

A BIOTECH MODE OF LIVING

Dr Rita Kumar is on a mission to provide sustainable solutions to a world grappling with wastewater pollution. **BY BINITA SINGH**



My passion is to bring out technologies for the proper monitoring and treatment of wastewater emanating from industrial establishments, municipal wastewater, and domestic wastewater emanating from households/residential establishments,” states Dr Rita Kumar when queried about her innovation—a biological method for rapid treatment of municipal wastewater. Her latest innovation, which is available for commercial expression of business interest on the DST-Lockheed Martin India Innovation Growth Programme website, is not a single stroke of genius. Dr Kumar, an Energy and Environmental Biotechnology Scientist at Institute of Genomics and Integrative Biology, Centre for Scientific and Industrial Research (CSIR), has 19 innovations in the field to her credit.

“With this passion I set out in 1993 to develop viable technologies for the monitoring of wastewaters. My first

technology—BODSEED—was commercialised in 1998,” says the scientist who has a PhD in Microbiology from Delhi University. Her latest innovation is but a continuation of her long years of dedicated research in the field of environmental biotechnology with major focus on developing different biosensors for pollution detection.

Rising industrialisation has led to a proportionate increase in industrial waste production, both organic and inorganic. The results of water quality monitoring carried out by Central Pollution Control Board (CPCB) particularly with respect to the indicator of oxygen consuming substances (biochemical oxygen demand [BOD]) and the indicator of pathogenic bacteria (total coliform and faecal coliform) show that there is gradual degradation in water quality (CPCB 2009), according to *India Infrastructure Report 2011*. The CPCB also sets down the standards for discharge of environmental pollutants from various industries.

The report of the working group on *Effectively Integrating Industrial Growth and Environmental Sustainability – Twelfth Five Year Plan (2012–2017)*, puts the cost of environmental damage at approximately US\$ 32 billion, as per figures identified by National Productivity Council of India. The report identifies wastewater from industrial activities as the main reason saying it is contaminated with highly toxic organic and inorganic substances, some of which are persistent pollutants and remain in the environment for many years.

Dr Kumar’s long years of research and her series of innovations are targeted at solving these problems. In recent years, biological waste treatment has caught the attention of the world as a comparative low-cost and efficient



Science & the Scientist: Dr Rita Kumar in her lab demonstrating the technology perfected by her.

technology for treatment of pollutants; Dr Kumar is making rapid inroads in the field with her targeted researches.

As she says, “In order to understand the problems of society and industry in depth, I have interacted with different industrial houses sector wise.” The resultant innovations are at different stages of development, i.e., a couple commercialised and a few demonstrated at field scale.

Dr Kumar has gone a step beyond the call of simple academic research, involving herself in robust scientific collaboration with the industry. She has demonstrated ample managerial capabilities, interpersonal, and networking skills, which she counts among her core strengths, and has served as CMD,

National Research Development Corporation (NRDC), New Delhi, on an additional charge in August-September 2012 and April-September 2013. She is also on the Board of Directors of Biotech Consortium of India Limited (BCIL), New Delhi.

Innovations need to be commercialised on a mass scale for their benefits to reach the masses. Dr Kumar says, “For effective dissemination and further commercialisation, it is pertinent that generated knowledge be embodied in some form of IPRs, preferably in the form of patents.” So,

emphasis was given on aggressive patenting (filed patents – 120; granted patents – 97).

Talking about her first technology that was commercialised, Dr Kumar says, “BODSEED is a mixture of different bacteria, available in dried powder form, and serves as a reference seeding material for reproducible BOD values. BODSEED was patented in India and has also been included in Bureau of Indian Standards (BIS) for use in BOD analysis. The BOD values correspond to the pollutional load of waste water. For checking the pollutional load, BOD analysis is done. This test requires reviving of BODSEED prior to performing the test and so I set forth to develop an instant seeding material for BOD analysis and I succeeded in developing an instant seeding material named



HONOURS & AWARDS

- Arya Bhatt Puruskar 2013, organised by Indian Swadeshi Vigyan Andolan (Vigyan Bharti, Delhi)
- CSIR Technology Innovation Award 2012
- Merck Millipore India Innovation Award 2012
- Gold Medal in DST-Lockheed India Innovation Growth Programme -2010
 - A total of two technologies selected in top 30 in 2011
 - A total of three technologies selected in top 30 in 2010
 (Ref: Compendium of Selected Technologies: DST-Lockheed Martin India Innovation Growth Programme (2007-12))
- Best Researcher Award in New Millennium Conference – *Retrospect of Indian Research on Environmental Pollution focus 21st Century, 1999*
- Certificate on Authenticated use of BODSEED from Member Secretary, Central Pollution Control Board, Delhi 1998

BODBEADS which was patented in India, Great Britain and the USA.”

Dr Kumar though was not content to sit on her early successes. Demonstrating her research instincts she continues her story, “There was one more lacunae in this technology,” and the environmental crusader was not willing to give up.

The drawback that Dr Kumar referred to was the time taken by the technology to test the pollution load. “The BOD test requires three–five days to arrive at the result of pollution load,” says the scientist.

It is a common practice for industries to discharge polluted water when they use clean water. This polluted water needs to be tested for pollution load before the industries discharge it. In the present scenario, the pollution load can only be arrived at in 3–5 days, but the wastewater has to be discharged every day as it cannot be retained because of huge consumption/discharge. There was a crying need for a

technology that could plug this time lag and save the water bodies from industrial pollutants.

“It was felt that if we could develop a quick monitoring method for checking pollution load, it will save our water bodies from getting polluted,” says Dr Kumar. Soon enough, the team, with this goal in mind, developed a BOD Biosensor, which can detect the pollution load in just one hour as against the earlier 3–5 days.

The product has been a success; with national and international patents filed and granted, it has been commercialised. The BOD Biosensor is now entering the market through Forbes Marshall Pvt Ltd, Pune, informs Dr Kumar. However, the environment scientist’s campaign against wastewater was not yet at an end. The BOD Biosensor was but the stepping stone to more penetrative technologies for water pollution treatment.

“After perfecting monitoring devices, we set forth to develop biological methods for pre-treatment of polluted water,” reveals Dr Kumar. The first endeavour of the team centred around developing neutralisation of highly alkaline wastewater effluents from industries like beverage (soft drinks), pulp and paper, textiles, power plants, etc.

A report by research consultancy firm Frost & Sullivan in 2012 had forecast that the growth in spending on wastewater treatment by Indian dairy product and beverage manufacturers would almost double from ₹278 crore (US\$ 44.96 million) in 2011 to ₹538 crore (US\$ 87 million) in 2016. This, the report said, would be because with rising consciousness consumers would prefer companies that adopted greener practices. The carbonated soft drinks market forecast to grow at a compound annual growth rate of about 10 per cent up to 2015 and the fresh juice and health drinks segment at 25 per cent CAGR is to spur the growth of wastewater treatment solutions in the sector as well.

In August 2013 at an ETI Dynamics

and Indian Institute of Kanpur (IIT-K) roundtable at the India International Centre, industry stakeholders from across the country expressed a high degree of concern regarding wastewater and effluent treatment in the industry. In an increasingly stringent regulatory environment, they were looking for sustainable and cost-effective solutions. The rising water pollution from industrial effluents has both experts and policymakers aiming for zero liquid discharge (ZLD) to ensure safety of water bodies and land resources.

Dr Kumar and her team have a solution to the industry’s common problem. Their technology for treatment of pulp and paper industry wastewater has been tested at field scale at the Star Paper Mill, Saharanpur. The neutralisation technology has been tested on field at a Coca Cola plant.

Biochemical Oxygen Demand or BOD

The amount of organic material that can rot in sewage is measured by the biochemical oxygen demand (BOD). BOD is the amount of oxygen required by micro-organisms to decompose the organic substances in sewage. Therefore, the more organic material there is in the sewage, the higher the BOD.

It is among the most important parameters for the design and operation of sewage treatment plants. BOD levels of industrial sewage may be many times those of domestic sewage. Dissolved oxygen is an important factor that determines the quality of water in lakes and rivers. The higher the concentration of dissolved oxygen, the better the water quality.

When sewage enters a lake or stream, micro-organisms begin to decompose the organic materials. Oxygen is consumed as micro-organisms use it in their metabolism. This can quickly deplete the available oxygen in the water.

Source: edugreen.teri.res.in

Conventionally, neutralisation is done by use of acids and since a huge volume of water is used by industries, it requires large volumes of acid. This is an expensive process as it entails incurring substantial expenses on the purchase of acids. Besides, handling acids is hazardous for workers. “We have developed a biological solution against this,” says Dr Kumar, adding, “Again, the technology has been patented widely, nationally and internationally.”

Dr Kumar’s research in the field of municipal wastewater treatment has also borne results. “The technology on biological method for treatment of municipal wastewater has been tested in lab scale and needs to be tried at pilot/field scale,” says the scientist.

Cost-effective and large-scale municipal wastewater treatment is an urgent requirement in India. The per capita wastewater generation by the Class-I cities and Class-II towns, representing 72 per cent of urban population in the country, has been estimated to be around 98 lpcd while that from the National Capital Territory-Delhi alone (discharging 3,663 mld of wastewaters, 61 per cent of which is treated) is over 220 lpcd (CPCB, 1999).

Dr Kumar’s technology is a biological process used to treat contaminants in sewage water. The technology treats wastewater within permissible limits in less time than other methodologies. Dr Kumar explains, “The process brings the pollution BOD limits up to 8-10 mg/l in one-fourth time as compared to conventional methods, generates less sludge (75 per cent), and reduces energy usage by 75 per cent.”

CSIR owns the intellectual property of the processes that have been developed at lab-scale/field scale. Meant for municipalities, sewage treatment plants and wastewater treatment companies, the biological processes promise to be commercial successes.

Meanwhile, the indefatigable scientist continues on her crusade for the environment. ■