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THE GRAND CHALLENGES FOR TECHNOLOGISTS IN INDIA

Winning Solutions p31

Electronic Toilet, Haptic Shoe, Low-Cost Ventilator, Needle-Free Diagnostic Kit For Anemia, Plastic Morph, Power Saver, Pre-screening Opthalmology Device, Solar Multi-Effect Distillation System, and TB Breathalyzer.

Genetically engineered microbes can enzymatically breakdown plastic into biodegradable end products.

Plastic Morph

The world's plastic waste management situation is in a crisis. On one hand, we continue to generate over 200 million tons of plastic products and on the other hand, there are no clear methods to turnover/degrade plastic. Plastic is highly resistant to natural decay and degradation, thus posing enormous burden on the environment. Millions of tons of plastic waste exists in landfills, oceans, rivers, soil, and more. Burning of plastic is not a remedy since it generates toxic fumes and releases harmful chemicals into the environment. Recycling offers only a temporary solution. It is therefore imperative and urgent to have an alternative method to tackle the menace of plastic waste and develop technologies that can convert plastic into biodegradable matter.

The innovation of Praveen Bhat Gurpur of Jubilant Biosys, Bangalore, is the PlasticMorph, which is proposed to systematically bio-engineer microbes to synthesize enzymes capable of degrading the plastic polymer into simpler, biodegradable monomers.

Gurpur's team is currently in the process of building a working prototype of the PlasticMorph. They are working out the conditions needed for the plastic membrane, the pore-size, the nutrients which are limiting, the microbial species, and more. The patent filing process will be completed as soon as they have the working prototype ready.

The central principle of the PlasticMorph is to force bacteria to survive in an environment where their only source of energy is obtained by degrading plastic and selecting for survivors. These survivors will have mutations in genes that produce special enzymes to degrade plastic. This gives them an advantage over their peers and they will survive, whereas the non-mutated ones will die. In PlasticMorph essential growth nutrients are separated from bacteria by a semi-permeable plastic membrane. This process is based on directed evolution.

According to the developers, most of the small- to medium-gauge thick plastic products like polythene bags, plastic water bottles, plastic coverings and protectives can be degraded into biodegradable end-products in their reactors. This has the capability to impact multiple spheres of life. tr

HIGHLIGHTS

SOLUTION ARCHITECT
Praveen Bhat Gurpur

COMPANY
Jubilant Biosys

Solar multi-effect distillation system to produce low cost desalinated, potable water.

Desalinated Potable Water

Drinking water scarcity is higher in coastal regions in comparison to the interior parts of India as the the groundwater is saline and not suitable for drinking. Therefore, desalination of sea water becomes an ideal solution to bridge the widening gap between growing drinking water needs and scarcity of the same in major coastal cities of India. Transporting water tanks has been proved costlier than water supplied by desalination. And a continuous effort to amend the desalination technology can prove beneficial. The conventional desalination plants are usually centralized, require huge capital cost, and enormous amount of concentrated energy from fossil fuel. The team from KG Design Services has looked at seawater desalination using solar thermal energy.

KG Design Services has developed an indigenous method of concentrating solar energy by the linear fresnel reflector (LFR). A solar collection field with 1,404 square meter of mirror area works regularly in KGDS research cen

ter in Coimbatore, Tamil Nadu. On a hot day, with directed solar insolation around 850 watts per meter square, this field collects 480 kilowatts of heat energy and produces about 640 kilograms per hour of steam. The field can produce a peak output of 6,000 liters per hour of desalinated water. For a small rural community of a thousand people this system can provide the vital potable water requirement.

Multi-effect distillation (MED) is a thermal distillation process. The seawater is sprayed onto the surface of the evaporator tubes of different chambers (effects) in a thin film to promote evaporation after it has been preheated in the final condenser. The evaporator tubes in the first effect are heated by steam from the LFR. The steam produced in the first effect is condensed inside the evaporator tubes of the next effect where again vapor is produced. The surfaces of all the other effects are heated by the steam produced in each preceding effect. Each effect must have a lower pressure than the preceding one. This process is repeated to bring about six effects. The steam produced in the last effect is condensed in a separate heat exchanger called the final condenser, which is cooled by the incoming seawater.

KGDS is working on both solar desalination done with solar energy as well as solar energy integrated with the solar-biomass hybrid power plant and desalination done using the steam output from the turbine. The first approach is understood to be India's first indigenous industrial scale solar thermal desalination of seawater. The plant in Narippeiyur village, Ramanathapuram, when completed at the end of Phase II in April 2012 may be the largest solar thermal sea water desalination plant in the world. The cost of desalinated water through both approaches is estimated to be ₹479 per 1,000 liters.

In India, around 20 major cities are on the coastline and the water requirement for all these cities in 2008 stood at 6,267 million liters per day (MLD). And the five cities of Mumbai, Chennai, Surat, Kolkata, and Visakhapatnam account for 93 percent of the total water requirement. The projected water requirement for all coastal cities in 2026 is estimated to be 23,607 million liters per day (MLD), a four-fold increase from 2008. By 2026, Mumbai would alone account for 55 percent share of the total water requirement from the coastal cities. As a consequence, Mumbai would require a desalination capacity of 2,600 MLD and this calls for an estimated investment of ₹230 billion. tr

HIGHLIGHTS

SOLUTION ARCHITECTS
MP Ramaswamy, Raju Abraham, RV Pujeri, and SP Viswanathan

COMPANY
KG Design Services

THERMAL DISTILLATION The linear fresnel reflector steam generation in Coimbatore.