Vasant R. Gowariker (1933–2015)

In the passing away of Vasant R. Gowariker on 2 January 2015, India has lost a multi-faceted personality who left indelible marks in a host of disciplines, which included solid propellant rockets, polymer science, science administration as well as education.

Vasant Ranchod Gowariker was born in Pune on 25 March 1933 and had his early education in the princely city of Kolhapur. His Master's degree and Doctoral research work were carried out in chemical engineering in the University of Birmingham, UK. After obtaining his Ph D, Gowariker joined the Theoretical Physics Division of the Atomic Energy Research Establishment at Harwell. He subsequently moved to Imperial Metal Industries (Kynoch) Ltd of the Summerfield Research Station, Kidderminster as Senior Technical Officer in the Ballistics and Mathematical Services Department. The young Gowariker was active in research those days in topics related to heat and mass transfer as well as solid rocket graphite nozzle erosion. He was also interested in mathematics and was elected as an Ordinary Member of the American Mathematical Society in 1963.

Along with the Thumba Equatorial Rocket Launching Station, Vikram Sarabhai had also established the Space Science and Technology Centre (SSTC) with a view to develop solid propellant rockets for sounding rocket applications. For this purpose, Sarabhai had scouted and recruited engineers with background in aeronautics, mechanical engineering, materials, computer science and control and guidance in the United States. The development of the propellant system was a key activity and for this function he chose Vasant Gowariker – a person with experience in design and performance of solid rocket systems. Rocket development at SSTC in 1967 was at a nascent stage with three teams involved in the development of solid propellants. Gowariker took charge of the situation fairly quickly and succeeded in developing a propellant based on commercially available polyester resin. The RH-75 rocket using the first indigenously developed propellant was flown in February 1969.

With the initiation of the SLV-3 project in the early 1970s, the demand for development of propellants with good ballistic properties and energetics took on new urgency. Very early in the space programme, Gowariker realized the importance of planning and establishing facilities that were needed for translating technology development into usable products. He went on to establish facilities that would not only cater to the production of various input materials, but

also to the processing of propellants along with associated inspection and quality control capabilities. Between 1973 and 1978, he successfully established the Polymer Complex – R&D wing for polymers and chemicals; the Propellant Fuel Complex for scaling up the products and process; the Ammonium Perchlorate Experimental Plant for producing the solid propellant oxidizer and the Solid Propellant Space Booster Propellant Plant for processing large-sized case-bonded propellants. This scale of planning for a new, indigenously developed technology set a trend for the country that has subsequently been followed by others. The capability and confidence with which he pursued his goals and the way he encouraged, demanded and received dedicated contribution from his engineers was aptly reflected in his favourite quote from Alfred, Lord Tennyson's *Ulysses* – To strive, to seek, to find, and not to yield.

Gowariker was the Director of Vikram Sarabhai Space Centre during the years 1979 to 1985. This period saw the culmination of the SLV project and initiation of the PSLV project. The development of the Hydroxyl Terminated Polybutadiene (HTPB) propellant was a significant event and his decision to use this in the PSLV solid propellant rocket stages was a momentous one. HTPB proved to be superior in energetics, mechanical properties and ageing characteristics over other contemporary propellant systems. India was one of the earliest to adopt this propellant system in the world. HTPB-based propellant system today is widely employed in the country's launch vehicles and missiles. India's strong capabilities in solid rocket technology can be directly linked to initiatives pioneered by Gowariker during this crucial phase of the space programme.

His interests were not just confined to polymers and propellants. In mid 1970s, Gowariker took up a project to make petroleum crude from non-edible oilseeds. The non-edible oilseeds were a renewable source available from the forests. The crude was called 'space crude' and the petrol fractionated from the crude was used to test run an Ambassador car. The project was shown to be technically feasible, but had to be closed due to economic considerations. However, his passion with space crude continued and he restarted the work in 2008 in the University of Pune. At this time the crude oil prices had breached the US$ 100 per barrel mark. His idea was to have self-sustaining small plants for a cluster of villages.

During his tenure as Secretary to the Government of India in the Department of Science and Technology (DST) during 1986–1991, Gowariker embarked upon path-breaking initiatives. These included the setting up of the Technology Information Forecasting and Assessment Council, Vigyan Prasar for taking up large-scale science popularization tasks/activities and the National Centre for Medium Range Weather Forecasting. He also initiated measures to popularize science and was the Founder-President of the National Children's Science Congress and the National Centre for Science and Technology Communication.

Gowariker can rightly be credited with a much earlier vision of 'clean India'. His approach to the 'clean India' campaign was to initiate socially relevant technology projects that would benefit the common man. He proposed implementation of such a scheme first in a city like Mumbai, followed by replication of the scheme in other big cities of the country. The 'Good Morning Project' undertaken in Mumbai in the late 1980s had two components. One component involved use of ferrocement pre-fab

elements for quick assembly of toilet units in congested slum areas. These units, provided with bathing facilities and equipped with washing machines, were to be managed by the slum dwellers on 'pay and use' basis. The technology element came as the second part and involved establishing a pilot plant for recovery of combustibles from urban municipal solid waste to produce fuel pellets and briquettes. These briquettes, known as refuse derived fuel (RDF), could be used along with coal in power plants. RDF technology had good potential for integrated urban municipal solid waste management as it included both energy recovery as well as organic manure production, but unfortunately the 'clean India' campaign did not take off, essentially due to non-technical reasons.

After his stint as Secretary, DST, Gowariker served as Scientific Adviser to the Prime Minister between 1991 and 1993, and then subsequently relocated to Pune to take over the Vice-Chancellorship of Pune University. His emphasis was on strengthening the research base in the University and towards this he entered into joint research agreements with DAE, ISRO and DRDO. He encouraged Government departments and corporate bodies to endow chairs in the University departments for encouraging research.

In April 1998, he took up a DST-sponsored project to bring out a *Fertilizer Dictionary*. This was a nine-year effort resulting in what is now called the *Fertilizer Encyclopedia*. The Encyclopedia is a massive compilation with more than 4500 entries that provide details on chemical composition, manufacturing methods, environmental effects, application techniques, handling and safety, soil chemistry and plant deficiency symptoms of various fertilizers. Norman Borlaug, Nobel laureate and father of the green revolution, in his prologue refers to the encyclopedia as an invaluable resource for students, academics and industry people world over. The encyclopedia was first published in India in 2005 and John Wiley later published the international edition in 2009.

As a sequel to this, DST commissioned the preparation of a *Pesticide Encyclopedia* in 2006. The work was carried out between 2006 and 2012. The *Pesticide Encyclopedia* provides comprehensive information regarding chemical pesticides, biocontrol agents and biopesticides. Topics related to pesticide toxicity, handling, storage, safety aspects as well as legislation and regulation are covered. The encyclopedia was published by CABI, UK (2014).

Gowariker was appointed by the Maharashtra Government as Chairman of the Rajiv Gandhi Science and Technology Commission for a period of five years in 2008. The Commission is an innovative action plan of the Maharashtra Government for the socio-economic development of the people through the application of science and technology (S&T). The Commission plays a catalytic role and facilitates initiation of S&T projects. The establishment of a Gene Bank, a Biomedical Engineering Centre and a Science Centre at Solapur are examples of the Commission's work under Gowariker's leadership.

Gowariker's writings ranged from the popular to the serious. His earliest writing – a series of articles under the title of 'Out into Space' appeared in *Science Today* during 1968–69 – was aimed at young readers. His later writings included books on polymer science, demography and *Katha ISRO Chi* – the story of ISRO in Marathi. Gowariker was a Fellow of all the leading science and engineering academies in India and the recipient of a number of honorary doctorates and awards of professional bodies, including the Aryabhata Award of the Astronautical Society of India and the FIE Foundation Award. In recognition of his significant contributions, the Government of India conferred on him the Padma Shri in 1984 and Padma Bhushan in 2008.

Vasant Gowariker was a warm-hearted and liberal-minded person who was widely admired by his colleagues, friends and associates. He was a visionary leader who could inspire his colleagues to do their best. In his passing away, the S&T community in the country has lost a towering personality devoted to the cause of research, development, science administration and science education. He is survived by his wife Sudha and three daughters.

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