Tamilnadu State Council for Science and Technology
Sponsored

One day National Seminar on

ADVANCED NANOMATERIALS FOR MICROPLASTIC MITIGATION

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Seminar Proceedings

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MESSAGE

Prof. Dr. S. VINCENT, D.Sc., FNABS., FASCh., FRSB (Lon).,
Member Secretary
Tamil Nadu State Council of Science & Technology, Chennai

It gives me immense pleasure to extend my greetings on the occasion of the *One Day National Seminar on "Advanced Nanomaterials for Microplastic Mitigation"*, scheduled to be held on **February 20th, 2026**, at **Indra Ganesan Institutions, Tiruchirapalli**.

Microplastic pollution has emerged as a critical environmental challenge with far-reaching consequences for ecosystems and human health. In this context, the exploration of advanced nanomaterials for effective detection, remediation, and mitigation of microplastics represents a promising and forward-looking area of research. This seminar provides a valuable platform for academicians, researchers, scientists, and students to exchange ideas, share recent advancements, and foster interdisciplinary collaboration aimed at addressing this global concern.

I am confident that the deliberations, technical sessions, and discussions during this seminar will enrich scientific understanding and inspire innovative solutions aligned with sustainable development goals. The proceedings of this seminar will serve as a meaningful record of contemporary research contributions and will be a useful reference for the academic and research community.

I congratulate the organizing committee for their dedicated efforts in conceptualizing and organizing this timely national-level seminar, and I wish the event every success.

Member Secretary

MESSAGE

Er. S. Sivaranjani
District Environment Engineer
Tamil Nadu Pollution Control Board, Tiruchirappalli

I wish to extend my felicitations to Indra Ganesan Institutions for organizing the One Day National Seminar on *Advanced Nanomaterials for Microplastic Mitigation* on February 20th, 2026. Microplastic pollution has emerged as a critical environmental concern affecting the human health and eco system. I hope that the application of advanced nanomaterials offers promising and sustainable solutions for control of plastic pollution and environmental protection, which is need of the hour. I appreciate the initiative taken to create awareness and promote research in this important domain. Such academic forums play a vital role in bridging science, policy, and environmental management. I wish the seminar fruitful deliberations and meaningful outcomes contributing to a cleaner and safer environment.

District Environmental Engineer
Tamil Nadu Pollution Control Board,
Tiruchirappalli

MESSAGE

Dr. K. Muthukumar
Programme Officer
EIACP, Department of Environment and Climate Change
Government of Tamil Nadu, Chennai

I am pleased to extend my felicitations on the successful organization of this seminar.The theme Advanced Nanomaterials for Microplastic Mitigation addresses a pressing environmental concern. Microplastic pollution demands innovative and science-based solutions.The research contributions presented in this abstract book reflect thoughtful and responsible inquiry. Advanced nanomaterials offer promising pathways for effective environmental remediation.Such academic initiatives strengthen sustainable development goals.I appreciate the efforts of the organizers, researchers, and participants.This seminar encourages collaboration between science, policy, and environmental action.I am confident these studies will contribute meaningfully to environmental protection.I wish the seminar every success and impactful outcomes.

Dr.K.Muthukumar

MESSAGE

Er. G. Rajasekaran
Secretary, Indra Ganesan Institutions
Trichy, Tamil Nadu

I am pleased to extend my heartfelt felicitations to the organizing committee, eminent speakers, and participants of the One Day National Seminar on *Advanced Nanomaterials for Microplastic Mitigation*. The theme of the seminar is highly relevant in the present environmental scenario. Microplastic pollution poses a serious global challenge, and advanced nanomaterials offer promising solutions. I appreciate the efforts taken by the department in organizing this scholarly event. Such academic platforms encourage innovative thinking and research excellence. I wish the seminar a grand success and hope the deliberations lead to meaningful outcomes.

Er.G.Rajasekaran

MESSAGE

Dr. G. Balakrishnan

Director, Indra Ganesan Institutions, Trichy, Tamilnadu

I am delighted to convey my sincere felicitations to all those associated with this One Day National Seminar on *Advanced Nanomaterials for Microplastic Mitigation*. The seminar reflects the institution's commitment to research and sustainable development. The application of nanomaterials in environmental protection is an emerging and impactful research area. I commend the organizers for selecting a socially significant theme. I encourage participants to actively engage in discussions and knowledge sharing. I wish the seminar every success and fruitful technical interactions.

Dr.G.Balakrishnan

MESSAGE

Dr. M. Anusuya
Registrar, Indra Ganesan Institutions, Trichy, Tamilnadu

I am happy to extend my felicitations to the distinguished speakers, delegates, and organizing team of this National Seminar on *Advanced Nanomaterials for Microplastic Mitigation*. The seminar provides an excellent platform for exchanging ideas and recent research findings. Addressing microplastic pollution through nanomaterial innovations is both timely and essential. I appreciate the sincere efforts of the faculty members and student volunteers. I thank the management for their constant support. I wish the seminar a successful and enriching academic experience for all.

Dr. M. Anusuya

HUMAN HEALTH AT RISK: ENVIRONMENTAL MICROPLASTICS AND NANOMATERIALS AS EMERGING CAUSES OF DISEASES AND THEIR CONTROL

Dr. T. Mariappan
(Consultant & Advisor), Former Scientist-F (Dy. Director Sr. Grade), ICMR-VCRC Madurai

ABSTRACT

Present environment is the most conducive for various kinds human diseases mostly related to their living conditions especially both in rural and urban situations. In the case of usage of various kinds of plastics and nano materials emerging as a great threat to the human welfare in the present days. The practical use of those materials for various purposes lead to not only distress human beings but also affect animals as evidenced from the current scenario. The known fact that the age of plastics emerged in 1907, when Leo Baekeland, a Belgian chemist emigrated to the United States, invented the first fully synthetic plastic while searching for a shellac varnish substitute. As we know that high concentrations of microplastics (<100 nm) seem to be higher rates of hypertension, diabetes, stroke and other noncommunicable diseases. At the same time, minute (<5mm) fragments of plastic have become universal in our environment and our bodies. Various kinds of serious diseases, include at least three forms of cancer, disruptions to the endocrine system and hormone imbalances, endometriosis, male fertility struggles and problems for fetus development and others. Microplastics may cause oxidative stress in the airways and lungs when inhaled, leading to respiratory symptoms such as coughing, sneezing, and shortness of breath due to irritation and damage. Though the recent development in nanotechnology has opened up new frontiers by creating new nanomaterials, nanostructures, and nano-heterostructures that have shown excellent performance in sustainable applications, including, energy, environmental and healthcare. However, different forms of emerging contaminants include diverse range of synthetic and naturally occurring chemicals, including pharmaceuticals and personal care products (PPCPs), endocrine-disrupting chemicals (EDCs), micro- and nano-plastics (MNPs), and biological agents in the current environment. Most of the fruits and vegetables are also found microplastic with highest levels and research-based study proved that pears, broccoli, lettuce, potatoes, radishes, and turnips with MNPs. Mostly drinking water contaminants include nitrates, bacteria and viruses, arsenic, fluoride, and lead also because

of the usage of MNPs in our human life. Available report stated that non-recycled toilet paper, microplastic concentrations range from 18 to 23 particles per 10 grams and the mean concentration of microplastics is calculated to be 20.5 particles per 10 grams. Significant health concern reported Ischemic Heart Disease, Stroke, Cancers, Chronic Respiratory Diseases, Diabetes, Alzheimer's/Dementia, Diarrheal Diseases, Tuberculosis, and Lower Respiratory Infections. Preventable health risks through contaminated water and poor sanitation lead to transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid and polio. The long-term health consequences are still being investigated, but current research indicates a significant, emerging, and largely underestimated public health threat. An estimated 10 to 40 million metric tons of these particles are released into the environment every year, and if current drifts continue, that number could double within ten to fifteen years. Scientist's forecasts estimate that 13.2 billion tons of plastic waste will be present in ecosystems by 2050. The various kinds of studies have led to caution the present scenario of the environmental microplastics and nanomaterials as emerging sources of diseases. Thereby prevention / control of such diseases is basically in the hands of community as a whole. An account on these aspects is discussed and well documented in the present gatherings of the conference in detail.

Keywords: *microplastics, sustainable applications, nanomaterials, public health*

MICRO PARTICLES, MASSIVE DAMAGE: MICROPLASTICS AND CLIMATE EMERGENCY

Dr Balathandayuthabani
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Abstract

Microplastics—plastic particles less than 5 mm in size—have emerged as a pervasive and persistent environmental contaminant, posing serious threats to ecosystems, human health, and the global climate system. Generated through the degradation of larger plastic debris and released directly from consumer products, textiles, and industrial processes, microplastics are now detected in air, water, soil, polar ice, and living organisms. While their ecological and health impacts are increasingly recognized, their role in exacerbating the climate emergency remains underexplored. Microplastics contribute to climate change both directly and indirectly. The plastic lifecycle is inherently carbon-intensive, from fossil-fuel extraction and manufacturing to disposal and degradation. As microplastics break down, they release greenhouse gases such as methane and ethylene, intensifying global warming. In marine environments, microplastics interfere with phytoplankton growth and carbon sequestration, weakening the ocean's capacity to act as a carbon sink. Additionally, their interaction with pollutants and microorganisms alters biogeochemical cycles, further destabilizing climate-regulating systems. The presence of airborne microplastics also raises concerns about atmospheric transport and radiative effects, linking plastic pollution to climate feedback mechanisms. Addressing microplastic pollution is therefore not only an environmental or public health priority but also a critical component of climate action. This seminar highlights the sources, pathways, and climate implications of microplastics, emphasizing the urgent need for sustainable materials, improved waste management, policy interventions, and public awareness. Combating microplastics is essential to mitigating massive environmental damage and achieving long-term climate resilience.

Keywords: *ecosystems, human health, plastic pollution, carbon-intensive, waste management*

IMPACT OF MICROPLASTICS ON THE HUMAN BODY

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Abstract

Microplastics, defined as plastic particles smaller than 5 mm, have emerged as a pervasive environmental contaminant with increasing evidence of human exposure and potential health risks. These particles originate from the degradation of larger plastic materials or are manufactured as primary microplastics for industrial and consumer use. Humans are exposed to microplastics primarily through ingestion of contaminated food and water, inhalation of airborne particles, and dermal contact. Recent studies have detected microplastics in human tissues, including the lungs, blood, placenta, liver, and gastrointestinal tract, raising concerns about their biological interactions and long-term health effects.Once inside the body, microplastics may induce physical and chemical toxicity. Their small size allows translocation across biological barriers, leading to cellular uptake and tissue accumulation. Microplastics can trigger inflammatory responses, oxidative stress, mitochondrial dysfunction, and cytotoxicity. Additionally, they act as carriers for toxic additives such as plasticizers, stabilizers, and adsorbed environmental pollutants, including heavy metals and persistent organic contaminants, which may enhance their toxic potential. Emerging evidence also suggests possible endocrine disruption, immune dysregulation, and alterations in gut microbiota composition. Inhaled microplastics may contribute to respiratory irritation, fibrosis, and reduced lung function, while ingested particles may impair intestinal barrier integrity and promote systemic inflammation. Potential associations with metabolic disorders, reproductive toxicity, and carcinogenic risk are currently under investigation. However, most available data are derived from in vitro and animal studies, and comprehensive human epidemiological evidence remains limited.

Given the widespread presence of microplastics in the environment and their detection in human biological systems, there is an urgent need for standardized detection methods, long-term exposure assessment, and mechanistic studies to clarify their health implications. Understanding the toxicokinetics and biological effects of microplastics will be critical for risk assessment and the development of regulatory strategies to minimize human exposure and protect public health.

BIOINDICATORS OF MICROPLASTICS - AN ASSESSMENT THROUGH NANO TECHNOLOGY

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Joint Director, National Centre of Excellence (MHRD), Thiagarajar College, Madurai

Abstract:

The issue of microplastic pollution is increasingly becoming a significant environmental problem due to its durability and potential risks to both ecosystems and human health. Bioindicators, which are organisms that indicate the state of the environment, are frequently employed to track pollutants like microplastics. By integrating nanotechnology with bioindicator-based evaluations, a more sensitive and effective method for detecting microplastics can be achieved. Nanomaterials, including nanoparticles, quantum dots, and carbon nanotubes, can be used to develop highly sensitive sensors capable of identifying even minute quantities of microplastics in biological tissues. These nano-sensors facilitate real-time monitoring and improve the ability to track microplasticbuild up in organisms such as fish, mussels, and plankton. Moreover, the use of nanoparticle labeling and advanced imaging techniques, such as atomic force microscopy and scanning electron microscopy, enables researchers to observe microplastics within cells and tissues, offering valuable insights into their bioaccumulation and toxicity.

Nanotechnology also provides new opportunities for examining the effects of microplastics at the molecular and cellular levels, allowing for the detection of sub-lethal impacts like oxidative stress and genetic damage. Despite its promise, there are still challenges in ensuring the safety of nanomaterials themselves and addressing the complexity of microplastic mixtures. Additionally, scalability and cost-effectiveness are crucial factors that need to be considered for widespread implementation. Nonetheless, the combination of bioindicators with nanotechnology offers a powerful tool for enhancing environmental monitoring, providing deeper insights into microplastic contamination, and advancing efforts to mitigate its effects on ecosystems and public health.

Keywords: *Microplastic, Bioindicators, Nanotechnology, Nano-scale Detection,*

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