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Survey, Selection and Initiation of the Analyses of Emerging Chemical Contaminants (ECCs) of Environment Concern: PCDDs/Fs, PBDEs, PPCPs, Plasticizers etc. in the Indian Samples Archived in the es-Bank of Ehime University, Japan.



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Aim

Obtaining data on the historic trends of various Emerging Chemicals through archived specimens in es-Bank, Ehime University, Japan

Introduction

Regular usage and continuous release of synthetic chemical compounds lead to ubiquitous contamination in all the spheres of the planet earth. In recent years, they have been increasingly detected in environmental and human samples at trace levels ranging from nanograms (ng) to several micrograms (μg). Chemical compounds that are not currently regulated and cause undesirable impact on human or ecological health are regarded as emerging contaminants (ECs). They include antibiotics, hormones, pesticides, pharmaceutical and personal care products, disinfection by-products, plasticizers, preservatives, antimicrobials, synthetic fragrances, UV stabilizers as well as their degradation products (Ramaswamy, 2015). Further, es-Bank of Ehime university is housed with large number of for more than 35 years, from 1983 to 2018. These samples were analyzed for various chemicals of persistent nature like HCHs, DDTs, PCBs, CHLs, HCB, PCDDs/Fs, PBDEs, HBCDs, PAHs, PPCPs, heavy metals, etc. and were published in high ranking scientific journals and presented in international meetings. All these efforts should continue to analyze more samples and to get a holistic picture of the pollution by emerging chemicals and to compare at a global scale.

The numbers of Indian samples analyzed were only limited with respect to conventional pollutants like pesticides, PAHs, PCBs, PCDDs/Fs, Dioxins etc. and a considerable percentage of the samples are stocked in the es-Bank unutilized and particularly for Emerging Chemical Contaminants (ECCs) of endocrine disrupting potential in non target organisms. If those samples are analyzed for emerging chemicals the data can provide a complete history of the usage of these chemicals from the year 1983 (first sampling in India by Ehime University) to till date.

Emerging Chemical Contaminants

Pharmaceutical and personal care products (PPCPs)

Pharmaceuticals and personal care products are usually described as “any product used by public for personal well-being or cosmetic purposes or used by farming industry to improve the growth or health of livestock.”

Phthalate Plasticizers

Plasticizer is a polymer additive that serves to increase the polymers' flexibility, elongation or ease of processing. Plasticizers are used in manufacturing of plastics, food packaging, vinyl flooring and wall covering and PVCs. Further, they are also used in manufacturing of personal care products, such as nail polish, hair sprays, aftershave lotions, soaps, shampoos, perfumes and other fragrance preparations (Net *et al.*, 2015).

Phenolic Compounds

Wastewaters from industrial, agricultural and domestic activities are the main source for Phenolic compounds in the environment. Bisphenol A (BPA) is used to manufacture polycarbonate plastics. Nonylphenol (NP) and octyl phenol (OP) are alkylphenol ethoxylates bearing similar structures are the precursors in the manufacture of non-ionic surfactants used in detergents, emulsifiers, wetting agents, dispersants or solubilizers (Selvaraj *et al.*, 2014).

Surfactants

The synthetic detergents (or surfactants) are the most common group of chemical compounds that are increasingly being used in modern civilization. Surfactants are common contaminants of aquatic environments due to their large consumption in all types of washing and cleaning operations (Seth *et al.*, 2013).

Preservatives

Parabens are a group of p-hydroxybenzoic acid esters, with alkyl substituents ranging from methyl to butyl or benzyl groups. They are extensively used as preservatives and bactericides in many personal care products, as well as in food and pharmaceutical products, textile dyes and paints. The main sources of parabens for the aquatic environment are STP effluents, and wastewaters from hospitals and industries (like textile manufactures, tanneries, etc.) (Ramaswamy *et al.*, 2011).

Antimicrobials

Compounds like Triclosan (TCS) and Triclocarban (TCC) are broad-spectrum antibacterial agents incorporated in a wide variety of household and personal care products such as hand soap, toothpaste, and deodorants but also in other consumer products (e.g., toys, undergarments and cutting boards among other things).

Sunscreens / UV Filters

Benzotriazole ultraviolet stabilizers are applied to protect from ultraviolet radiation damage in a variety of daily-use and industrial products such as car accessories, film, shoes, building materials, antifogging agents owing to their absorption ability in the full spectrum of UV-A (320-400 nm) and UV-B (280-320 nm) light. The environmental contamination by

benzotriazole ultraviolet stabilizers (BUVSS) has received considerable attention due to their long-term and widespread usage in various consumer and industrial products (Vimalkumar *et al.*, 2018).

Benzotriazoles

Benzotriazoles (BTs) is a group of heterocyclic compounds which have been widely applied in industrial activities and domestic life mainly as corrosive inhibitors. BTs have been ubiquitously detected in receiving environments and bring potential toxicity to no-target organisms. In 2008, BTs were classified as emerging organic pollutants (EPs) by the United States Environmental Protection Agency (Richardson *et al.*, 2008).

For performing all these, all the Indian samples stored at es-Bank should be checked (some of them might be unusable even beyond storage). Selected samples should be processed for analysis. While the Japanese collaborating scientists take care of the furtherance of the analytical work, both the Indian scientists will take care of the guidance *via* online and during their future visits to Ehime University, if any.

Result:

For doing all the above, two Indian scientists (Prof. R. Babu Rajendran and Prof. Annamalai Subramanian) visited CMES, Ehime University and carried the following works from 22-09-2019 to 29-09-2019.

1. Collated the published work on Indian samples by Ehime University, Japan by sitting in the initial days of visit in the libraries of CMES and Ehime University.
2. Gathered some of the unpublished data on Indian samples that are available in seminar proceedings, annual progress report seminars, and theses of the students who have obtained M.Sc. and Ph.D. from CMES, Ehime University, Japan. As the data available is voluminous further such work is necessary.
3. Decided on what the emerging chemicals are to be carried out based on existing literature and the suitable samples that can be utilized for further research and the chemicals (mentioned earlier) that can be decided.
4. Checked the information on Indian samples available in es-Bank using the computerized list and other available documents (e.g. field sampling check list).
5. Physically checked and short-listed the samples to find out their suitability for analyzing them with the help of Mr. Ogawa, In-charge, es-Bank.
6. As the annual meeting 2018-19 of CMES was being held during our visit, further discussion and selection of students for further processing of the samples could not be done during our visit.
7. We found that major percentage of both animate and inanimate samples from India are in good condition, suitable for chemical analyses of various emerging chemicals. In our opinion nearly about 4000 well suited samples are available (Annexure-I) for usage of quantifying the historic data of many emerging chemicals.

Expected outcome:

1. Usage of suitable samples collected from India for the past four decades and stocked in the *es*-Bank of CMES, Ehime University
2. Gain wider knowledge on the history of usage and pollution by targeted emerging chemicals
3. Dissemination of the obtained data to the scientific community via publications and presentation in international for a.

Perspectives in future:

Analysing and gaining data from the above samples will lead to supply of valuable historic data on emerging chemicals for more than past four decades. Availability of such organised samples are not available in any of the specimen banks of the world. Publishing and presenting data obtained from these samples will certainly bring fame to the *es*-Bank of Ehime University, Japan

So, we suggest that funds may be made available by applying to various funding agencies for the analyses of these valuable samples. Long term/short term scholarships may also be made available for two students from Bharathidasan University, India and two from Ehime University, Japan. These scholars may be entrusted with the work of different emerging chemicals from different groups of animals. The data obtained can be used to produce M.Sc./Ph.D. thesis of those students, published in journals and also presented in scientific fora. This will certainly raise the fame of *es*-Bank, CMES to new heights in International scientific arena.

List of samples that can be used: Dust, water, Soil/sediment, Terrestrial and Marine Birds, Marine Mammals, Human samples etc.

(See Annexure)

Future Publications:

The data already available on India in the CMES annual seminar proceedings, M.Sc. and Ph.D. Theses of CMES together with the data to be obtained from the future work by Indian and Japanese students will be processed and published.



Photos showing the physical verification of archived specimens at es-bank of CMES

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