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Furans & Dioxins(FD) need to fixed with higher interest rate for sustainable tomorrow

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Abstract— Dioxins are a group of closely related tricyclic chlorinated aromatic chemical compounds which are produced as a result of burning of chlorinated substance the most common practice is during incineration of PVC(Poly-Vinyl Chloride). It can also be formed during combustion processes in the presence of chlorine and organic matter. Dioxins so defined are the most harmful chemical to human health as they are carcinogenic. An effect on health includes developmental & reproductive toxicity. Global distribution of Dioxins occurs largely by atmospheric transport and to a lesser extent by oceanic currents. Prior to analysis sample preparation is needed which comprises of extraction, purification and concentration as determination is done at the level of parts per trillion/parts per quadrillion level with highly sophisticated analytical instrumentation, i.e. Gas chromatography coupled to High Resolution Mass Spectrometry (HR- GCMS) because of significant hazard which dioxin can cause there is a need to monitor this pollutant at a much lower order of magnitude than for any other atmospheric pollutant for a better and sustainable tomorrow.

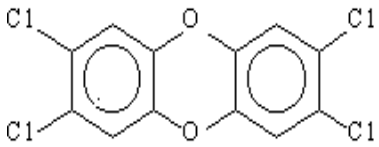
Keywords— Dioxins, PVC, GCMS, Toxicity, Sustainable

I. INTRODUCTION

Poly**c**hlorinated **D**ibenzo-p-**D**ioxin (PCDDs) and **P**oly**c**hlorinated **D**ibenzo**F**uran (PCDFs) popularly referred to as dioxins and furans, or even simply as "**dioxins**" are a group of closely related tricyclic chlorinated aromatic chemical compounds. It consists of 210 different compounds out of which 75 are classified as dioxins & remaining 135 as furans. There are about 17 congeners (2,3,7,8 chlorine substituted compounds) which are are toxic and identified as = "the dirty seventeen" (ref. TABLE I for details).

Dioxins and Furans may be formed during chemical processes involving chlorine and organic compounds. It can also be formed during combustion processes in the presence of chlorine and organic matter [2]. These are strongly adsorbed on surfaces of particulate matter and have extremely low vapour pressure and low water solubilities making it to be highly persistent and non-biodegradable. The half life of dioxins and furans in sediments and water ranges from 30 to 200 years. The non-polar and lipophilic character together with their thermal stability (thermally stable below 750°C), with high melting and boiling point along with an increase in octanol water coefficient with high level of chlorination hence making it soluble in oil, fat with affinity for organic matter is sufficient enough to classified it as "the most toxic synthetic chemical known to have 10,000 times more toxic potent than cyanide."

The present study deals with the sources, health effects of dioxins and how the **TEQ- (toxic equivalent amount of dioxins)**, which is the conventional way of reporting the quantities of dioxins is calculated.

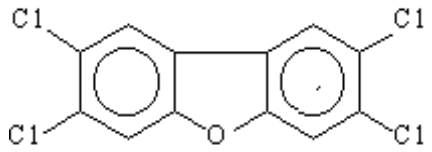


2,3,7,8 TCDD

(PCDDs) Dioxin

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2,3,7,8 TCDF

(PCDFs) Furan

II. SOURCES OF DIOXINS

Dioxins are produced as a result of burning of chlorinated substance the most common practice is during incineration of PVC, similarly when an organic substance is undergoing chlorination dioxins will be formed. These are anthropogenic sources, in addition to these there are natural sources specifically forest fires because of significant hazard which dioxin can cause there is a need to monitor this pollutant at a much lower order of magnitude than for any other atmospheric pollutant.Ambient standards in air are of less than 1 picogram[1] per cubic metre of air, TEQ basis [1].

Combustion Sources

a) Incinerators

b) Vehicle fuels

c) Inorganic chlorochemical processes

d) Metallurgical processes

Industrial Sources

a) Pulp & Paper industry

b) Chemical industries

c) Synthesis of aliphatic compounds

d) PVC incineration

e) Recycling of PVC containing products

f) Synthesis of chlorinated solvents

Global distribution of Dioxins occurs largely by atmospheric transport and to a lesser extent by oceanic currents. Due to its poor solubility in H_2O and low volatility, dioxins become attracted to fine particles and are predominantly transported in suspension in air or water associated with this particulate matter, rather than being in gaseous or dissolved states.

III. HEALTH IMPACTS

Dioxins so defined are the most harmful chemical to human health as they are carcinogenic. However, the compounds which make up dioxins will differ in their toxicity and the less toxic ones will be assigned a fractional value of most toxic dioxin i.e. 2,3,7,8 - Tetrachlorodibenzodioxin (2,3,7,8-TCDD). This is the basis of TEQ- toxic equivalent--amount of dioxins, which is the conventional way of reporting the quantities of dioxins. 90% of the exposure to the human population of dioxins occurs through food intake. An effect on health includes developmental & reproductive toxicity. The virtual safe dose" defined by USEPA 1985 for Dioxins is 0.01 pgTEQ/kg bw/day [3].

IV. DIOXIN ANALYSIS

Gaseous and particulate PCDDs/PCDFs are isokinetically withdrawn from an emission source and are collected in a multi component sampling train. Prior to analysis sample preparation is needed which comprises of extraction, purification and concentration as determination is done at the level of parts per trillion/parts per quadrillion level with highly sophisticated analytical instrumentation, i.e. Gas chromatography coupled to High Resolution Mass Spectrometry (HR- GCMS).

TABLE I

	I-TEF for dirty 17
PCDDs / PCDFs	
Dioxins (Structure)	International Toxic Equivalency Factors (I-TEF)
2.3.7.8 Tetra-CDD	1.000
1.2.3.7.8-Penta-CDD	0.500
1.2.3.4.7.8-Hexa-CDD	0.100

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1.2.3.6.7.8-Hexa-CDD	0.100
1.2.3.7.8.9-Hexa-CDD	0.100
1.2.3.4.6.7.8-Hepta-CDD	0.010
OCDD	0.001
Furans	
2.3.7.8-Tetra-CDF	0.100
1.2.3.7.8-Penta-CDF	0.050
2.3.4.7.8-Penta-CDF	0.500
1.2.3.4.7.8-Hexa-CDF	0.100
1.2.3.6.7.8-Hexa-CDF	0.100
1.2.3.7.8.9-Hexa-CDF	0.100
2.3.4.6.7.8-Hexa-CDF	0.100
1.2.3.4.6.7.8-Hepta-CDF	0.010
1.2.3.4.7.8.9-Hepta-CDF	0.010
OCDF	0.001

TABLE I. For the TEQ calculation the amount or concentration of each relevant congener is multiplied with the corresponding TEF [3].

REFERENCES

[1] Available: http://www.epd-sg.gov.sk/textonly/english/report/dioxin02.php

[2] J.C Jones, Atmospheric Pollution, Jones & Ventus publ ApS, 2008

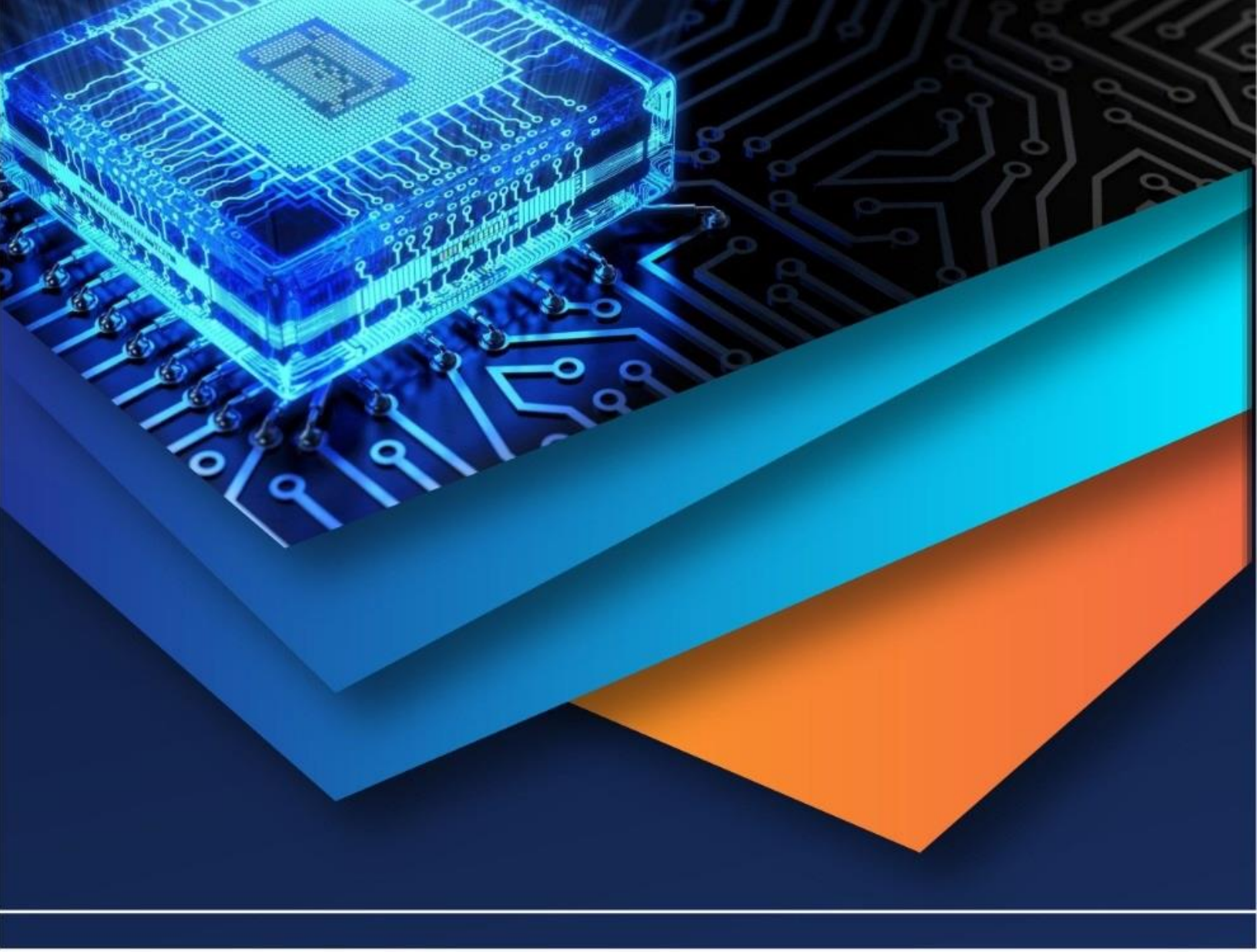
[3] Sampling of PCDDs / PCDFs , EN 1948-1:2006:E

Notes

[1]1 picogram (pg) = 10^{-12} g

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