VETRII I.A.S STUDY CIRCLE

SUCCESS GUARANTEED

VETRII IAS GATEWAYY

www.iasgatewayy.com

SCIENCE REPORTER

MARCH - 2019

044-26265326 / 98400 97666 / 96001 24042

INDEX

GRAPHENE FROM DISCARDED LITHIUM-ION BATTERIES

- Researchers have developed an eco-friendly technique for producing graphene from discarded lithium-ion batteries.

About:

- Scientists from the CSIR–Central Electrochemical Research Institute in Tamilnadu and CSIR–Central Salt and Marine Chemicals Research Institute in Gujarat invented a simple process that can generate reduced graphene oxide from graphite isolated from spent lithium-ion batteries.

How It Works:

- Graphene oxide made from the graphite was converted into reduced graphene oxide using the iron and aluminium present in the metallic cover of the batteries and acid. The reduced graphene oxide had sheet-like structures with wrinkles and scrolls on the surface.
- Electrodes made of the reduced graphene oxide displayed efficiencies to store charge – an interesting property for making super capacitors.
- When exposed to 20,000 cycles of charging and discharging at a high current density, one of the electrodes retained 70% of its efficiency for storing a charge up to 85 cycles. This efficiency began to rise and reached almost 108% after 85 cycles.
- The process is faster and cheaper than other methods for generating reduced graphene oxide at lower temperatures, showing its potential for making materials for fabricating next-generation high-performance supercapacitors.

Benefits:

- Such graphene made from spent batteries could potentially be used to make efficient supercapacitors.
- Graphene supercapacitors serve as energy storage devices with a capacity for faster charging and longer life span than traditional electrolytic batteries.
- Lithium-ion batteries are widely used in portable electronic devices such as mobile phones and laptops. When such batteries run out of fuel, they are disposed of as electronic waste, generating pollutants that are harmful to human health and the environment. So using this technique reduce the e waste generated.

Graphene:

- Graphene is an allotrope form of carbon consisting of a single layer of carbon atoms arranged in a hexagonal lattice. It is a semimetal with small overlap between the valence and the conduction bands.

- It is the basic structural element of many other allotropes of carbon, such as graphite, charcoal, carbon nanotubes and fullerenes.
- Graphene has many uncommon properties. It is the strongest material ever tested, conducts heat and electricity efficiently, and is nearly transparent. Graphene shows a large and nonlinear diamagnetism greater than that of graphite, and can be levitated by neodymium magnets.
- Graphene is a transparent and flexible conductor that holds promise for various material/device applications, including solar cells, light-emitting diodes (LED), touch panels and smart windows or phones.
- Graphene has also been used in other fundamental electronic devices, such as capacitors and Field Effect Transistors (FETs), in which it can act as an atomically thin channel. In the same framework, fluorine-doped graphene has shown to have insulating properties and it can be used as a passivation layer in graphene FETs, leading to a substantial increase in carrier mobility.

STUDY ON AGE OF TERMITES

- In the new study, an international team of scientists explains that the mounds cover a complex subterranean network tunnels that allow termites, guided by pheromones, to move from mound to mound, exploiting a food supply of rotting, fallen leaves.

About:

- Termite mounds typically outlive the colonies that built them, so it was doubly astonishing when thousands of insects were recently discovered existing among tall, dirt monoliths discovered in north-eastern Brazil.
- Now, it's obvious that tens of millions of conical mounds cover this part of the world and have done so for thousands of years.
- This massive array of termite mounds is shown from an aerial view in the video above. There are approximately 200 million of these mounds, each about 2.5 meters tall and 9 meters across. The regularly spaced piles look like polka-dots from above and cover a region roughly the size of Great Britain.
- The mounds themselves examined through a combination of satellite surveys and on-land excavations have been there for thousands of years.
- Soil sample analysis revealed that the oldest mounds were built about 3,820 years ago, meaning that termites began building these eusocial settlements about the same time as humans were building the Pyramids of Giza.

Finding:

- The working theory behind the mounds' existence is that they are a byproduct of a single termite species' effort to build a network of tunnels, which would bring them close to dead leaf dinners.
- As the termites built their tunnels, mounds of dirt accumulated. These dumps of dirt mark evenly spaced locations and create a spatial pattern not unlike Namibian fairy circles.
- The mounds do not contain any internal structure, just a central tunnel that descends into the earth and intersects with other underground tunnels and narrow galleries containing dead leaves or more termites.
- Unlike other termite mounds, these haven't revealed any nesting sites and do not appear to serve as a ventilation system. Mysteriously a queen chamber hasn't been found either and in turn, no queen.
- Termites exist as self-organized systems in which every insect is divided into one of three social castes: soldiers, workers, and winged termites that are there to reproduce. Termite queens lay about 20,000 eggs daily and can reach ages of up to 20 years.

STUNTING LINKED TO OPEN DEFECATION

- The South Asian region registers the highest rates of child malnutrition in the world despite the fact that the per capita income and GDP growth rate of this region is better than many other poor countries, including sub-Saharan Africa.
- Some scholars in the mid-1990s termed this peculiar problem as the 'Asian Enigma'.

Study:

- India's sustained level of growth since the 1980s and unprecedented economic growth rates in the last decade do not seem to have impacted the high levels of child malnutrition in the country.
- However, the same period saw Bangladesh and Nepal catch up with and leave India far behind in key indicators, such as life expectancy and child survival. Several scholars have identified two key factors responsible for child malnutrition in South Asia, specifically India
- First, the status of women and their participation in the decisions related to their bodies, economic resources, and social and public services, which have been instrumental in transforming the landscape of Bangladesh, at least as far as child nutrition is concerned.

- Secondly, sanitation which includes provision of safe and clean drinking water and, in the case of India, the practice of open defecation.
- The National Family Health Survey (NFHS)-4 suggests that about 52% of all Indian households defecate in the open.
- The share for rural India was much higher at 63%. The proportion of women between the age group 20-24 years who were married before they attained the age of 18 years was about 27%.
- The share of women between the age group of 15-49 years who were anaemic decreased from 55.3% to 53% between NFHS-3 (2005-06)and NFHS-4 (2015-16), a decline of less than two percentage points over a decade.
- The reduction in key child malnutrition indicators over a decade spanning from NFHS-3, pertaining to 2005-06 and NFHS-4 (2015-16) has also been very slow.
- Take for instance, the reduction in the proportion of children under five years who were stunted (low height for age):
- The figure came down from 48% in the year 2005-06 to about 38% in 2015-16.
- The share of children who were wasted (low weight for height), in fact, increased from 19.8% to 21% in the given time period.
- The same is true for the proportion of children who were severely wasted which rose from 6.4% to 7.5% between NFHS-3 and NFHS-4.
- The decline in the share of children under five years who were underweight has been very slow, from 42.5% to 35.7%.
- The government of India and other multilateral international agencies even today swear by the myth that it is poverty which is at the root of open defecation.
- but social inequalities play a bigger role in explaining why a majority of rural Indian families continued to defecate in the open.

Consequences of poor sanitation:

- Poor standards of public and private sanitation lead to the spread of germs and diseases, many of which are life threatening for children.
- This is not simply a nutritional or height disadvantage but is closely linked with the ability of Indian children to grow healthier and learn better and when they grow, earn better. The economic consequences of poor sanitation are multifaceted and extreme.
- The environment of open defecation which leads to diseases traps poor populations into intergenerational deprivation from good health, education and wages.

- Objectively speaking, the caste system in India influences the life chances of all the poor persons in the country. Through its impact on public sanitation, it affects everyone.

Way Forward:

- The government and/or civil society need to find out how many Indians defecate in the open and where.
- The datasets that we have are actually about the construction of latrines which perform more of an accounting purpose for a scheme like Swachh Bharat.
- Awarness and cultural change is needed to make use of build toilet under the Swachh Bharat.

PAPER KIT TO TEST MILK

- Scientists at the Indian Institute of Technology (IIT), Guwahati, have developed a simple paper kit that can test freshness of milk and tell how well it has been pasteurised.

About:

- Aided with a smart phone app, the kit can help ensure that milk is consumed before it turns too sour.
- Being a widely consumed food, the safety of milk is of prime concern to consumers. More so because it's highly perishable and prone to action of enzymes and microorganisms inherently present in it.
- Although pasteurisation, freezing and preservation using additives are widely used to prevent spoilage, perishability of milk is still a concern.

Present System:

- At present there is no easy way to know if milk is fresh or stale or how effective is the pasteurisation.
- Tests used in dairies and dairy industries are time consuming and need sophisticated equipment like spectrophotometers.
- Fabrication in the laboratory at present costs around Rs 80 to Rs 125 per kit .

Process:

- A milk enzyme, Alkaline Phosphatase (ALP), is considered to be an indicator of milk quality because its presence even after pasteurisation indicates presence of microbes that may not have been rendered inactive with pasteurization.

- Researchers used ordinary filter paper to prepare the detector. The filter paper was cut into small discs using office punch and impregnated with chemical probes that preferentially react with ALP.
- The 'probes' used are antibodies that specifically bind to ALP. When ALP comes into contact with the probe, it turns white paper disc into a coloured one.
- The soaked paper discs in 4-carboxybenzene diazonium solution and then chemically treated to expose-COOH groups on the diazonium.
- The -COOH groups then attach to NH2 groups on anti-ALP probe molecules. Thus the anti-ALP probes are fixed on paper. When a drop of milk is poured on the tiny paper disc, the ALP in milk reacts with probes, resulting in change of colour.
- The colour change on paper discs is then photographed by a smartphone camera and images processed to obtain corresponding colour values.
- These values are then compared with standard data stored in the phone.

Advantages:

- The new detection kit could make testing easy and fast. It takes just about 15 minutes to detect raw milk from pasteurized one.
- Thus, not only the presence of ALP could be detected but the amount of it in milk could also be measured.
- The sensor works in both qualitative and quantitative modes. So no separate reader is required for qualitative analysis as it works just like pregnancy test strips. While colour change shows ALP's presence, the exact amount of ALP is determined using a smartphone.
- The kit could come handy in milk bars, large kitchens and at milk collection centres where freshness of milk is a concern. It can find other applications too.
- Since ALP is also tested in various body fluids, the kit can also be utilised in clinics.

SCIENCE OF HOLI

- Holi, the festival of Colours is celebrated in different corners of India with pomp and gaiety on full moon day in the month of Phalgun which is the month of March as per the Gregorian calendar.

Science of Holi:

- Holi is played in the Spring Season which is a period between end of winter and advent of summer. We normally go through the transition phase of winter and summer.

- The period induces the growth of bacteria in the atmosphere as well as in the body. When Holika is burnt, temperature of the nearby area raises around 50-60 degree Celsius.
- Following the tradition when people perform Parikrama (go around the bonfire/pyre), the heat coming from the bonfire kills the bacteria in the body and cleanses it.
- In some parts of the country, after Holika Dahan (burning of Holika) people put ash on their forehead and also mix Chandan (paste of sandal wood) with the young leaves and flowers of the Mango tree and consume. It is believed to promote good health.
- This is the time, when people get the feeling of tardiness. This is quite natural for the body to experiences some tardiness because of change in weather from cold to the hot in the atmosphere.
- To counter this laziness, people sing Songs (Phag, Jogira etc.) with Dhol, Manjira and other traditional instruments.
- This helps in rejuvenating the human body. Their physical movement while playing with colours also helps in the process.
- Colours play vital role in fitness of human body. Deficiency of a particular colour could cause an ailment and can be cured when that colour element is supplemented either through diet or medicine.
- In ancient times, when people started playing Holi, the colours used by them were made from natural sources like turmeric, Neem, Palash (Tesu) etc.
- The playful pouring and throwing of colour powders made from these natural sources has a healing effect on the human body.
- It has the effect of strengthening the ions in the body and adds health and beauty to it.

Synthetic Colours:

- Now a day, market is mostly flooded with synthetic colours and herbal colours are not available in adequate quantity.
- Synthetic Colours are also cheap and people feel we have to pour this on others and not on ourselves, hence they opt for it.
- But they forget one thing that everybody thinks in the same way and others also pour you with same synthetic colours.

Problems caused by some common Synthetic colours:

- The synthetic colours available in the market comprises of toxic components such as lead oxide, diesel, chromium iodine and copper sulphate which lead to rashes on the skin, allergies, pigmentation, frizzy hair and eye irritation.

- In extreme cases, it can cause serious skin diseases and clogging of hair cuticles resulting in severe hair damage.
- **Green –** It might contain copper sulphate and can cause problems like eye allergy and temporary blindness.
- **Red –** It might contain mercury sulphide, which can lead to skin cancer, mental retardation, paralysis and impaired vision.
- **Purple –** It might contain chromium iodide leading to health problems like bronchial asthma and allergies.
- **Silver –** It might contain aluminum bromide, which is carcinogenic.
- **Blue –** It might contain Prussian blue, which can cause contract dermatitis.
- **Black –** It might contain lead oxide leading to health problems like renal failure and learning disability.

3D ADAPTIVE AIDS FOR ARTHRITIS

- Researchers and students at Michigan Technological University have used a 3D printer to create adaptive aids for arthritis patients, which could help people perform daily tasks such as opening doors or getting dressed.

About:

- A new study that analyzes how the 3D printer application can be used to produce adaptive aids
- The devices are a small fraction of the cost of commercial alternatives, meet or improve on existing standards, and are customizable for individual patients.

Background:

- The CDC estimates that almost 25% of the U.S. population suffers from some form of arthritis.
- The disease can make routine tasks, such as turning a key in a lock, difficult or nearly impossible for sufferers. In addition, sufferers earn lower salaries than the average, but are forced to spend more on medical expenses.
- Adaptive aids, which are typically simple pieces of plastic, are available to make it easier for arthritis patients to grip and manipulate objects.

- However, they are frequently very expensive. For example, a commercially available phone holder aid can cost $49 dollars, but a 3D-printed alternative could be as little as 79 cents.

Advantage:

- The class printed a wide array of devices, and 20 of their creations meet or exceed the standard of commercial devices, but at a fraction of the cost.
- The devices can also be customized to suit the needs of specific patients, and the designs can account for patient-specific parameters such as hand size and grip strength.
- The students used printers that cost $500 or less, and their designs are freely available, suggesting that arthritis patients who use a lot of aids could benefit by buying their own 3D printers.

ARTHRITIS:

- Arthritis means joint inflammation, but the term is used to describe around 200 conditions that affect joints, the tissues that surround the joint, and other connective tissue. It is a rheumatic condition.
- The most common form of arthritis is osteoarthritis. Other common rheumatic conditions related to arthritis include gout, fibromyalgia, and rheumatoid arthritis (RA).
- Rheumatic conditions tend to involve pain, aching, stiffness, and swelling in and around one or more joints. The symptoms can develop gradually or suddenly. Certain rheumatic conditions can also involve the immune system and various internal organs of the body.
- Some forms of arthritis, such as rheumatoid arthritis and lupus (SLE), can affect multiple organs and cause widespread symptoms.
- Arthritis is more common among adults aged 65 years or older, but it can affect people of all ages, including children.
- Factors in the development of arthritis include injury, abnormal metabolism, genetic makeup, infections, and immune system dysfunction.
- Treatment aims to control pain, minimize joint damage, and improve or maintain quality of life. It involves medications, physical therapies, and patient education and support.

SAFEGUARDING MARINE ECOSYSYTEM IN INDIA

- Coastal and marine ecosystems are among the most productive ecosystems in the world, provide many services to human society and are of great economic value. The services include provision of food and water resources, and raw materials like sand, and other high-value heavy minerals like ilmenite, zircon, monazite etc., which are collected from beach sand.

- They also provide regulating and cultural services, like storm protection, erosion control, tourism and support functions such as climate regulation.

Indian coastal ecosystem:

- Indian coastal ecosystems comprising of mudflats, sandy beaches, estuaries, creeks, mangroves, coral reefs, marshes, lagoon, sea grass beds, and sandy and rocky beaches extend to 42,808 sq km.
- The Exclusive Economic Zone of India is 2.02 million sq km.
- The number of species in the coastal and marine ecosystems is suggested to be more than 13,000.
- It is also known for high biological productivity, which provide a wide range of habitat for many aquatic flora and fauna.
- Marine fish production has increased from 0.5 million tonnes in 1950 to 3.8 million tonnes in 2013, contributing substantially to nutritional security, income and livelihood of a large population of the country.

Ecosystem function:

- Sustainability of any typical ecosystem largely depends on its function and processes and should have the ability to keep them within homeostatic limits so as to maintain its well-being.
- Critical physical, chemical and biological processes such as water retention capability, carbon trapping and cycling, nutrient exchange, biotic and abiotic energy flux and protection against natural catastrophes determine the habitat integrity.
- Hence it is imperative to examine the site's habitat integrity before considering it for conservation. The most important goals related to major ecosystem functional mechanisms are described in the following.

a. Freshwater discharge/recharge function – The presence of sufficient freshwater drainage and provisions for recharging facilities have been considered to give value to a site.

b. Erosion control system – Dynamic coasts are prone to erosion, and this poses serious problems to the sustainability of an ecosystem and its function. Ranking is based on the presence of any natural features that control erosion to sustain the ecosystem.

c. Carbon sequestration– Sites with diverse habitats having provisions to sequester carbon are valued. d. Natural protection - Sites having any natural features that protect their habitats against disaster so as to sustain the ecosystem function are identified

Threat:

- Major human-induced drivers of ecosystem degradation include habitat conversion to other forms of land use, overexploitation of resources and associated destructive harvesting practices, spread of invasive alien species, pollution from agricultural, domestic and industrial effluents, and climate change.

Regulations:

- For conserving and managing coastal and marine resources and ecosystems, a strong legislative framework exists in India.
- The acts and supporting rules and regulations directly and indirectly related to management of coastal and marine areas and biodiversity are as follows:

1. Coast Guard Act, 1978
2. Merchant Shipping Act, 1958
3. Wildlife (Protection) Act, 1972
4. Water (Prevention and Control of Pollution) Act, 1974
5. The Territorial Waters, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act, 1976
6. Forest Conservation Act, 1980
7. Marine Fishing Regulation Acts, 1981
8. Coastal Pollution Control Series, 1982
9. Environment Protection Act,
10. National Environmental Tribunal Act, 1995
11. Coastal Zone Management Plans,1996
12. The Biological Diversity Act, 2002
13. Coastal Aquaculture Authority Act, 2005.

- India has established 31 Coastal and Marine Protected Areas (CMPAs) and several species have been listed under Wildlife (Protection) Act 1972.
- In spite of these efforts, several gaps exist in the management of coastal and marine areas. There is lack of understanding on the effective functioning of the measures and benefits acquired.

- Available information indicates that the oceans and coastal biomes contribute substantially to the ecosystem services that make up the country's natural capital.
- India has opportunities to reap many economic benefits from living and non-living resources of coastal and marine areas including fisheries and biodiversity.

Steps to restore ocean health:

- Limit plastic use
- Reduce carbon footprint
- Clean up waste
- Reduce chemical use

Technology to conserve ocean:

Marine skin tag

- An sensor tag used to study marine ecosystem without disturbing its ecosystem.
- The gathered data will be analyzed to preserve and to enhance the marine ecology not only in the Red Sea but anywhere in the world,"
- These sensors measure depth, water temperature and salinity, although other sensors could be added in the future, including ones that monitor the physiological state of the animal.

Seabin:

- The Seabin is a floating rubbish bin that is located in the water at marinas, docks, yacht clubs an commercial ports.
- The Seabin moves up and down with the range of tide collecting all floating rubbish.
- The Seabin also has the potential to collect a percentage of oils and pollutants floating on the water surface

Way Forward:

- Managing the marine and coastal ecosystems requires an understanding of the socio-ecological systems and their inter-connections.
- Recognizing blue carbon ecosystem services, Marine Spatial Planning and suggestions on the effectiveness of current management measures are a few initiatives that would pave the way for enhancing delivery of ecosystem services.
- In order to achieve this, there is a need to bridge the gaps in knowledge on coastal and marine ecosystem services and functions and support mainstreaming of biodiversity and

ecosystem considerations into both national policy-making and broader societal perspectives.

- The important interactions between marine, coastal and other terrestrial systems need to be integrated to understand the ecosystem services.
- In examining the incidence of poverty among people who are dependent on coastal and marine ecosystem services, the existing national policies have to be disaggregated to address micro level issues.