ISSN 2349-5596

GREEN INSIGHTS

Newsletter on "Environment Literacy - Eco-labelling and Eco-friendly Products"

January - March 2024, Vol 18. No 4

Biopolymers – An Important Eco-product

Sponsored by:
Ministry of Environment, Forest and Climate Change, Government of India
Environmental Information, Awareness, Capacity Building and Livelihood Programme (EIACP) Programme Centre, Resource Partner on:
Environment Literacy - Eco-labelling and Eco-friendly Products

GREEN INSIGHTS
January - March 2024

Contents

Shri Praful Amin
CERC, Chairman

Uday Mawani
Chief Executive Officer

Editorial Team

Anindita Mehta
Programme Coordinator

Dr. Kartik Andharia
Programme Officer

Karan Thakkar
Information Officer

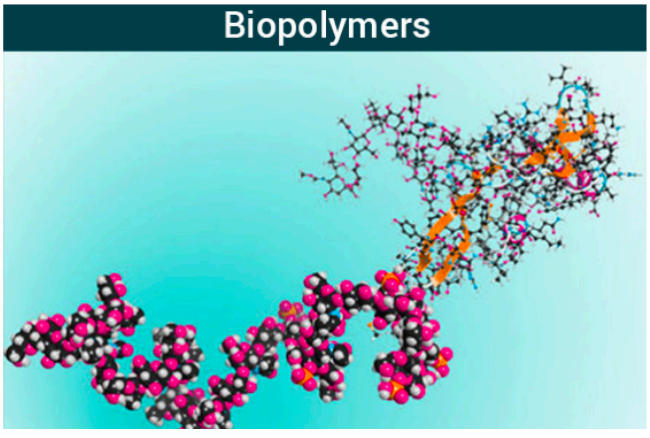
IZGARA DESIGN
Design & Graphics

Foreword

Plastics undoubtedly offer significant utility, yet they also pose considerable threats to biodiversity, human health, and the environment. However, heightened public awareness of their detrimental impacts is prompting many companies to seek alternatives in their offerings. Synthetic polymer materials, constituting plastics, boast advantageous properties but also carry environmental liabilities. Conversely, the sought-after attributes of plastics can be replicated by creating polymers derived from biological sources rather than synthetic chemicals. These bio-based polymers are devoid of the undesirable characteristics of traditional plastics, and their biodegradability further enhances their attractiveness. Today, these biopolymers go by various names such as bio-plastics, Green polymers, and Natural polymers, among others.

Biopolymers are seeing a surge in utilization across diverse sectors, including packaging, agriculture, biomedicine, the food industry, and textiles. Many restaurants now favor bio-plastic bags over traditional polyethylene bags for take-away food packaging. Biodegradable pots are being embraced for plant cultivation, not only curbing plastic waste but also enriching the soil with organic nutrients. Additionally, biopolymers are playing a pivotal role in wastewater treatment processes, facilitating bio-flocculation, sedimentation, and the removal of pollutants. These instances underscore the expanding applications of biopolymers, a trajectory expected to persist as awareness continues to grow. This newsletter delves into different aspects of biopolymers like structure, classification, applications and their potential to revolutionize various industries.

Biopolymers: An Overview



Biopolymers basically are complex molecules that form the building blocks of life. From DNA to sturdy plant cell walls, these naturally occurring polymers play an important role in every living organism, and it also brings about variations in characteristics of different life forms.

Biopolymers like any other synthetic polymer are constructed from smaller repeating units called monomers. These monomers are glued together by a covalent bonds. This forms a long chain with unique properties. The chemical and physical properties of a biopolymer are determined by the specific functional group present on its monomers, much like how the design of Jibbitz influences the appearance and functionality of Crocs. For the science geeks, common functional groups found in biopolymers include: Hydroxyl (-OH), Carboxyl (-COOH), Amino (-NH2) etc.

These polymers can be sourced from various outlets including plants, animals, bacteria, and fungi. Recent efforts have focused on environmental preservation through the adoption of natural renewable resources capable of biodegradation. Biopolymers, also referred to as natural polymers, owe their name to their origin from flora and fauna with the inherent ability to produce repeating monomeric units through natural biochemical processes.

Biopolymers can be categorized into three main groups depending on the type of repeating monomer units they consist of: polysaccharides, polypeptides, and polynucleotides.

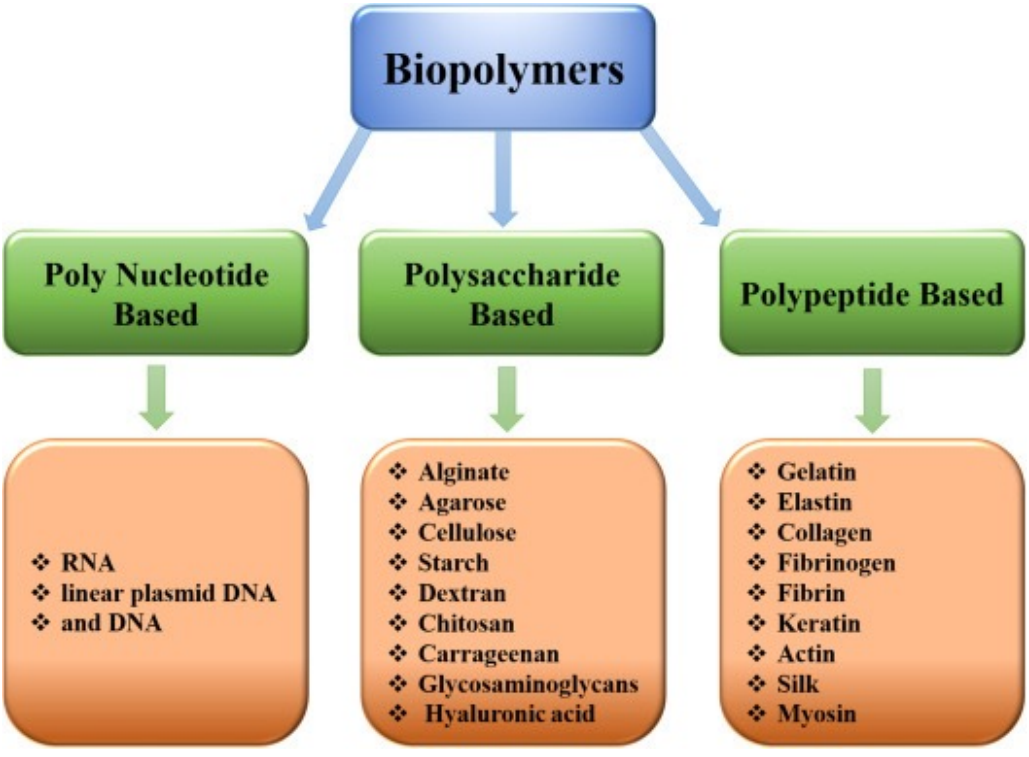
- **Polysaccharides –** These are the polymers of sugar molecules. This group is one of the most abundant class of biopolymers and therefore they tend to be affordable. By volume, derivatives of the α- and β-glucose, starch, and cellulose are the most abundant. These polysaccharides are widely used across the industries ranging from packaging, textile, paper board, print, etc. Polysaccharides are also used in food industries as food additives and thickening agents.
- **Polypeptides –** Amino acids are the monomers of this group of biopolymers. Presence of a peptide bond between amino acid renders these biopolymers degradable. Biodegradation of polypeptides through hydrolysis gives carboxylate and amine as end products. Hydrogen bond donors and acceptors present in these biopolymers defines their secondary and tertiary structures.
- **Polynucleotides –** Polynucleotides like DNA and RNA are biopolymer of nucleotide units. Our life is governed by the genetic code which is carried by the biopolymers called deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). These biopolymers are playing important role in maintaining the life of all the living beings. This group of biopolymers produced in much smaller quantities compared to the polysaccharides.

Let us go through some unique properties of Biopolymers which makes them a better option than synthetic polymers:

- **Biocompatibility:** Their natural origin makes them generally well-tolerated by living systems, hence, lesser risk of rejection in medical applications.
- **Biodegradability:** Since these polymers are easily degradable by various microorganisms

into harmless components, minimal environmental impact is achieved.

- **Renewable resource:** A lot of polymers are derived from readily available plant or microbial sources, fostering sustainable production practices.



Source: https://doi.org/10.1016/B978-0-323-98827-8.00002-3

On the basis of the origin, biopolymers can be classified as below:

Plants	Animals	Microorganism
Cellulose and its derivatives (polysaccharide)	Chitin (polysaccharide)	PHAs (e.g., P3HB, P4HB, PHBHV, P3HBHHx)
Lignin	Chitosan (polysaccharide)	PHF
Starch and its derivatives (mono-saccharide)	Hyaluronan (polysaccharide)	Bacterial cellulose
Alginate (polysaccharide)	Casein (protein)	Hyaluronan (polysaccharide)
Lipids (triglycerides)	Whey (protein)	Xanthan (polysaccharide)
Wheat, corn, pea, potato, soy, potato (protein)	Collagen (protein)	Curdlan (polysaccharide)
Gums (e.g., cis-1, 4-)	Albumin (protein) polyisoprene	Pullulan (polysaccharide)
Carrageenan	Keratin, PFF (protein)	Silk (protein)
PLA (from starch or sugar cane)	Leather (protein)	

Source:

1. https://doi.org/10.1515/9781501521942-001
2. Mazuki, N. F., Saadiah, M. A., Fuzlin, A. F., Khan, N. M., &Samsudin, A. S. (2022). Basic aspects and properties of biopolymers.
3. https://doi.org/10.1016/B978-0-12-803581-8.11573-5
4. Mallik, T. (2022). Biopolymers: Classification and Properties. Journal of Emerging Technologies and Innovative Research, 9(1), c69-c73.

Biopolymers in consumer products

Many modern products are now either encased in biopolymers or constructed from them. Biopolymers are known for their biodegradability, unlike traditional plastics which can persist in the environment for hundreds of years, breaking down into harmful micro plastics. Recognizing the severity of the plastic pollution crisis, advancements in material science have been driven by the need to address this issue. The solution has emerged in the form of bio-based polymers derived from substances such as starch, cellulose, chitin, chitosan, zein, gelatin, among others. These materials are now utilized in a wide array of consumer goods including packaging materials, adhesives, edible films, paper products, and more.

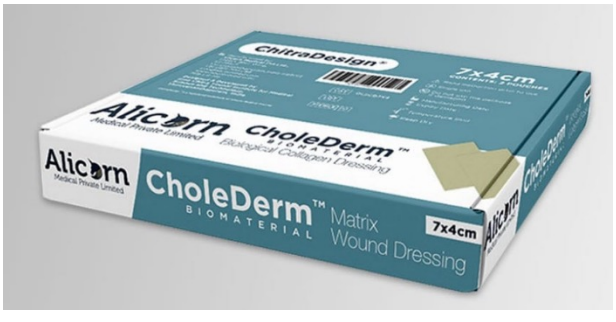
- **Biomedical applications:** Biopolymers, including synthetic, semi-synthetic, and natural polymers, are extensively utilized in drug delivery systems and regenerative medicine applications due to their versatility and biocompatibility. These materials offer innovative solutions for tissue regeneration, controlled drug administration, and various biomedical implants, ranging from vascular grafts to artificial organs. Chitosan for instance, plays an important role in cell attachment and growth. It is also used in bone-tissue engineering and in dietary supplements.
- **Bio plastics:** Every other information article, blog, report points on how harmful plastic is for the environment. With the advancement in material science, we now have an option to substitute regular plastic with bioplastics. Bioplastics derived from resources like corn starch or cellulose offer a more eco-friendly alternative. These are as packaging, disposable cutlery and even textile.
- **Green Composites:** Biopolymers like PLA (polylactic acid) are used to create biodegradable composites, replacing traditional petroleum-based materials in applications such as automotive parts and furniture.
- **Cosmetics and personal care:** Biopolymers such as hyaluronic acid and alginates are finding use in moisturizers, wound dressings, and hair care products due to their moisturizing and gelling properties.
- **Agriculture:** Biodegradable mulches made from biopolymers can suppress weed growth and conserve soil moisture, promoting sustainable agricultural practices. Natural hydrogels are a potential tool for agricultural applications as they can retain a large amount of water and allow the controlled release of fertilizers and other agrochemicals.

For sustainable future, biopolymers have immense potential. With the advance in material science, increasing prospects will uncover. Biopolymers will probably find their way into wider range of applications, with improved production practices which could involve use of genetically modified organisms to produce biopolymers more efficiently.

The Eco-label - “Compostable” is a registered trademark of European Bioplastics and is used to show that packaging is certified to be compostable.

Cosmetic product containing Hyaluronic acid which is a biopolymer made using fermentation by bacteria like *Streptococcus zooepidemicus*

Biopolymers in agriculture



Bio-Medical application of Biopolymer: A collagen based scaffold for wound dressing made by SreeChitraTirunal Institute for Medical Sciences and Technology

Source:

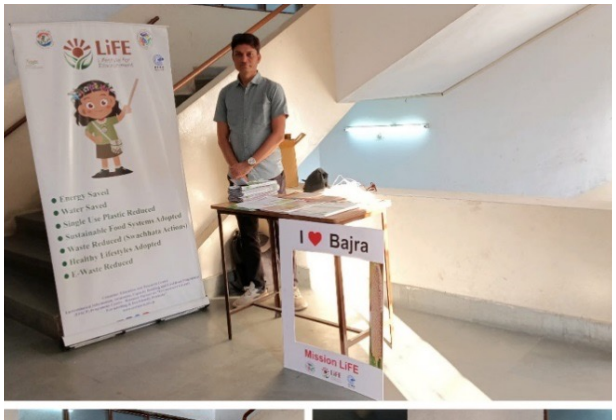
1. Kumar, A. Biopolymers for Medical Applications. Encyclopedia. Available online: https://encyclopedia.pub/entry/20640 (accessed on 15 March 2024).
2. https://dst.gov.in/indian-drugs-controller-approves-first-indigenously-developed-animal-derived-tissue-engineering
3. https://www.un.org/en/exhibits/exhibit/in-images-plastic-forever#:~:text=But%20when%20does%20plastic's%20life,just%20gets%20smaller%20and%20smaller.

Events (January - March 2024)

1.Mr. Karan Thakkar, Information Officer held session on Mission LiFE, Eco label, Millets and Sustainable Lifestyle with law interns at CERC on 1st January, 2024 at CERC.

2. Dr. Kartik Andharia, Programme Officer at CERC-EIACP participated in the expert panel discussion along with Mr. Kiran Nair, Head of Adani Green in the Technology Department, and Dr. Neeru Bansal, Head for the Adani Group. They sparked discussion on energy conservation, electricity production, transportation, and climate change.

3. Dr. Kartik Andharia, Programme Officer, CERC-EIACP, along with his team, visited a cultural programme, BCRC (Bengal Cultural and Recreation Centre), at Prakash Higher Secondary School, Ahmedabad, on 11th February 2024. More than 200 people visited our stall and the team made them aware about Mission LiFE, sustainable lifestyle and benefits of Millets.



4. Dr. Kartik Andharia, Programme Officer, CERC-EIACP PC RP, Ahmedabad attended one day seminar of Padma Shri Dr. Khader Vali, The Millet Man of India, on theme “Change the Food, Change the Life”, organized by Omni Ojas Foundation on 18th February 2024 at Gujarat Vidyapith, Ahmedabad, Gujarat

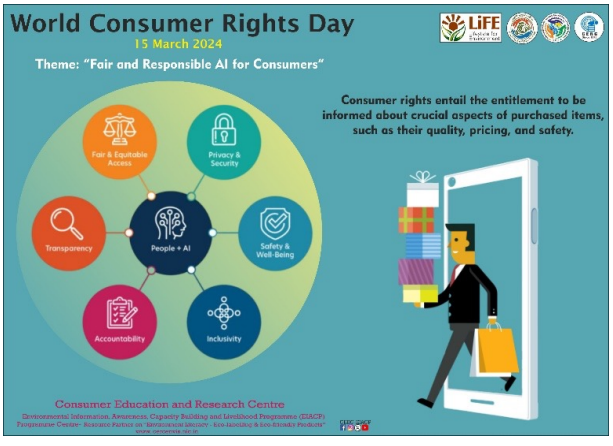
5. CERC-EIACP PC-RP commenced a workshop on “Making of Compost at Home” at Karadiya Rajput Samaj Primary School, Gandhinagar. Dr. Kartik Andharia, Programme Officer, CERC-EIACP, explained the composting process to the students. Mr. Karan Thakkar, Information Officer, CERC-EIACP briefed on the World Wildlife Day. Around 50 students of standard VII, VIII and IX and 4 staff members were sensitized and educated about the concept of recycling kitchen waste to organic manure by composting technique.

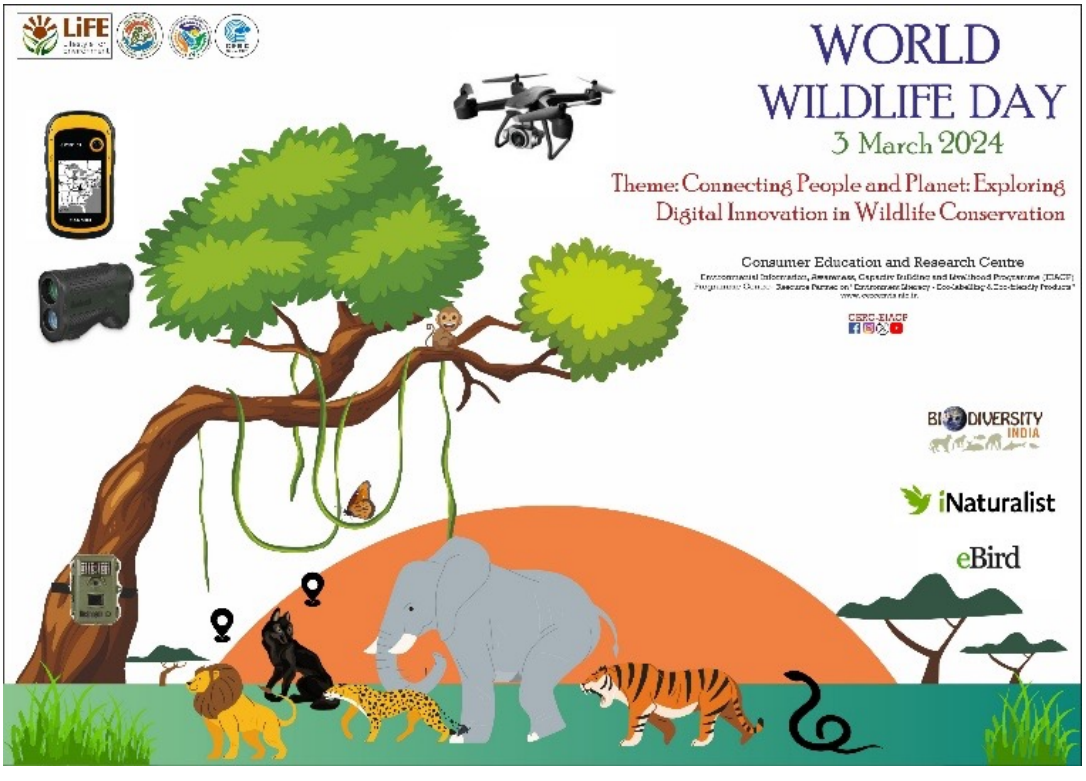
6. CERC-EIACP PC-RP, Ahmedabad organized an awareness session on Adopt Sustainable Food System for the students of Department of Food and Nutrition, Gujarat University. Dr. Kartik Andharia, Programme Officer, explained how to adopt a sustainable food system in daily life and its benefits.

7. CERC-EIACP PC-RP organized an Essay Competition on the occasion of International Forestry Day and World Water Day on themes “Forests and Innovation” and “Water and Peace” at Gujarat University. 40 PG students and 10 research students of the Department of Environment Science have taken part in this competition. Dr. Kartik Andharia, Programme Officer, conducted this competition. All students have taken a Pledge to adopt an environment friendly lifestyle.

Posters (January-March 2024)

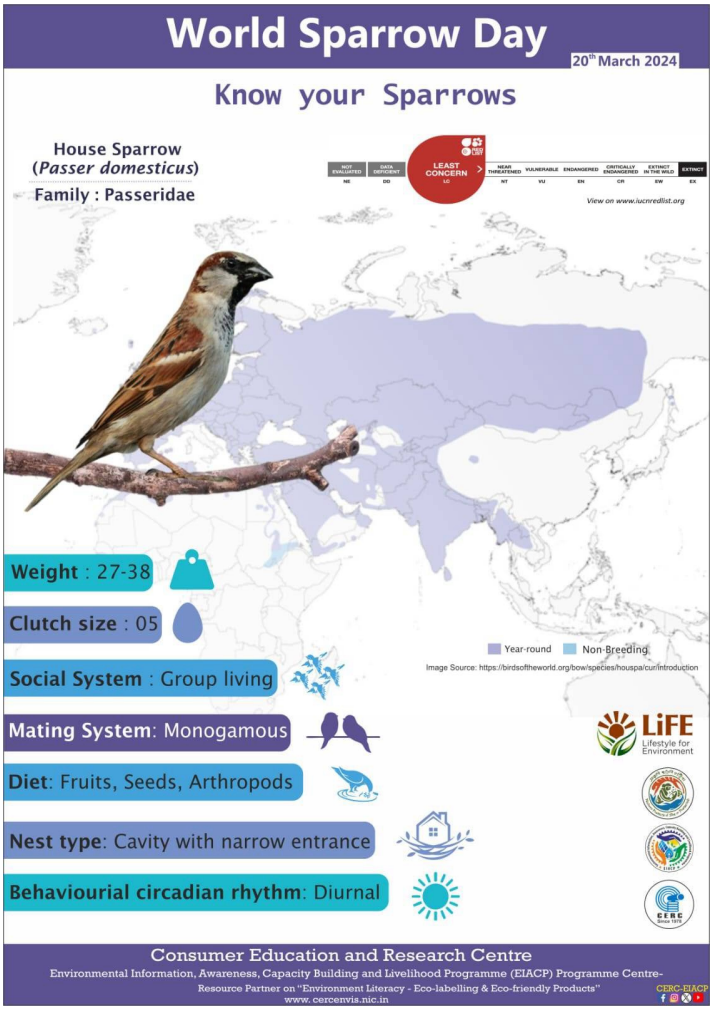
Calendar Link :https://cercenvis.nic.in/PDF/Calendar%202024.pdf






LiFE
Lifestyle for Environment
International Day of Forests
Theme: Forests and innovation: new solutions for a better world.
21 March 2024
Consumer Education and Research Centre
Environmental Information, Awareness, Capacity Building and Livelihood Programme (EIACP) Programme Centre-
Resource Partner on "Environment Literacy - Eco-labelling & Eco-friendly Products"
www. cercenvis.nic.in


WORLD WATER DAY
22th March 2024
Theme: Water for Peace
HOW YOU CAN HELP?
run them fully loaded
while brushing your teeth turn off the water
use the toilet water efficiently, don't use it as a trash can
repair visible leak
take shorter showers, the longer you shower, the more water is wasted
Consumer Education and Research Centre
Environmental Information, Awareness, Capacity Building and Livelihood Programme (EIACP) Programme Centre-
Resource Partner on "Environment Literacy - Eco-labelling & Eco-friendly Products"
www. cercenvis.nic.in


World Sparrow Day
20th March 2024
Know your Sparrows
House Sparrow
(Passer domesticus)
Family : Passeridae
LEAST CONCERN
View on www.iucnredlist.org
Weight : 27-38
Clutch size : 05
Social System : Group living
Mating System: Monogamous
Diet: Fruits, Seeds, Arthropods
Nest type: Cavity with narrow entrance
Behaviourial circadian rhythm: Diurnal
Year-round
Non-Breeding
Image Source: https://birdsoftheworld.org/bow/species/houspa/cur/introduction
LiFE
Lifestyle for Environment
Consumer Education and Research Centre
Environmental Information, Awareness, Capacity Building and Livelihood Programme (EIACP) Programme Centre-
Resource Partner on "Environment Literacy - Eco-labelling & Eco-friendly Products"
www. cercenvis.nic.in

Source: https://www.ekato.com/solutions/processes/biopolymers/

Environmental Information, Awareness, Capacity Building and Livelihood Programme acronymed as EIACP erstwhile Environmental Information System (ENVIS) was implemented by the Ministry of Environment, Forest & Climate Change by end of 6th Five Year Plan as a Plan Scheme for environmental information collection, collation, storage, retrieval and dissemination to policy planners, decision makers, scientists and environmentalists, researchers, academicians and other stakeholders. MoEF&CC has identified Consumer Education and Research Centre (CERC), Ahmedabad, as one of the Resource Partner to collect and disseminate information on "Environment Literacy - Eco-labelling and Eco-friendly Products". The main objective of EIACP Programme centre- Resource Partner is to disseminate information on Environment literacy, Eco-products, International and National Eco-labelling programmes.

Periodical Printed & Published By

Programme Coordinator, CERC-EIACP Programme Centre, Resource Partner On Behalf of Consumer Education & Research Centre, 801, 8th Floor Sakar II Building, B/H Ellisbridge Shopping Centre, Ashram Road, Ahmedabad- 380 006, Gujarat, India.

Phone: 079-353372 62-65

cerc@cercindia.org <cerc@cercindia.org>;

http://www.cercenvis.nic.in/

@CERC.EIACP
@cerc_eiacp
@cerc_eiacp
@CERC-EIACP

Write to us: We value your views and suggestions. Please send your feedback on this issue. We would also like to invite your contributions on the Eco Product and Eco Labelling.

Disclaimer

The material used in this newsletter does not necessarily represent the views of CERC or EIACP. The images and contents provided in the publication are intended solely to provide information from secondary sources.

Printing

Print Express, Ahmedabad.