional successes, the boss for whom they would work long hours without cribbing - Dr. VRG was a boss that anyone would dream of having. The PED Fund which grew into the VSSC Benevolent Fund, Count-

down - VSSC's house magazine which still chronicles the successes and failures of the Center, the tree-lined avenues at 70 acre area - Dr. VRG's legacy lives through these and many more. He did not hesitate in offering a lift, even to bunking employees. Of course, they stopped bunking after that. He was a step ahead of others - way back in the seventies, he started working on green energy,

and trying to convert oils from non-edible seeds into biofuel. He called it space crude. Even after four decades, he

believed that biofuels can reduce petroleum imports of India. He was busy in this effort even when he breathed his last.

I have learnt that Dr. Gowariker was a protégé of Dr. Vikram Sarabhai, who recruited him from the UK. Dr. VRG started propellant engineering and pyrotechnic research in the then Space Science and Technology Centre (SSTC). He pioneered the development of solid propellants in the country and created an illustrious band of scientists and technologists for India's rocket related pro-

grammes. But for his solid propellants, ISRO would not have been what it is today. He started propellant research from scratch starting with cordite. Now we have reached the level of S-200 motors. To make resin in-house, he created the, SPROB, Propellant Fuel Complex. He established the Ammonium Perchlorate Experimental Plant (APEP) at Aluva to produce the much needed oxidiser. He founded the Polymer Complex to research on the fine chemicals needed for space research. Dr. VRG made ISRO self sufficient in chemicals and materials. Thanks to him, most of us have seen the floors of VSSC.

His words - Tiger is behind us, To strive, to seek, to find and not to yield ring in our ears for ever and ever. Indeed a Great soul with qualities seen only in sadhus and maharshees only. It is believed that such men are born only once in a thousand years!. But for us, it is difficult to wait another thousand years for his reincarnation.

He will live in our memories forever as long as sun and moon are there. We express our heartfelt condolences to the bereaved family and pray that his soul rest in the everlasting peace.

*The author is thankful to Shri V.P. Balagangadharan for sharing many information on Dr. Gowariker*

## Dr. Gowariker, a philosopher, a thinker and a man full of virtues

Dr. V.V. Karunakaran, VSSC (Rtd.)

I am very much saddened by the passing away of this towering personality greatly admired especially by the old PED lot of the ISRO community. We were an inspired lot under him. I was fortunate to have worked under him from the day I joined ISRO till he left for taking up assignment as the adviser to PM. After our training from BARC when I joined ISRO I remember the first day when I met him at the Main Building in

1972 and formed a great impression in my mind. We enjoyed working under him. I was deeply influenced by him learnt to be committed in all my career. He laid the foundation for indigenization and becoming self reliant in Rocket Technology. I also remember my last meeting him in 1988 when he was handed over a few pictures of ISRO Polyol Plant set up at Kuttippuram under Technology Transfer.

He was remarkably a philosopher, a thinker and full of virtues. He believed that whatever work done for Space must benefit humanity at large and drove all to pursue this. We remember the old PFC/PED days when we used to be called to his house for the early completion of targets. I used to admire him. His was a life of dedication and missionary zeal. By his passing

away we the Space Community, have lost a great human being a great son of our Country and patriot.

We can only pray for the departed soul and offer our heartfelt condolences to the bereaved family. We offer our humble and floral tributes. His portraits should be adorned and decorated and that way we can pay respects to this leader of ours.

## Tributes

He was such a towering personality! It is a great loss for the Indian Scientific and engineering communities. I fondly remember a few a few things. Though I was in RPP, he used to be friendly and benevolent. My interactions with him as General Secretary of SEA were conducive, though he was not for it. Duty officer System and & 70 Acre promenade with canopy of trees will ever speak of him!

It was a great honour and I cherish that I occupied the chair decorated by him. Though I had opportunities to have become Head of any other Division, I was adamant and patient to become Head, PED!

Maybe, Almighty wanted him now! I pray for his soul RIP.

*Dr.Rm.Muthiah, VSSC (Rtd.)*

Yes, Very sad. I am shocked. I feel today as though I lost my father a second time in my life. My mentor - Oh no - "My God". His words - Tiger is behind us, To strive, to seek, to find and not to yield ring in our ears for ever and ever. Great Man. His mission on this planet is over - and I am sure God the Almighty wanted to give Him a bigger mission in his New Abode above.

*Sastri KS, VSSC (Rtd.)*



A Jewel of ISRO is lost. Sad to know, heartfelt condolences. He put the foundation of the ISRO culture which is behind

its all successes. Loved by all his colleagues. Who met him once, appreciated his humane and dignified approach. Prey

God bless is soul. Rest in Peace.

*Dr. Desh Deepak, VSSC (Rtd.)*

I am saddened to hear the passing away of our dear Dr VRG. I know him for more than 3 decades now right from the time when he was my boss to much later when he was still working on space crude project from Pune. Each time I met him I was awed by his tireless commitment his love for work and his urge to contribute to society. He was my inspiration during my early formative years as scientist at VSSC till today. many things i learnt from him like an Ekalivya. My heartfelt condolences to his family. May God use him more effectively with him in heaven.

*Alwan.S, VSSC (Rtd.)*

## Memories



*Dr. Gowariker with Ambassador of France to India, Mr. Andre Ross at VSSC*



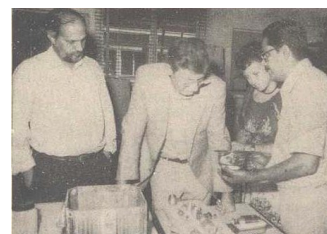
*Dr. Gowariker with Mr. Vladimir Aleksandrovich Kotelnikov, a pioneer in information theory and radar astronomy*



*Dr. Gowariker welcomes the then President of India, Shri Giani Zail Singh to VSSC*



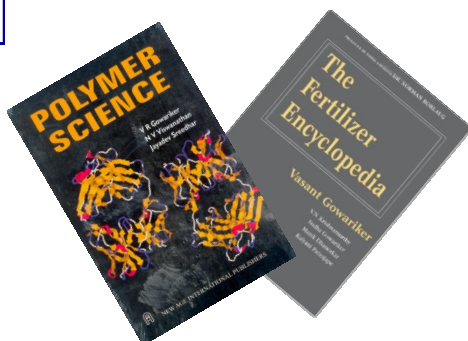
*Dr. Gowariker with the then Ambassador of India to USA, Shri K. R Narayanan*



*When the then ESA Director General Mr. Erick Quistgaard visited VSSC*

*All photographs in this page are credited to Technology Transfer and Documentation Group, VSSC and VSSC in-house magazine, COUNTDOWN*

## Major Publications of Dr. Gowariker as Author/Co-author



1. Rocket propellants and other chemicals for Space Technology
2. Out into space by rockets
3. Polymer Science
4. Inevitable Billion Plus : Exploration of interconnectivities and action possibilities
5. New materials : Focus on advanced composites and structural ceramics of relevance to India
6. Katha ISRO ki
7. Fertilizer encyclopedia : Overviewing plant growth, soil fertility, fertilizer chemistry, nutrient management and environmental issues



## “Stimuli-Responsive Drug Delivery Systems Derived from Clay, Chitosan and Superparamagnetic Iron Oxide Nanoparticles: Synthesis, Characterization and *in vitro* Drug Release Studies”

Dr. Sandeep S, National Test House (SR), Department of Consumer Affairs, Government of India, Chennai-600113

The main problems currently associated with the general systemic distribution of therapeutic drugs are the lack of drug specificity towards a pathological site, the necessity of a large dose to achieve high local concentration, nonspecific toxicity and other adverse side effects. Current attempts to solve these problems are focusing on the use of targeted and controlled drug delivery system.

In controlled drug delivery systems, the active agent is released in a pre-designed manner. The controlled drug delivery systems draw increased attention due to its enhanced efficacy of existing potent drugs at lesser expenses and fewer dosing schedule. Controlled delivery system maintains the drug level in the blood between the maximum and minimum therapeutic levels at a minimum dosage for an extended period of time. Conventional delivery system provides fluctuated drug level in the blood, either exceeding the maximum or falling below the minimum therapeutic level, resulting in toxic side effects or inefficacy. A very effective way of achieving site-specific drug targeting and controlled drug delivery is by employing stimuli-responsive polymers. The use of stimuli-responsive drug delivery systems offers an interesting opportunity for drug delivery where the delivery system becomes an active participant,

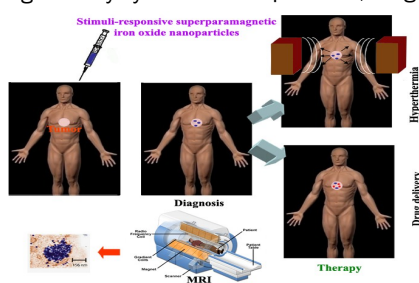


Fig. 1. Schematic representation of the drug-loaded superparamagnetic iron oxide nanoparticles localization by MRI followed by the treatment of the tumour either by hyperthermia or by the drug release

rather than passive vehicle, in the optimization of therapy. Several families of molecular assemblies are employed as stimuli-responsive drug delivery systems for either passive or active targeting. Although there are many responsive elements that can be incorporated in synthetic materials or modified biopolymers, much of the research to date has involved pH, temperature, magnetic field or light as the stimulus. Superparamagnetic iron oxide nanoparticles (SPIONs) based DDS are emerging as promising candidates for targeted drug delivery, due to their ultra fine sizes, biocompatibility and superparamagnetic behavior. In the context of *in vivo* biomedical applications, an ideal biocompatible stimuli-responsive and SPIONs system is able to the monitoring, the kinetics and biodistribution of the medication in the organism non-invasively using MRI followed by the treatment which can be made by different ways such as the local drug delivery using the sensitive properties of the polymer and thus, preserving most of the healthy tissues and cells or hyperthermia. Figure.1 illustrates the action of an ideal magnetic system for *in vivo* biomedical applications.

As in nature, the bulk response of the polymer is usually due to multiple co-operative interactions such as progressive ionization or loss of H-bonding,

which although individually small, ultimately evoke a large structural change in the material when summed over the whole polymer. This behavior intrinsically lends itself to biomedical applications and in this article the aim is to highlight the merits of clay, cyclodextrin, chitosan and superparamagnetic iron oxide nanoparticles based stimuli-responsive drug delivery systems in targeted and controlled release of anticancer, antibiotic and protein drugs for bringing these materials into therapeutic use.

In order to exploit the potential of host-guest interaction of cyclodextrin molecules and the controlled release property of sodium montmorillonite, we have developed a novel composite hydrogel (CH): namely, maleated cyclodextrin-grafted silylated montmorillonite (MACD-g-MPTMS/MMT) for colon specific tetracycline hydrochloride (TCH) drug delivery [1]. This was achieved by an intercalation method as follows, Figure. 2

The CH was characterized by using techniques such as Fourier transform infrared spectroscopy (FTIR), scanning electron microscope (SEM) and X-ray diffraction (XRD). Effect of pH on the encapsulation of TCH was studied and found to be maximum at pH 3.0. The study of the surface morphology of CH using SEM showed an irregular and rough surface morphology, which favors TCH drug loading. In TCH loaded CH, the shift of FTIR bands of amide I and II in comparison to crystalline TCH suggested a strong interaction between the amide

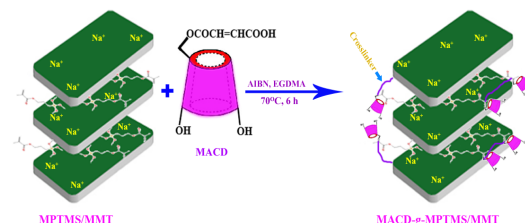


Fig. 2. Proposed reaction scheme for the preparation of MACD-g-MPTMS/MMT

groups and the clay surfaces. The swelling behavior of CH was measured in different media and found to be maximum at pH 7.4. The release profile of TCH from the drug loaded MACD-g-MPTMS/MMT composites hydrogel in different pH buffers is shown in Figure 3. It can be observed from the release profile that the amount of drug released from the composites hydrogel is higher in pH 7.4 buffer solutions than in pH 2.4 buffer solution.

The drug delivery results demonstrated that CH could successfully deliver TCH to the colon without losing the drug in the stomach, and could be a good candidate as an orally administered drug delivery system. Results showed that the prepared CH showed good biocompatibility in the range 10-75 µg/ml, being also able to effectively stimulate cell proliferation.

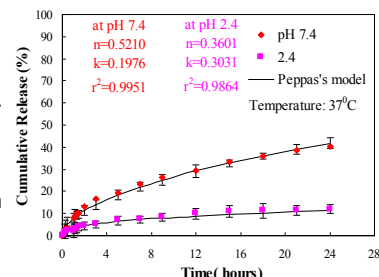


Fig.3. Releasing profiles of TCH from the MACD-g-MPTMS/MMT at pH 2.4 and pH 7.4, the lines are based on the fitting of Peppas's empirical model

A novel pH-sensitive composite hydrogel (CH), namely 2-Acrylamido-2-methylpropane sulfonic acid (AMPS) grafted N-maleoylchitosan (MACTS) intercalated montmorillonite

## Stimuli-Responsive Drug Delivery Systems... (contd. from page 9)

nite has been synthesized by in-situ intercalation graft copolymerization of AMPS with MACTS intercalated MMT (MACTS/MMT) by using potassium persulfate (KPS) as a free radical initiator, in the presence of N,N-methylenebisacrylamide (MBA) as a crosslinking agent[2]. The reaction scheme is shown in Figure 4.

A hydrophilic anticancer drug, 5-fluorouracil (5-FLU), has been chosen to investigate the loading and release

properties of the CH. The CH formation and 5-FLU loading ability of CH have been confirmed by FTIR. XRD analysis supports the intercalation reaction of MACTS with MMT, since after intercalation reaction there is an increase in basal spacing. SEM image of drug loaded CH shows a smoother surface whereas blank CH has cracked and rough surface, this reveals the high affinity of 5-FLU to CH.

The encapsulation efficiency of CH reaches the maximum value of 94.0% with CH prepared using 4.0 g of MACTS/MMT, 1.5 g of AMPS, 0.75 g of MBA and 75.0 % of drug loading. Swelling profiles obtained shows that the CH swelling rate increase with increases of pH up to 6.4 and then start to decrease. Release profiles of 5-FLU from CH have been studied under both simulated gastric and intestinal pH conditions. The results obtained show that the release rate of the loaded drug molecules was slow at pH 2.4 but increased significantly at pH 7.4.

The cell viability test displayed

that the 5-FLU loaded CH exhibited an enhanced cell inhibition than that of pure 5-FLU. Figure. 5 shows the cell viability using human colon cancer cells (HT-29) by MTT assay. It could be seen that the blank AMPS-g-MACTS/MMT has no appreciable suppressing effect. However,

when the amount of blank AMPS-g-MACTS/MMT increased from 0.1 to 0.2 g shows a very little suppressing effect. However, when 25 and 50  $\mu\text{g}$  of 5-FLU loaded

AMPS-g-MACTS/MMT composite hydrogel samples have a better suppressed effect than 25 and

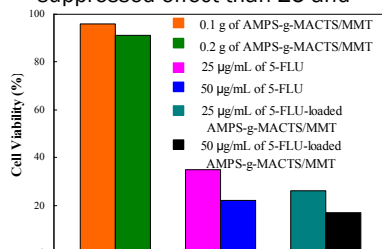


Fig. 5. Cell viability of HT-29 colon cancer cells

50  $\mu\text{g}$  of 5-FLU alone. This is due to the presence of MMT in the polymer matrix, since the presence of clay mineral enhanced cellular uptake efficiency of the polymer. The studies described in the paper demonstrate the potential viability of a pH-sensitive CH carrier for colon specific anticancer drugs.

A novel MIP matrix, namely protein-imprinted N-maleoylchitosan grafted-2-acrylamido-2-methylpropanesulfonic acid polymer matrix (MIP) was prepared by using bovine serum albumin (BSA) as a template [3] and

mechanism for the preparation is proposed.

The characteristics of the MIP were investigated using FTIR, SEM, XRD and Zeta Potential Analyses. The effects of monomer to template ratio, cross linking density, porogen, pH and ionic strength on the loading of BSA into MIP were investigated. The adsorption studies showed that MIP exhibit good recognition for BSA, as compared to non-imprinted polymer (NIP). The experimental adsorption isotherms of BSA onto MIP and NIP were determined and well fitted by Sips isotherm model with a maximum binding capacity of 113.51 mg/g for MIP and 76.39 mg/g for NIP. A pseudo-second-order kinetic model adequately described the kinetic rate in comparison to a pseudo-first-order model. In vitro release profiles of model drug from the MIP, was investigated in physiological buffer solution using an UV/vis spectrophotometer. The changes in the rate of release of BSA from the MIP were studied at the pH 3.4 and 7.4 (Physiological buffer solution). The MIP showed rapid swelling/deswelling dynamics in response to the changes of pH. It is proved that the faster release of BSA could be obtained from MIP at pH 7.4. Changing the pH of MIP contains medium leads to changes in the repulsive forces exerted by the carboxyl and sulfonate groups, which results slow and fast release of BSA at pH 3.4 and 7.4, respectively. In addition, the release mechanism of drug was analyzed by

fitting the amount of drug released into Peppas's empirical equation.

The primary inadequacy of chemotherapeutic drugs is their relative nonspecificity and potential side effects towards healthy tissues. To overcome this, in this study a novel drug delivery system, namely, carboxymethyl chitosan capped superparamagnetic iron oxide nanoparticles intercalated montmorillonite nanocomposites (CMCS-capped-MNP/MMT) was developed and characterized by Transmission Electron Microscopy (TEM), Dynamic light scattering (DLS), FTIR, XRD, Small-angle X-ray

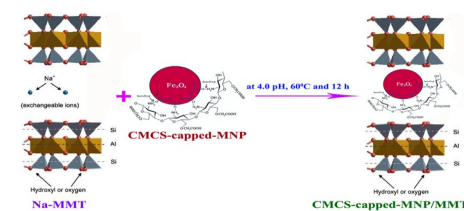


Fig. 6. The proposed reaction scheme for CMCS-capped-MNP intercalation with Na-MMT

scattering (SAXS), Zeta potential analyzer and Superconducting quantum interference device (SQUID)4. Figure 6 shows the proposed reaction of CMCS-capped-MNP/MMT preparation.

The magnetic properties were also characterized using an external magnetic field. As illustrated in Figure 7. without the presence of a magnetic field, CMCS-capped-MNP/MMT particles were homogeneously dispersed in the PBS solution.

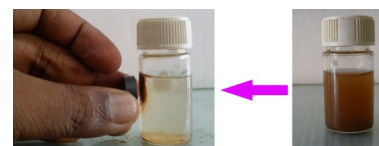


Fig. 7. Photographs of the CMCS-capped-MNP/MMT nanocomposites solutions. The CMCS-capped-MNP/MMT is easily dispersed in water and also can be drawn from the solution to the sidewall of the vial by an assistant magnet field

was analyzed by

## Stimuli-Responsive Drug Delivery Systems... (contd. from page 10)

After applying a magnetic field, most of the CMCS-capped-MNP/MMT particles were drawn to one side of the vial closer to the permanent magnet after 5 minutes. Removing the magnet, CMCS-

capped-MNP/MMT particles went back to dispersed state again. Effective and reversible responses to magnetic field were proven.

The optimum pH value for the encapsulation of doxorubicine (DOX) into CMCS-capped-MNP/MMT was examined. The controlled release behavior of DOX was examined at pH 5.0 and 7.4. The release rate of the loaded drug molecules was slow at pH 7.4 but increased significantly at acidic pH 5.0. The cytotoxicity of DOX-loaded-CMCS-capped-MNP/MMT towards MCF-7 cancer cells was investigated. The results showed that DOX-loaded-CMCS-capped-MNP/MMT retained significant antitumor activities. Figure 8 shows the confocal laser scanning microscopy images of HeLa cells after 4 h incubation with coumarin-6-loaded CMCS-capped-MNP/MMT nanocomposite at 250 µg/mL concentration, in which the image (A) was obtained from PI channel (red), the image (B) was from FITC channel (green), and image (C) was the combination of the two images. We can see from this Figure 5.13 that the fluorescence of the coumarin-6-loaded CMCS-capped-MNP/MMT nanocomposite (green) is closely located around the nuclei (red,

stained by PI), which indicates that the nanocomposite have

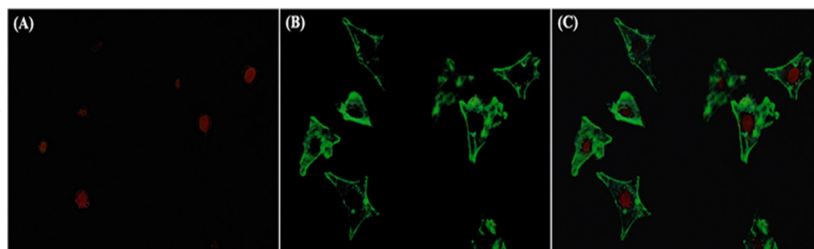


Fig. 8. Confocal laser scanning microscopy (CLSM) of HeLa cells after 4 h incubation with coumarin 6-loaded CMCS-capped-MNP/MMT nanocomposites at 250 µg/ml concentration. The image (A) was obtained from propidium iodide (PI) channel (red), which shows the nuclei; image (B) one was obtained from FITC channel (green), which shows the coumarin 6-loaded-CMCS-capped-MNP/MMT, and image (C) is combined from image (A) and (B)

been internalized by the cells, which are located in the cytoplasm around the nucleus after 4 h cell culture

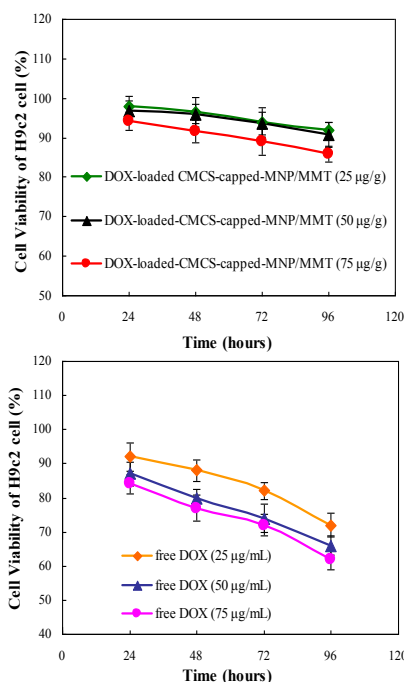


Fig. 9. Results of cardiomyocyte viability assay of DOX and DOX-loaded-CMCS-capped-MNP/MMT on H9c2 cells

The effects of DOX and DOX-loaded-CMCS-capped-MNP/MMT on H9c2 cell death were investigated by using microplate reader. The heating characteristics of the magnetic nanocomposites were investigated in a high frequency alternating magnetic gradient; a stable maximum temperature of

450C was successfully achieved within 40 min. The study demonstrated that CMCS-capped-MNP/MMT not only a good delivery system for DOX but also appears to be a promising strat-

egy for protecting against oxidative injury observed in DOX induced cardiotoxicity, shown in Figure 9.

### Conclusion

The works reported in this article is mainly devoted to the synthesis, characterization, in vitro and controlled release behavior of stimuli-responsive drug delivery systems for clinical administration of anticancer drugs, antibiotic drugs and protein drugs. From the results obtained so far, the developed novel drug delivery systems demonstrated the feasibility as an efficient drug delivery system. However, it would be more convincing for the clinical application of these drug delivery systems if in vivo experiments could be done to support the existing evidences of feasibility. The biodistribution study can identify how the drug administered is distributed in the body after administration. Thus, the efficacy of drug delivery system can be further evaluated. Tissue engineering utilizes hydrogel scaffolds for bioactive molecule delivery which allows for very specific localized delivery. So, future work needs to be done to establish whether the prepared novel molecularly imprinted hydrogel is most ef-

fective for tissue engineering or not.

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Dr. Sandeep S is the 2014 SPSI Gold Medal Award winner for the Best PhD Paper by SPSI Thiruvananthapuram Chapter

## Chapter News

### Polymer Conference for Young Researchers-PCYR-14



Release of the Souvenir



Invited speakers delivering the lectures



Best Poster award winners receive certificates from Dr. A. Ajayaghosh. From left to right: Kum. Sheeba Alexander; Shri Ramakrishna S and Shri S.S. Vaisakh

In keeping with its tradition of organizing unique activities beneficial to academic and student communities, a novel form of Conference was organized by SPSI Thiruvananthapuram Chapter. It is Polymer Conference for Young Researchers (PCYR-14). The Conference was intended to promote polymer research among the young and sprouting researchers within India. The Conference gave young researchers a unique opportunity, first in their career, to deliver invited lectures to an august audience.

The Conference was attended by more than 100 students and researchers from both within and outside Kerala. Dr. C.P. Reghunadhan Nair, Group Director, VSSC gave an informative keynote address on polymers and space research.

6 researches were invited to give talk on their research findings as part of their Ph.D work. Shri Rahul Dev Mukhopadhyay of NIIST, Thiruvananthapuram spoke on mesoscale

self-assembly of photoreponsive co-ordination polymers while the topic of Kum. Dhanya Augustine of VSSC was "Mechanistic and Kinetic Aspects of Propargyl-mediated curing of Phthalonitrile Resin". Smt. Parvathy J of Department of Chemistry, University of Kerala talked on functionalized polysaccharide/clay formulations as novel drug carriers for potential applications in myocardial infarction, asthma, diabetes, hypertension and antimicrobial infections. The topic of presentation of Smt. Deepalekshmi Ponnamma of Mahatma Gandhi University, Kottayam was "A solvent sensor from natural rubber carbon nanotube nanocomposite" whereas Shri Finosh G T of SCTIMST, Thiruvananthapuram spoke on the topic alginate-polyester co-macromer based chimeric hydrogel

scaffolds, which is a new generation template for cardiac revitalization. Shri Raneesh Konnola of IIST gave a talk on covalent integration of polymers on carbon nanofillers for improving fracture toughness of epoxy nanocomposites.

More than 30 posters from M.Sc, M.Phil and Ph.D students were presented in the second session of the Conference. Three posters were selected as Best Posters and Certificates were distributed to the award winners. Kum. Sheeba Alexander, Department of Chemistry, University of Kerala, Shri S. Ramakrishna, VSSC and Shri S.S. Vaisakh, Material Science and Technology Division, CSIR-NIIST. received the Best Poster Awards

The overwhelming response of the Conferences prompted the Chapter to continue the Conference in coming years thereby giving opportunity to the researchers to present papers as invited speakers.

### Prof. Pulickel Ajayan Felicitated



Prof. Ajayan delivers the talk



Shri V. Srinivasan, President, HEMSI Thiruvananthapuram Chapter presents a memento to Prof. Ajayan

It was yet another moment of joy for all the SPSI members when the Thiruvananthapuram Chapter joined hands with Materials Research Society of India (MRSI), Kerala Academy of Sciences (KAS) and High Energy Materials Society of India (HEMSI) to felicitate one of the pioneers in materials research, Prof. (Dr.) Pulickel M. Ajayan, who visited Thiruvananthapuram on August 2014. Dr. Ajayan is the Professor in Department of Materials Science and Nanoengineering, Rice University, USA.

Professor Ajayan talked in detail on the research on materials science with atomic layers

where he spoke on the applications of various nanolayers on energy storage and related applications. He described his research on carbon nanolayers such as graphene and inorganic nanolayers based on boron nitride. He spoke on nanotechnology enabled energy storage devices (battery, supercapacitor and hybrid devices), nanocomposites, layered materials, 3D nanostructured materials, and smart material systems

Members of HEMSI, MRSI, KAS and SPSI in large number attended the talk. Dr.

A. Ajayaghosh, President, SPSI-Thiruvananthapuram Chapter, Dr. Oommen V. Oommen, President, KAS, Dr. V. Sreenivasan, President, HEMSI and Dr. T.D.P. Rajan, MRSI spoke on the occasion and felicitated Dr. Ajayan.

Dr. Ajayan congratulated the chapters in their active role in promoting science among youngsters and actively took part in the interaction session. A memento was presented to Prof. Ajayan on behalf of all the societies.

## Awards and Honors (July-December 2014)

- Dr. A. Ajayaghosh, NIIST, Thiruvananthapuram has been awarded the Indian Society of Analytical Scientists (ISAS) National Award for Excellence in Science and Technology.
- Dr. A Ajayaghosh shared the annual award instituted by the Third world academy of sciences (TWAS) in chemistry with Dr. Chung-yuan Mou of Department of Chemistry, National Taiwan University, Taipei, Taiwan.
- Dr. Roy Joseph and Mr. C.V. Muraleedharan, SCTIMST, Trivandrum have won the fourth National Award for the Technology Innovation in Petrochemicals & Downstream Plastic Processing Industry under the category 'Polymers in Public Health Care'. They received the award for the development of "Fluoropolymer Coated and Hydrogel Sealed Vascular Graft Implant."
- Dr. T S Anirudhan and team, Department of Chemistry, University of Kerala, have received four Best Paper Prize Awards in various national/international conferences.
- Dr T S Anirudhan has been nominated as (I) Dean, Faculty of Science, University of Kerala (II) Co-ordinator of Inter University Center for Advanced Materials Research (III) Chairman of the 'Admission Monitoring Committee' for admission to all PG and M.Phil degree courses (IV) Chairman of the Committee for Students Grievance Redressed Cell, University of Kerala.
- Dr. Bhoje Gowd, NIIST, Thiruvananthapuram and team have won two Best Paper Awards in national/international conferences.
- Smt. K.Indulekha, VSSC won Best Paper Award in the 2nd Indian International Symposium on Fluorine Chemistry (IISFC-2014) held at IICT, Hyderabad and National Seminar on Frontiers in Polymers and Advanced Materials (FPAM-2014) organized by Department of Chemistry, University of Kerala.
- Smt. Sandhya C.P, VSSC, has won Best Paper Award in the National Seminar on Recent and Emerging Advances in Chemical Science", 8-9 January, 2015, Trivandrum

## Academic and Technical Contributions of Chapter Members (July-December 2014)

### Technical support for National Seminar

- Thiruvananthapuram Chapter extended technical support to the National Seminar on Frontiers in Polymers and Advanced Materials (FPAM-2014) organized by Department of Chemistry, University of Kerala during 5-7 November 2014. Many of the SPSI members have given invited talks and contributed papers.

### Book Chapters/Review papers

- Dr. T.S. Anirudhan, J. Nima, and P.L. Divya, "Synthesis and characterization of a sulfonyl-terminated polymer-grafted-magnetic nanocellulose and its application as a pH-responsive antibiotic drug carrier for the controlled delivery of ciprofloxacin" Cellulose-Based Graft Copolymers: Structure and Chemistry (Taylor & Francis Group) 2014
- "Lithium titanate as anode material for lithium-ion cells: A Review", Sandhya. C.P., Bibin John, Gouri. C, Ionics, 2014.

### Publications in international journals

- Dr. C.P Reghunadhan Nair and team, VSSC, published 18 papers.
- Dr. T S Anirudhan and team, University of Kerala, published 15 papers.
- Dr. J.D Sudha and team, NIIST, published 15 papers .
- Dr. Santhosh Kumar KS and team, VSSC, published 5 papers.
- Dr.A.R.R Menon and team, NIIST, published 2 papers
- Smt. Temina Mary Robert and team, VSSC, published 2 papers

### Presentations in national/international conferences

- Dr. C.P. Reghunadhan Nair and team have presented 25 papers/posters.
- Dr. T S Anirudhan and team have presented 27 papers/posters.

### Patents

- Dr. C.P.Reghunadhan Nair and team filed/submitted 8 Indian patents.

### Popular Articles

- C.P.Reghundhan Nair, Polymer Technique, Mathrubhumi newspaper, Vidyapage, vol 30, 21 August 2014
- C.P.Reghundhan Nair, "രസതന്ത്രം നമുക്കു ചുറ്റും"(Rasathnthrathiram Namukku Chuttum), , Balarama Digest (Malayala Manorama), exclusive volume, pp 1-50, Nov 15-22, 2014.
- Dr. A Jayakrishnan, "Free Science from Oligarchy", opinion in The New Indian Express, December 1, 2014.

### Seminars/talks organized during July-December 2014

- Polymer Conference for Young Researchers (PCYR-14) on 18-10-2014
- "Particle Diffusion in Colloid Gels" , Dr. Dominique Durand, Research Director Emeritus, UMR CNRS – University of Maine, France, on 26-10-2014
- "Chemical Modification of High Performance Polymers by Click Chemistry" , Dr. Prakash P. Wadgaonkar, Chief Scientist, CSIR-NCL, Pune on 07-11-2014
- "Functional Materials from Renewable Resources: The Sustainable Approach", Dr. KI Suresh, Sr. Scientist, IICT Hyderabad on 07-11-2014.

The above lists are incomplete. Please provide details of the awards, honors, achievements and publications of Chapter members to publish in the Newsletter. Please send the details to [spsitvm@gmail.com](mailto:spsitvm@gmail.com)



*A newsletter of the Society of Polymer Science, India, Thiruvananthapuram Chapter*

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[www.spsitvm.org](http://www.spsitvm.org)  
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## ഒരു രസതന്ത്ര കവിത

(പ്രിയ രസതന്ത്ര അധ്യാപകന്മാരുടെ ജന്മദിനത്തിനു ആശംസകൾ നേർന്നു കൊണ്ട്)

ഒരു പുതു രസതന്ത്രദിനം ജൈനിയോളിൻ സൗരഭം പരത്തുമ്പോൾ...  
 ഒരു പേറ്റന്റോവിൻ ആനന്ദത്തിൽ പുളകിതയാകുമ്പോൾ  
 ഹോട്ടോസിനസിസിൻ സ്മിൾമോം ഊഷ്മളതയാൽ  
 കേട്ടോ! ഞങ്ങളോർക്കുന്നു അങ്ങയെ ലൂയി പാസ്റ്ററെപ്പോൾ

അർക്കനാൽ അന്യഗ്രഹിതമിദിനം നമുക്കെല്ലാം പ്രിയ രസതന്ത്രദിനം  
 അർഹതപ്പെട്ടൊരിദിനം... അങ്ങയ്ക്കു ഉയർന്ന വിഹായസ്സുപോൾ...  
 ഊർജ്ജവും ദൃഢിയും നൽകിയന്യരാക്കി ഫാരവെയെപ്പോൾ  
 ഞങ്ങളോർജിച്ചു വിദ്യാധനം ബൻസിൻ തന്മാത്രപോൾ...

സർപ്പവും നൽകുന്ന അരുമയാം പ്രകൃതിയെപ്പോൾ  
 സർപ്പം സദാ കാര്യബുദ്ധ്യേനാം അങ്ങു സമ്പൂജ്യനായ്  
 രാസവിദ്യാമൂലം നവ ജീവവായുവും പകർന്നു  
 രാസകരമാക്കി ജീവിതം രാസ സൂത്രങ്ങളാൽ

ബഹുമാന-സ്മേഹ നിർഭര മനസ്സാൽ... വന്ദിക്കുന്നു  
 ബഹുലക രാസസൂത്രമോതിയാ മനസ്സിനു നന്ദി..  
 വിരിയട്ടെ! ആ ജീവിതത്തിൽ ഒരായിരംപൂക്കൾ!  
 പൊതിയട്ടെ! സന്തോഷപ്പൂക്കളങ്ങയെ തയൊഹിൻ തന്മാത്രപോൾ! .....

ഈ ദിനം മാത്രമേ,..... കല്പാന്തകാലത്തോളവും.....

ഡോ.സി.പി.രഘുനാഥൻ നായർ

## Condolences

SPSI Thiruvananthapuram Chapter deeply mourns the sad demise of Prof. (Dr.) S.S Bhagawan, who was one of the active members of the Society right from its inception. Before joining the Coimbatore campus of Amrita School of Engineering, Prof. Bhagawan was working as Scientist at Vikram Sarabhai Space Centre, Thiruvananthapuram. Prof. Bhagawan expired on 3rd September 2014. Our condolences to the bereaved family



## Superannuation



Dr.A.G. Rajendran, Group Director, VSSC, superannuated from service on 30th November 2014. SPSI wishes Dr. Rajendran a happy, prosperous and purposeful retired life. Hope that Dr. Rajendran can spend more time in the activities of SPSI during their retired life.

### SPSI Thiruvananthapuram Chapter Officer bearers—2014-'16

President	:	Dr. A. Ajayaghosh (Director-grade Scientist, NIIST)
Vice President	:	Prof. (Dr.) T.S. Anirudhan (University of Kerala)
Secretary	:	Shri R. Muraleekrishnan (VSSC),
Treasurer	:	Dr. R.S. Rajeev (VSSC),
Joint Secretaries	:	Dr. Roy Joseph (SCTIMST) and Dr. J.D. Sudha (NIIST)
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