Study
on
Plastic Waste Disposal
through
“Plasma Pyrolysis Technology"

Central Pollution Control Board

(Ministry of Environment & Forests & Climate Change)
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Content

Background of the Study

Plasma pyrolysis is one of the technologies which could be opted for disposal of plastic waste. In Plasma Pyrolysis, high temperature is produced using plasma torch in oxygen starved environment to destroy plastic waste efficiently and in an ecofriendly manner. To find out its performance, Central Pollution Control Board (CPCB) sponsored a project titled "Plastic Waste Disposal using Plasma Pyrolysis Technology" to Facilitation Centre for Industrial Plasma Technology (FCIPT), Institute for Plasma Research, Gandhi Nagarar (Gujarat). The experiment has been conducted using different categories of plastic waste such as thin carry bags, metalized and multilayer pouches etc. During the experiment, emission of pollutants i.e. particular matter (PM), Oxides of Nitrogen (NO_2), Carbon Monoxide (CO), Dioxins and Furans were also monitored. The analytical data indicates that the emission of toxic pollutants including dioxins and furans are lower than the prescribed standards for hazardous waste incinerators. Pyrolysis of plastic (polyethylene) provides 90% combustible gases. It would be appropriate to recover energy to make plasma pyrolysis economically viable. This report can be useful to municipal authorities, health care facilities, religious and tourist places for disposal of non-recyclable and multi-layered and metalized plastic wastes.

Executive Summary

Disposal of plastic waste is a serious concern in India. New technologies have been developed to minimize the adverse effect on the environment. Currently widely accepted technology used for the plastic disposal is incineration, however, incinerators designed poorly, releases extremely toxic compounds (chlorinated dioxins and furans) therefore, facing strong opposition from various organizations. In India to introduce a cleaner and safer technology, FCIPT, Institute for Plasma Research had taken initiatives to develop plasma pyrolysis technology with the financial support from Technology Information, Forecasting & Assessment Council (TIFAC) and Department of Science and Technology (DST), New Delhi. In this technology extremely high temperature is produced using plasma torch in oxygen starved environment which destroy plastic waste efficiently and eco-friendly manner. FCIPT developed and demonstrated the technology successfully for waste disposal capacity approximately 15 Kg/hr.

Based on above developments on plasma pyrolysis technology, Central Pollution Control Board (CPCB) has sponsored a study to FCIPT, Institute for Plasma Research to conduct emission monitoring trials for Dioxins and Furans, PM, NOx, CO etc. from a recognized laboratory under Environment (Protection) Act, 1986. On the basis of emission results, CPCB may take initiatives to resolve issues of plastic waste disposal by installing few plasma systems in the country. The analytical results in respect of dioxins and furans emission results are found within the standards set for hazardous waste incinerators in case of disposal of 100% metallized plastics, 100% polyethylene plastics and 80% Polyethylene+ 20% PVC waste is in the plasma pyrolysis system (15 kg/hr). However, process optimization is done for 50% PVC + 50% polyethylene and 100% multilayer plastic waste. The results of dioxins and furans emissions were found within prescribed limits.

In order to make plasma pyrolysis technology economically viable, energy recovery possibilities from plastic waste have been discussed in the report because plastic contains high calorific value and it could be possible to recover surplus energy from the system. It is therefore, recommended to use plasma pyrolysis system to re-solve the problems associated with plastic waste disposal. Further, there is an advantage that plasma pyrolysis system can be installed at hill stations, tourist places etc. to demonstrate decentralized disposal of plastic waste.

1. About Plasma Pyrolysis Technology (PPT)

Plasma pyrolysis technology is the disintegration of organic compound into gases and non- leachable solid residues in an oxygen-starved environment. Plasma pyrolysis utilizes large fraction of electrons, ions and excited molecules together with the high energy radiation for decomposing chemicals. In addition, both the physical and chemical reactions occur rapidly in the plasma zone.

In early 1990s, plasma pyrolysis emerged as a technology in the world, which provides a complete solution to destroy plastics, medical and other hazardous waste safely. The intense and versatile heat generation capabilities of plasma torches used in this technique enable it to dispose of all types of waste including polymer waste, municipal solid waste, medical waste and hazardous waste in a safe and reliable manner. The plasma pyrolysis technology has demonstrated that the quantity of toxic compounds such as dioxins and furans in the emissions are below the prescribed limits of EPA, USA. In USA, plasma pyrolysis technology has been recognized as a non-incineration process [1-2]. In this process the fourth state of matter i.e. plasmas (core temperature is 20,000°K) were used for dissociating molecular bonds. Plasma pyrolysis has recently been accepted as a technology alternative to incineration in USA. Plasma technology also falls in the category of non-burn technology and can be used for different categories of waste that cannot be treated with burn techniques [3]. Various alternative treatment technologies for the disposal of medical waste are suggested and plasma pyrolysis has also been considered as a technology alternative to incineration [4-12]. Solena and Wasting house plasma systems are in use for the safe disposal of variety of waste stream.

The plasma arc technology is a well-proven, well-demonstrated commercially viable technology, which is currently utilized in industrial plants worldwide. The Marc II plasma torch and heating system is the main piece of equipment for all of SOLENA Group's projects worldwide [13]. Retech Incorporation of California and U.S. Department of Energy initiated a collaborative program to destroy a variety of waste using plasma arc technologies in 1989 and later in 1994 developed a rotating plasma furnace [14-19]. The status of the thermal plasma technologies is reviewed recently by Pfender [20]. Plascon, In-Flight Plasma Arc System is designed to treat chlorinated organic compound. Destruction efficiencies of better than 99.99% were achieved for organic contaminants. Plascon system yielded very high destruction performance and releases dioxins and furans in the range of 0.005-0.009 ng/m^3, which is well below the set limit of environmental standard in the world [17].

Incineration is another technology that is currently used to destroy plastic, municipal and hospital waste especially biomedical waste and hazardous chemical waste by reducing volume and destroying some harmful constituents. Incineration utilizes combustion to reduce waste materials to noncombustible residue or ash and exhaust gases. Modern incinerator has burner (oil or gas fired), primary and secondary chambers, scrubber, cyclone separator, bag filter and induced draft fan. However, the demand for excess air- flow limits the temperature that is required in incineration. Due to insufficient temperature generated in the process chamber, incinerators produce extremely toxic products like furans and dioxins. Chlorinated dioxins and furans cause air pollution and dreaded disease like cancer, abnormalities etc. The toxic pollutants can remain in the bottom ash of incinerators, eventually finding their way into landfills. Incineration technique is facing much criticism in recent days because of the formation of toxic compounds.

The total consumption of plastic in India is around 8 million tonnes and it has been assumed that 70% of the total plastic consumed is converted into waste i.e. approximately 5.6 million tonnes of plastic waste is generated in the country every year. Apart from plastic waste generated through municipal solid waste (MSW), the disinfected plastic waste may also be treated through this technology. Keeping in view of significant and multifarious nature of plastic waste there is needed to undertake research in the area of Plastic Waste Management (PWM) like Plasma Pyrolysis Technology (PPT). This technology has extensive relevance in Indian context to resolve the problems associated specially with non-recyclable multilayer and disinfected medical plastic waste.

2. Objectives of the Study

The objective of the study is to demonstrate and evaluate the performance of Plasma Pyrolysis Technology for safe destruction of different categories of plastic waste.

3. Methodology

Following methodology was adopted for the execution of the proposed study.

(i) The Plasma Pyrolysis System (15 Kg/hr capacity) was made available for the trial of plastic waste disposal at FCIPT, Gandhi Nagarar (Gujarat).

(ii) Different types of plastic waste such as polyethylene bags, soiled plastic, metallized plastic, multi-layer plastic and PVC plastic have been used.

(iii) Initial experiments were conducted by FCIPT team however; the final emission monitoring has been carried out jointly by FCIPT and Vimta Lab, Hyderabad.

(iv) The sample collection and testing of dioxins, furans, from stack as well as from scrubber water and primary chamber residue and PM, S0x, NOx, CO from stack was carried out by M/s Vimta Lab and NIIST, Trivandrum.

(v) A report on various plastic waste disposal trials using Plasma Pyrolysis Technology was prepared.

4. Brief Description of Plasma Pyrolysis System and Process

The plasma generation is carried out in plasma pyrolysis system as shown at Figure:

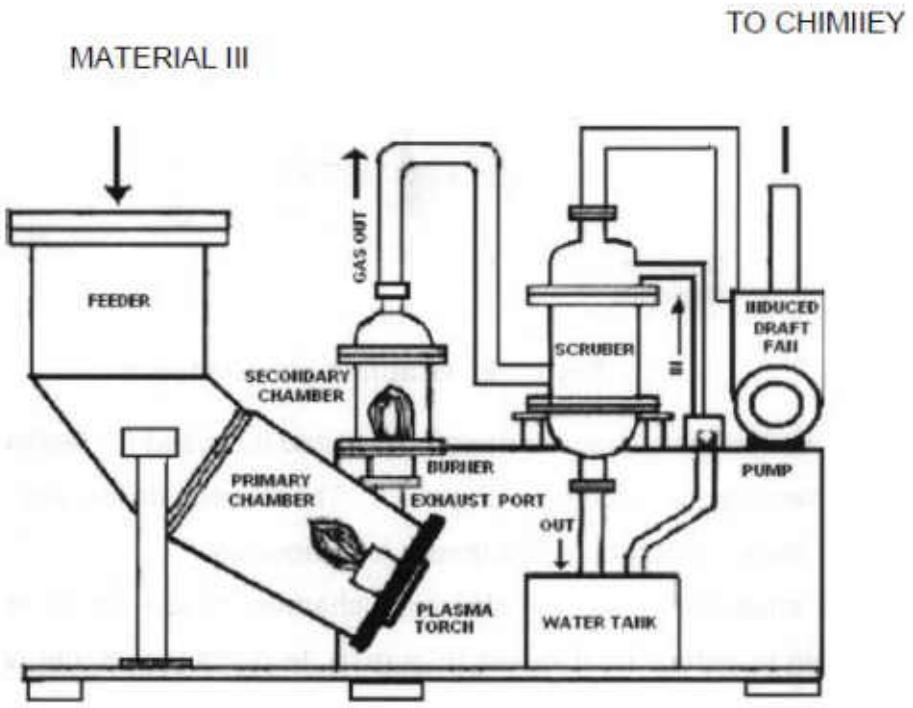

Figure 1: Flow diagram of Plasma

4.1 Description of Plasma Pyrolysis System

(i) Plasma torch & power supply: Plasma torch comprises of three graphite electrodes (one anode and two cathodes). DC power supply is used to produce plasma arc among these electrodes. Plasma torch converts electrical energy into heat energy in an efficient manner. It is used to heat the primary chamber where pyrolysis takes place as shown in **Figure 1.**

The graphite plasma torch produces non-transfer arc. Entire torch operation is auto-controlled to sustain continuous pyrolysis reaction. Graphite plasma torch used in the present set-up comprises of a tubular anode and two-rod shaped cathode. The

electrodes are mounted on holding arrangement. An arrangement is made to rotate cathodes in linear and angular motion. The electrodes are mounted at 90' angle as shown in (**Figure 2**). The electrodes are powered by indigenously designed and fabricated 200 Ampere and 125 Volt power supply. The advantage of graphite plasma torch is that it does not require electrode cooling, which eliminates heat losses. In addition, one can strike and maintain the plasma in the absence of gas flow. The graphite plasma torch produces non-transfer arc.

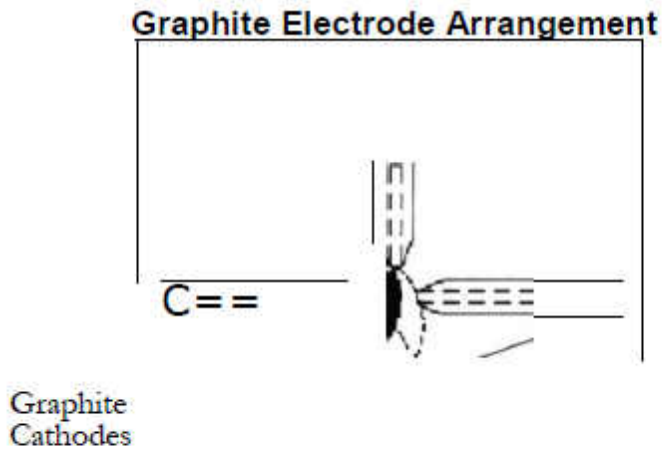

Figure 2: Graphite plasma torch

(ii) Feeder: Feeder has two door arrangements and it is used for feeding the waste material in primary chamber as shown in **Figure 1**. The feeder doors are opened and closed hydraulically. Steam is purged in the feeder to remove air.

(iii) Primary chamber: It is a rectangular chamber made-up of mild steel and it has refractory lining to reduce heat losses (**Figure 1**). In primary chamber, waste is pyrolysed at high temperature (>1000ºC near pyrolysis zone and >650ºC close to chamber wall) is generated by plasma torch. After the pre-heating, organic waste is fed into the primary chamber where it is decomposed in oxygen starved environment. In primary (pyrolysis) chamber, gases such as methane, carbon monoxide, hydrogen, are produced.

(iv) Secondary chamber: It is cylindrical chamber having refractory lining. In this chamber there is provision to mix air. One electrically operated igniter is mounted to ignite combustible gases that come out from primary chamber. The pyrolysis gases are combusted in secondary chamber which increases its temperature between **800-1000°C**. The product gases formed after the combustion reactions are primarily CO_2 and water vapour.

(v) Scrubbers: Venturi and secondary scrubbers are used for quenching as well as

for scrubbing the gases. In scrubbing chamber 12pH NaOH solution is sprinkled using a pump. The hot gases comes out from the secondary chamber are quenched in venturi scrubber and finally scrubbed in the secondary scrubber.

(vi) Induced draft fan and chimney: The gases such as CO_2, H_2O are released in the environment using induced draft fan.

4.2 Plasma Pyrolysis Process

Plasma is a fourth state of matter after solid, liquid and gas. It is the most active state of matter. Hot plasma which is generated using plasma torch and power supply is used for the disposal of waste. There are two types of plasma arcs: transferred arc and non-transferred arc. In this case non-transferred arc has been selected because organic waste has been used. Graphite plasma torch is used for the disposal of plastic waste. Plasma torch has three graphite electrodes (one anode and two cathodes). These electrodes are connected with power supply. Plasma arc is produced among these electrodes. Plasma torch converts electrical energy into heat energy and this heat is used to heat the primary chamber. In plasma pyrolysis the most likely compounds which are produced include carbonaceous matter, methane, carbon monoxide, hydrogen, carbon dioxide and water molecules. The possible chemical reactions which take place during the pyrolysis of polyethylene are described below:

$$\underset{\text{Polyethylene}}{[-CH_2\text{-}CH_2\text{-}]n} + H_20 + \text{Heat} \quad xCH_4 + yH_2 + zCO + \text{Soot} + \text{higher HC} \qquad \text{(i)}$$

$$CH_4 + H_2O \longrightarrow CO + 3H_2 \qquad \text{(ii)}$$

$$C + H_2O \longrightarrow CO + H_2 \qquad \text{(iii)}$$

5. Plastic Waste for Disposal, Sampling & Analysis Method

Different types of plastic wastes are packed into packets as shown in **Figures 3 to 6** for feeding into Plasma Pyrolysis System. The emissions from the system after pyrolysis were collected for analysis of Dioxins and Furans and other pollutants such as CO, NOx, SOx, PM etc. The analysis was conducted by VIMTA Lab, Hyderabad by using EPA, US methods 23A and 1613 for sample collection and analysis respectively. High Resolution Gas Chromatograph and High Resolution Mass Spectrometer having detection limit upto 0.01 picogram (pg) was used for the quantitative measurements of dioxins and furans.

Figure 3: Metallic Plastic

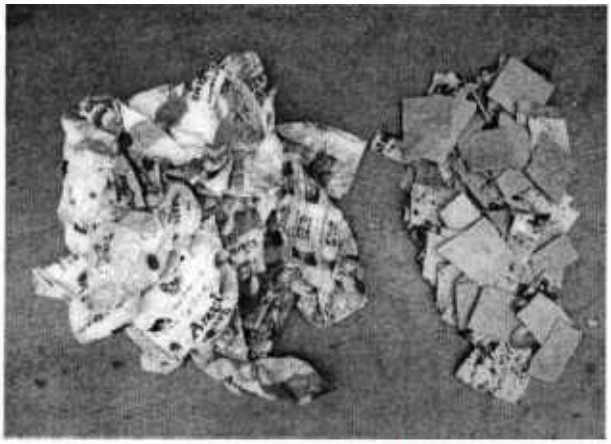

Figure 4: 50% PE + 50% PVC by weight

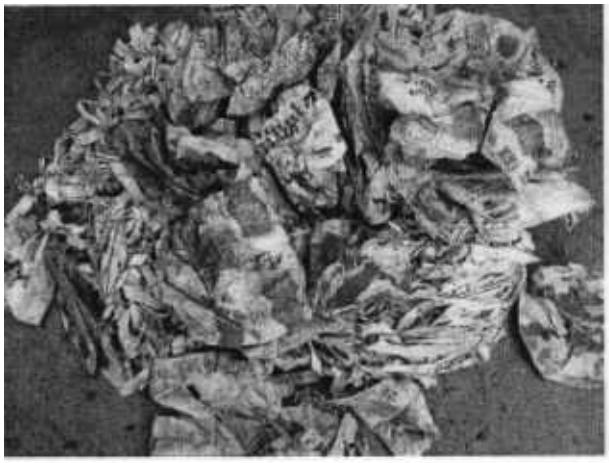

Figure 5: Soiled Plastics

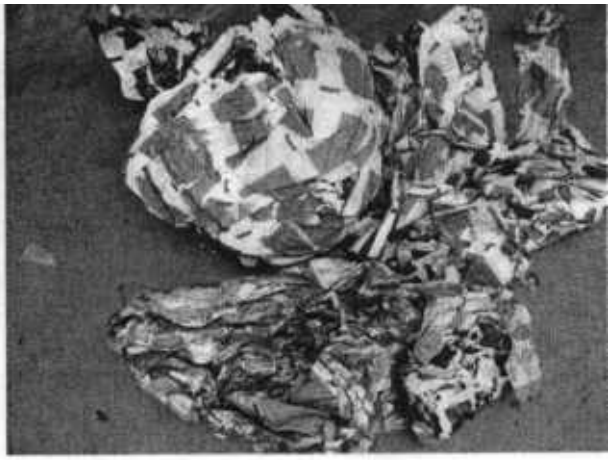

Figure 6: Multi Layer Plastic

Figure 7: Plastic Packets ready for feeding in Plasma Pyrolysis System

Figure 8: Plasma Pyrolysis System at FCIPT

6. Results & Discussion

Stack emission monitoring has been carried out for different categories plastic waste such as (i) 100% Polyethylene Waste (ii) 80% Polyethylene + 20% PVC Waste (iii) 100% Metallized Plastic Waste (iv) 50% Polyethylene + 50% PVC Waste (v) Soiled plastic waste and (vi) Multi-layer plastic waste. It has been observed that the emission of toxic pollutants such as dioxins and furans from the system is lower than the prescribed norms set for hazardous waste incinerators (Annexure C). The summary of the results are mentioned in the **Tables 1 to 3.**

Table 1: Dioxins & Furans Emissions from Plasma Pyrolysis System

Sr. No.	Specifications	Common Hazardous Waste Incinerator Norms (As per the Gazette of India Annexure C)	Emission from Plasma System(80% Polyethylene + 20% PVC Waste)*	Emission from Plasma System(100% Polyethylene Waste)*
1.	Dioxins and Furans **(Stack)**	0.1 ng/Nne TEQ	0.00004 ng/Nm^3	0.00001 ng/Nm^3
2.	Dioxins and Furans **(Scrubber Water)**	(Norms are not mentioned)	0.36 pg/L	0.58 pg/L
3.	Dioxins and Furans **(Primary Residue)**	(Norms are not mentioned)	<0.01 ng/Kg	<0.01 ng/Kg

Note: All the results are corrected to 11% 0_2 concentration.

*** Detailed results on emissions from 80% Polyethylene + 20% PVC and 100% Polyethylene waste are mentioned in Annexure A.**

Table 2: Gaseous Emissions from Plasma Pyrolysis System

Sr. No.	Specifications	Common Hazardous Waste Incinerator (As per the Gazette of India- Annexure C)	Emission from Plasma System (100% Metallized Plastic Waste)*	Emission from Plasma System (50% Polyethylene+ 50% PVC Waste)*
1	O_2	---	14.6%	13.6%
2	CO_2	> 7%	5.3 %	3.9%
3	CO	100 mg/Nm^3	43.7 mg/Nm^3	25 mg/ Nm^3
4	SO_2	200 mg/Nm^3	60.3 mg/Nm^3	55.6 mg/ Nm^3
5	NO	400 mg/^{3}	111.24 mg/Nm^3	127.7 mg/ Nm^3
6	SPM	50 mg/Nm	38.3 mg/Nm^3	19.9 mg/ Nm^3
7	HCl	50 mg/Nm^3	30.2 mg/Nm^3	41.3 mg/ Nm^3
8	Dioxins and Furans (Stack)	0.1 ng/Nm^3	0.02655 ng/Nm^3	0.14078 mg/ Nm^3
9	Dioxins and Furans (Scrubber water)	(Norms are not mentioned)	20.19 pg/L	157.58 pg/L
10	Dioxins and Furans (Primary Residue)	(Norms are not mentioned)	0.14 ng/Kg	6.13 ng/Kg

*** Detailed results on emissions from 100% Metalized and 50% polyethylene Et 50% PVC waste are mentioned in Annexure B.**

Table 3: Gaseous Emissions from Plasma Pyrolysis System

Sr. No.	Specifications	CPCB Norms (As per the Gazette of India-Annexure C)	Emission from Plasma System (Soiled Plastic Waste)*	Emission from Plasma System (Multi-layer Plastic Waste)*
1	O_2	---	16.2%	11.3%
2	CO_2	> 7%	4.2%	6.6%
3	CO	100 mg/Nm^3	15 mg/Nm^3	68.7 mg/ Nm^3
4	SO_2	200 mg/Nm^3	57.8 mg/Nm^3	53.2 mg/ Nm^3
5	NOx	400 mg/Nm^3	131.8 mg/Nm^3	125.7 mg/ Nm^3
6	SPM	50 mg/Nm^3	65.9 mg/Nm^3	57.3 mg/ Nm^3
7	HCl	50 mg/Nm^3	44.3 mg/Nm^3	33.5 mg/ Nm^3
8	Dioxins and Furans (Stack)	0.1 ng/Nm^3 TEQ	0.06697 ng/Nm^3	0.197 ng/ Nm^3
9	Dioxins and Furans (Scrubber water)	(Norms are not mentioned)	327.4 pg/L	390.17 pg/L
10	Dioxins and Furans (Primary Residue)	(Norms are not mentioned)	11.38 ng/Kg	0.40 g/Kg

*** Detailed result on emissions from Soiled Plastic and Multi-layer Plastic waste are mentioned in Annexure B.**

The results indicate that with 20% PVC, emissions were well within the emission standards however, when 50% PVC or 100% multi layer plastic was destroyed, the emissions were found little higher in stack emissions. Therefore, the processes have been optimized by adjusting different parameters. After the optimization, the waste which includes 50% polyethylene + 50% PVC given best result, multi-layer plastic and metalized plastics were destroyed and the sample collection and analysis was carried out by NIIST, Trivandrum (formerly known as RRL, Trivandrum). US-EPA methods 23 for sample collection and 8280B for measurements were followed by NIIST. High Resolution Gas Chromatograph and Low Resolution Mass Spectrometer was used to detect dioxin and furan consigners. All the emissions measured in the exhaust were reported within permissible limit. The wastes destroyed and stack emission results for dioxins and furans are shown in **Table 4**.

Table 4: Stack Emission Results 2,3,7,8-congener group of dioxins and furans in flue

COMPOUND NAME	50% PE+50%PVC TEQ (ng/Nm^3)	50% PE+50%PVC TEQ(ng/Nm)	Multi-Layer Plastic TEQ(ng/Nm3) Flue gas-7	Metallized Plastic TEQ (ng/Nm3)
DATE	**09.05.09**	**13.05.09**	**14.05.09**	**15.05.09**
2,3,7,8-TCDD	0	0	**0.005**	**0.005**
1,2,3,7,8-PeCDD	0	0	0	0
1,2,3,4,7,8-HxCDD	0	0	0	0
1,2,3,6,7,8-HxCDD	0	0	0	0
1,2,3,7,8,9-HxCDD	0	0	0	0
1,2,3,4,6,7,8-HpCDD	0	0	0	0
1,2,3,4,6,7,8,9-0CDD	0	0	0	0
2,3,7,8-TCDF	0.02	0	0	0
1,2,3,7,8-PeCDF	0	0	0	0
2,3,4,7,8-PeCDF	0	0	0	0
1,2,3,4,7,8-HxCDF	0	0	0	0
1,2,3,6,7,8-HxCDF	0	0	0	0
2,3,4,6,7,8-HxCDF	0	0	0	0
1,2,3,7,8,9-HxCDF	0	0	0	0
1,2,3,4,6,7,8-HpCDF	0	0	0	0
3,4,7,8,9-	0	0	0	0
1,2,3,4,6,7,8,9-0CDF	0	0	0	0
TOTAL TEQ	**0.02**	**0**	**0.005**	**0.005**

Note: PE- Polyethene, PVC-Polyvinyl-chloride

7. Energy Recovery Possibilities:

Plasma pyrolysis of plastic waste provides a large quantity of CO, H_2, and CH_4 and small quantity of higher hydrocarbon gases as mentioned in equation (i), (ii) and (iii). The electrical energy through plasma is consumed in melting of plastics, bond dissociation (degradation) and in endothermic reactions. When the combustion of CO, H_2 and CH_4 gas is carried out then following exothermic reactions take place and energy in the form of heat and light is released:

$CO + 1/2O_2 = CO_2$ AH = -67.63 Kcal .... (iv)

$H_2 + 1/2O_2 = H_2O$ AH = -57.82 Kcal (v)

$CH_4 + O_2 \text{—>} CO_2 + H_20$ AH = -212.22 Kcal (vi)

In plasma pyrolysis process on average **1kWh** energy is required to pyrolyse **1 kg plastic** waste [22]. It does not include losses through chamber wall and energy required to run other sub-systems. Consumables in the plasma pyrolysis process are

mainly electricity, and graphite electrode. Economic viability of the process along with the energy recovery options have been elaborated through calculations based on chemical reactions as well as by quantitative measurement of pyrolysed gases formed. Further, in a separate study to recover energy from pyrolysis of waste, few experiments were conducted using cotton and plastic waste in 70:30 proportion. Gas chromatograph results of the plasma pyrolysis of waste (cotton + plastic : 70%+30%) revealed that typical gaseous products formed are rich in hydrogen and carbon monoxide with some lower hydrocarbons; if the residual gas has to be used to recover energy in the form of electricity. However, it should be free from corrosives/toxins. Therefore the pyrolysis gases are cleaned first using multiple scrubbers and filters. The high calorific value gases produced in pyrolysis provide intense flame on burning. To recover energy, scrubbed and cleaned gas is combusted in the internal combustion (10) engine of Gas Generator that produce electricity **(Figure 9)**. Cool and clean pyrolysed gases are collected in a buffer tank. The fuel gases are supplied to the Gas-Generator set through this buffer tank. The provision of the buffer tank ensures the smooth supply of fuel gases to the Gas-Generator set, in case of any fluctuation in the gas production. It will ensure a constant output from the Gas-Generator set. The Gas-Generator set sucks the gases and generates sufficient negative pressure in the filter. The clean and cold (room temperature) pyrolysed gas is combusted in the Gas-Generator set to run it at 1500 rpm. The Gas-Generator set is coupled with an alternator to generate electric power at 50 Hz. Based on our calculations, considering losses into account, it is estimated that power generation from 15 kg/hr system would be around 15 kWh.

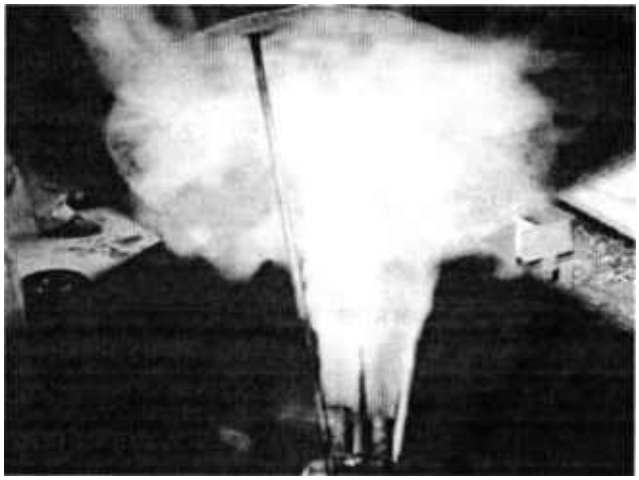

Figure 9: Combustion flame of pyrolysis gas at the exhaust

Table 5: Concentration of Gases formed when Polyethylene is pyrolysed using Graphite Plasma Torch

Gases	Volume (%)
Hydrogen	41.4
Carbon monoxide	15.3
Methane	17.7
Carbon dioxide	1.6
Higher Hydrocarbon*	16.7
Nitrogen	7.3

Higher Hydrocarbons present in pyrolysis gases where C2 - 75%, C3 & higher HC - 25%

Prior to the start of the actual experiments, a few calculations were carried out to find out the maximum possible energy released by the way of dissociation of the waste. To make these calculations simple, the initial 'waste to be pyrolyzed' is taken as either 100% plastic or 100% cotton. In the case of 100% plastic, the calculations have suggested that the released chemical energy would be 2 to 3 times more than the energy needed to pyrolyse the raw waste [20], whereas in the case of 100% cotton the released energy is almost equal to the spent energy.

It can be concluded that energy recovery is possible from the plasma pyrolysis of plastic and cotton waste. It is evident from calculations as well as from the demonstration of a few large capacity (0.3 ton/hr-3 ton/hr) plasma waste destruction systems elsewhere in the World [23, 24] that sufficient energy can be produced from disposal of plastic waste through Plasma Pyrolysis System. The analysis of primary chamber gas (at FCIPT) also reveals that high calorific value gases can be generated from plasma pyrolysis of plastic waste.

8. Demerits of PPT

- Wastes gasification and combustion ultimately releases carbon dioxide to the Atmosphere instead of sequestrating a large fraction of the carbon in a landfill.

- Requires large electrical energy input, if the waste stream does not contains a large fraction of hydrocarbon.

- The highly corrosive plasma may lead to frequent maintenance and component replacement with associated down time of facility.

9. Conclusion

- PPT can be used to destroy (i) Metallized plastics (ii) Polyethylene plastics (iii) 80% Polyethylene + 20% PVC (iv) soiled plastic, (v) 50% polyethylene + 50% PVC and (vi) Multi-layer plastics in an environment friendly manner.

- The plasma pyrolysis system can resolve the problems associated particularly non-recyclable and low grade plastic waste.

- Generation of extremely high temperature in oxygen starved environment makes this technology useful for the safe destruction of plastic wastes.

- PPT for the disposal of plastic waste along in conjunction with energy recovery makes it economically viable in higher capacity systems.

- This technology (PPT) can safely destroy chlorinated as well as multi-layer plastic wastes.

- The plasma pyrolysis system can be installed in tourist/hilly locations in the country where disposal of plastic bags, metalized pouches, bottles etc. is a matter of concern and significant transportation cost could be saved vis-à-vis energy could be co-generated.

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Annexure A: Emission Results

(Dioxins & Furans Emission Measurements when (i) 80% Polyethylene+20% PVC by weight & (ii) 100% Polyethylene waste disposed off)

A.1 Stack Emission, Waste: 80% Polyethylene +20% PVC

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TEST REPORT

Issued to:

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Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 10540/08/VLL/000/01C
Issued Date: 2009/01/27
Your Ref: FCIPT/DST-2/WO/040/08
Date: 2008/09/12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2008-12-27 Sample Collection Date: 2008-12-23
Analysis Starting date: 2008-12-30 Analysis Completion date:2009-01-18
Quantity received: 1No. Dragger tube, Filter paper, Line washings,
Sample collected at **Stack Attached to SCRUBBER OF PLASMA PYROLYSIS SYSTEM**.
Fuel Used Plastic Waste
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
EMISSION RATES			
1	Diameter of stuck	m	0.0762
2	Flue gas temperature	ºC	43
3	Velocity	m/sec	12.1
4	Volumetric flow rates	Nm^3/sec	0.05
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	ng/Nm^3 TEQ	0.000000
2	1,2,3,7,8-PeCDF	ng/Nm^3 TEQ	0.000000
3	2,3,4,7,8-PeCDF	ng/Nm^3 TEQ	0.000000
4	1,2,3,4,7,8-HxCDF	ng/Nm^3 TEQ	0.000013
5	1,2,3,6,7,8-HxCDF	ng/Nm^3 TEQ	0.000015
6	2,3,4,6,7,8-HxCDF	ng/Nm^3 TEQ	0.000011
7	1,2,3,7,8,9-HxCDF	ng/Nm^3 TEQ	0.000000
8	1,2,3,4,6,7,8-HpCDF	ng/Nm^3 TEQ	0.000002
9	1,2,3,4,7,8,9-HpCDF	ng/Nm^3 TEQ	0.000000
10	OCDF	ng/Nm^3 TEQ	0.000000
11	2,3,7,8-TCDO	ng/Nm^3 TEQ	0.000000
12	1,2,3,7,8-PeCDD	ng/Nm^3 TEQ	0.000000
13	1,2,3,4,7,8-HxCDD	ng/Nm^3 TEQ	0.000000
14	1,2,3,6,7,8-HxCDD	ng/Nm^3 TEQ	0.000000
15	1,2,3,7,8,9-HxCDD	ng/Nm^3 TEQ	0.000000
16	1,2,3,4,5,7,8-HpCDD	ng/Nm^3 TEQ	0.000000
17	OCDD	ng/Nm^3 TEQ	0.000000
Total Furans & Dioxin		**ng/Nm^3 TEQ Corrected to 11% O_2 Concentration**	**0.000004**

Method of Testing: As per USEPA 23 A & 1613
Remarks: All the value are corrected to 11% O2 as per CPCB Guidelines HAZWAMS/30/2005-06
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C336823

A.2 Scrubber Water, Waste : 80 % Polyethylene + 20% PVC

VIMTA LABS
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Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

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INDIA

Report No: 10540/08/VLL/000/02C
Issued Date: 2009/01/27
Your Ref: FCIPT/DST-2/WO/040/08
Date: 2008/09/12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SCRUBBER WATER-3

Sample Registration Date: 2008-12-27 — Sample Collection Date: 2008-12-23
Analysis Starting date: 2008-12-30 — Analysis Completion date:2009-01-18
Quantity received: 1No. Dragger tube, Filter paper, Line washings,
Sample collected at **Stack Attached to SCRUBBER OF PLASMA PYROLYSIS SYSTEM**.
Fuel Used Plastic Waste
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. — LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	Pg/L	<0.01
2	1,2,3,7,8-PeCDF	Pg/L	0.02
3	2,3,4,7,8-PeCDF	Pg/L	0.24
4	1,2,3,4,7,8-HxCDF	Pg/L	0.02
5			
6	2,3,4,6,7,8-HxCDF	Pg/L	0.02
7	1,2,3,7,8,9-HxCDF	Pg/L	<0.01
8	1,2,3,4,6,7,8-HpCDF	Pg/L	<0.01
9	1,2,3,4,7,8,9-HpCDF	Pg/L	<0.01
10	OCDF	Pg/L	<0.01
11	2,3,7,8-TCDO	Pg/L	<0.01
12	1,2,3,7,8-PeCDD	Pg/L	0.03
13	1,2,3,4,7,8-HxCDD	Pg/L	<0.01
14	1,2,3,6,7,8-HxCDD	Pg/L	<0.01
15	1,2,3,7,8,9-HxCDD	Pg/L	<0.01
16	1,2,3,4,5,7,8-HpCDD	Pg/L	<0.01
17	OCDD	Pg/L	<0.01
Total Furans & Dioxin		**Pg/l**	0.36

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

156727

A.3 Primary Residue, Waste: 80% Polyethlene + 20% PVC

VIMTA LABS
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INDIA

Report No: 10540/08/VLL/000/03C
Issued Date: 2009-01-27
Your Ref: FCIPT/DST-2/WO/040/08-
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: RESIDUE

Sample Registration Date: 2008-12-27 **Sample Collection Date**: 2008-12-23
Analysis starting date : 2008-12-30 **Analysis Completion date**: 2009-01-18
Quantity received: 1No. X 500 gm in glass bottle,
Sample code as IPRT (RESIDUE-3) used on 2008-12-23.
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2123966

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	Ng/Kg	<0.01
2	1,2,3,7,8-PeCDF	Ng/Kg	<0.01
3	2,3,4,7,8-PeCDF	Ng/Kg	<0.01
4	1,2,3,4,7,8-HxCDF	Ng/Kg	<0.01
5	1,2,3,6,7,8-HxCDF	Ng/Kg	<0.01
6	2,3,4,6,7,8-HxCDF	Ng/Kg	<0.01
7	1,2,3,7,8,9-HxCDF	Ng/Kg	<0.01
8	1,2,3,4,6,7,8-HpCDF	Ng/Kg	<0.01
9	1,2,3,4,7,8,9-HpCDF	Ng/Kg	<0.01
10	OCDF	Ng/Kg	<0.01
11	2,3,7,8-TCDO	Ng/Kg	<0.01
12	1,2,3,7,8-PeCDD	Ng/Kg	<0.01
13	1,2,3,4,7,8-HxCDD	Ng/Kg	<0.01
14	1,2,3,6,7,8-HxCDD	Ng/Kg	<0.01
15	1,2,3,7,8,9-HxCDD	Ng/Kg	<0.01
16	1,2,3,4,5,7,8-HpCDD	Ng/Kg	<0.01
17	OCDD	Ng/Kg	<0.01
Total Furans & Dioxin		**Ng/Kg**	<0.01

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

156731

A.4 Stack Emission. Waste: 100% Polyethylene

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
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INDIA

Report No: 10540/08/VLL/000/01D
Issued Date: 2009-01-27
Your Ref: FCIPT/DST-2/WO/040/08
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2008-12-27 **Sample Collection Date**: 2008-12-28
Analysis starting date : 2008-12-30 **Analysis Completion date**: 2009-01-18
Quantity received: 1No. X 500 gm in glass bottle,
Sample collected at **Stack Attached to SCRUBBEROF PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic Material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
EMISSION RATES			
1	**Diameter of stack**	**m**	**0.0762**
2	**Flue gas temperature**	**°C**	**53**
3	**Velocity**	**m/sec**	**11.5**
4	**Volumetric flow rate**	**Nm³/sec**	**0.05**
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	ng/Nm³ TEQ	0.000000
2	1,2,3,7,8-PeCDF	ng/Nm³ TEQ	0.000000
3	2,3,4,7,8-PeCDF	ng/Nm³ TEQ	0.000000
4	1,2,3,4,7,8-HxCDF	ng/Nm³ TEQ	0.000000
5	1,2,3,6,7,8-HxCDF	ng/Nm³ TEQ	0.000004
6	2,3,4,6,7,8-HxCDF	ng/Nm³ TEQ	0.000002
7	1,2,3,7,8,9-HxCDF	ng/Nm³ TEQ	0.000000
8	1,2,3,4,6,7,8-HpCDF	ng/Nm³ TEQ	0.000000
9	1,2,3,4,7,8,9-HpCDF	ng/Nm³ TEQ	0.000000
10	OCDF	ng/Nm³ TEQ	0.000000
11	2,3,7,8-TCDO	ng/Nm³ TEQ	0.000000
12	1,2,3,7,8-PeCDD	ng/Nm³ TEQ	0.000000
13	1,2,3,4,7,8-HxCDD	ng/Nm³ TEQ	0.000000
14	1,2,3,6,7,8-HxCDD	ng/Nm³ TEQ	0.000000
15	1,2,3,7,8,9-HxCDD	ng/Nm³ TEQ	0.000000
16	1,2,3,4,5,7,8-HpCDD	ng/Nm³ TEQ	0.000000
17	OCDD	ng/Nm³ TEQ	0.000000
Total Furans & Dioxin		**ng/Nm³ TEQ Corrected to 11% O2 Concentration**	**0.000001**

Method of Testing: As per USEPA 23 & 1613
Remarks: All the value are corrected to 11% O_2 as per CPCB Guidelines HAZWAMS/30/2005-08
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

156724

A.5 Scrubber Water. Waste: 100% Polyethylene

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INDIA

Report No: 10540/08/VLL/000/02D
Issued Date: 2009-01-27
Your Ref: FCIPT/DST-2/WO/040/08
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SCRUBBER WATER-3

Sample Registration Date: 2008-12-27 **Sample Collection Date**: 2008-12-28
Analysis starting date : 2008-12-30 **Analysis Completion date**: 2009-01-18
Quantity received: 1No. X 500 gm in glass bottle,
Sample collected at **Stack Attached to SCRUBBEROF PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic Material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
EMISSION RATES			
1	**Diameter of stack**	**m**	**0.0762**
2	**Flue gas temperature**	**°C**	**53**
3	**Velocity**	**m/sec**	**11.5**
4	**Volumetric flow rate**	**Nm³/sec**	**0.05**
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	ng/Nm³ TEQ	0.000000
2	1,2,3,7,8-PeCDF	ng/Nm³ TEQ	0.000000
3	2,3,4,7,8-PeCDF	ng/Nm³ TEQ	0.000000
4	1,2,3,4,7,8-HxCDF	ng/Nm³ TEQ	0.000000
5	1,2,3,6,7,8-HxCDF	ng/Nm³ TEQ	0.000004
6	2,3,4,6,7,8-HxCDF	ng/Nm³ TEQ	0.000002
7	1,2,3,7,8,9-HxCDF	ng/Nm³ TEQ	0.000000
8	1,2,3,4,6,7,8-HpCDF	ng/Nm³ TEQ	0.000000
9	1,2,3,4,7,8,9-HpCDF	ng/Nm³ TEQ	0.000000
10	OCDF	ng/Nm³ TEQ	0.000000
11	2,3,7,8-TCDO	ng/Nm³ TEQ	0.000000
12	1,2,3,7,8-PeCDD	ng/Nm³ TEQ	0.000000
13	1,2,3,4,7,8-HxCDD	ng/Nm³ TEQ	0.000000
14	1,2,3,6,7,8-HxCDD	ng/Nm³ TEQ	0.000000
15	1,2,3,7,8,9-HxCDD	ng/Nm³ TEQ	0.000000
16	1,2,3,4,5,7,8-HpCDD	ng/Nm³ TEQ	0.000000
17	OCDD	ng/Nm³ TEQ	0.000000
Total Furans & Dioxin		**ng/Nm³ TEQ Corrected to 11% O2 Concentration**	**0.000001**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

156728

A.6 Primary Residue, Waste: 100% polyethylene

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Issued Date: 2009-01-27
Your Ref: FCIPT/DST-2/WO/040/08-
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: RESIDUE 4

Sample Registration Date: 2008-12-27 **Sample Collection Date**: 2008-12-23
Analysis starting date : 2008-12-30 **Analysis Completion date**: 2009-01-18
Quantity received: 1No. X 500 gm in glass bottle,
Sample collected at **Stack Attached to SCRUBBEROF PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic Material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2123966

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	ng/Kg	<0.01
2	1,2,3,7,8-PeCDF	ng/Kg	<0.01
3	2,3,4,7,8-PeCDF	ng/Kg	<0.01
4	1,2,3,4,7,8-HxCDF	ng/Kg	<0.01
5	1,2,3,6,7,8-HxCDF	ng/Kg	<0.01
6	2,3,4,6,7,8-HxCDF	ng/Kg	<0.01
7	1,2,3,7,8,9-HxCDF	ng/Kg	<0.01
8	1,2,3,4,6,7,8-HpCDF	ng/Kg	<0.01
9	1,2,3,4,7,8,9-HpCDF	ng/Kg	<0.01
10	OCDF	ng/Kg	<0.01
11	2,3,7,8-TCDO	ng/Kg	<0.01
12	1,2,3,7,8-PeCDD	ng/Kg	<0.01
13	1,2,3,4,7,8-HxCDD	ng/Kg	<0.01
14	1,2,3,6,7,8-HxCDD	ng/Kg	<0.01
15	1,2,3,7,8,9-HxCDD	ng/Kg	<0.01
16	1,2,3,4,5,7,8-HpCDD	ng/Kg	<0.01
17	OCDD	ng/Kg	<0.01
Total Furans & Dioxin		**ng/Kg**	**<0.01**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

156732

Annexure B: Emission Results

(Dioxins & Furans emission monitoring when (i) 100% Metallized Plastic (ii) 50% Polyethylene+50% PVC by weight (iii) Soiled Polyethylene & (iv) Multi-layer plastic is disposed off)

B.1 Stack Emission. Waste: 100% Metallized Plastic

VIMTA LABS
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TEST REPORT

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Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/01A
Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2009-03-06 **Sample Collection Date**: 2008-12-23
Analysis starting date : 2008-03-13 **Analysis Completion date**: 2009-01-18
Quantity received: 1No. Dragger tube, Filter paper, Line washings,
Sample collected at **Stack Attached to PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic waste:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2123361

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
EMISSION RATES			
1	Diameter of stack	m	0.0762
2	Flue gas temperature	ºC	41
3	Velocity	m/sec	10.8
4	Volumetric flow rate	Nm²/sec	0.049
EMISSION RATES			
1	2,3,7,8-TCDF	ng/Nm², TEQ	0.000735
2	1,2,3,7,8-PeCDF	ng/Nm²	0.017549
3	2,3,4,7,8-PeCDF	ng/Nm²	0.002506
4	1,2,3,4,7,8-HxCDF	ng/Nm²	0.001216
5	1,2,3,6,7,8-HxCDF	ng/Nm²	0.002037
6	2,3,4,6,7,8-HxCDF	ng/Nm²	0.002220
7	1,2,3,7,8,9-HxCDF	ng/Nm²	0.000507
8	1,2,3,4,6,7,8-HpCDF	ng/Nm²	0.000568
9	1,2,3,4,7,8,9-HpCDF	ng/Nm²	0.000040
10	OCDF	ng/Nm²	0.000005
11	2,3,7,8-TCDO	ng/Nm²	0.001152
12	1,2,3,7,8-PeCDD	ng/Nm²	0.000000
13	1,2,3,4,7,8-HxCDD	ng/Nm²	0.000137
14	1,2,3,6,7,8-HxCDD	ng/Nm²	0.000197
15	1,2,3,7,8,9-HxCDD	ng/Nm²	0.000111
16	1,2,3,4,5,7,8-HpCDD	ng/Nm²	0.000106
17	OCDD	ng/Nm²	0.000000
Total Furans & Dioxin		**ng/Nm², TEQ Corrected to 11% O2 concerntartion**	**0.02655**

Method of Testing: As per USEPA 23 A & 1613
Remarks: All the values are corrected to 11% O_2 concerntration as per CPCB Guidelines HAZWAMS/30/2005-06.
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

C328652

E Shyam Sundar
Assoc. Vice President (EMI)

B.2 Scrubber Water. Waste: 100% Metallized Plastic

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INDIA

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Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SCRUBBER WATER-3

Sample Registration Date: 2008-03-06 **Sample Collection Date**: 2009-02-29
Analysis starting date : 2008-03-10 **Analysis Completion date**: 2009-03-20
Quantity received: 1No. X 1L in glass bottle,
Sample collected at **SCRUBBEROF PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic waste:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	pg/L	0.98
2	1,2,3,7,8-PeCDF	pg/L	0.68
3	2,3,4,7,8-PeCDF	pg/L	8.73
4	1,2,3,4,7,8-HxCDF	pg/L	0.83
5	1,2,3,6,7,8-HxCDF	pg/L	1.21
6	2,3,4,6,7,8-HxCDF	pg/L	1.48
7	1,2,3,7,8,9-HxCDF	pg/L	0.37
8	1,2,3,4,6,7,8-HpCDF	pg/L	0.29
9	1,2,3,4,7,8,9-HpCDF	pg/L	0.02
10	OCDF	pg/L	<0.01
11	2,3,7,8-TCDO	pg/L	1.64
12	1,2,3,7,8-PeCDD	pg/L	0.74
13	1,2,3,4,7,8-HxCDD	pg/L	0.12
14	1,2,3,6,7,8-HxCDD	pg/L	0.13
15	1,2,3,7,8,9-HxCDD	pg/L	0.12
16	1,2,3,4,5,7,8-HpCDD	pg/L	0.05
17	OCDD	pg/L	<0.01
Total Furans & Dioxin		**Pg/L**	**20.19**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C3286564

B.3 Primarv Residue. Waste: 100% Metallized Plastic

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/01C
Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: RESIDUE 4

Sample Registration Date:	2008-12-27	Sample Collection Date:	**2009-02-26**
Analysis Starting date	2008-12-30	Analysis Completion date:	2009-01-18

Quantity received: 1No. X 500 gm in glass bottle,
Sample coded as Residue collected on 2009-20-26
Fuel Used: Plastic Material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD LAB REF: EC/2123966

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	ng/Kg	<0.01
2	1,2,3,7,8-PeCDF	ng/Kg	<0.01
3	2,3,4,7,8-PeCDF	ng/Kg	<0.01
4	1,2,3,4,7,8-HxCDF	ng/Kg	<0.01
5	1,2,3,6,7,8-HxCDF	ng/Kg	<0.01
6	2,3,4,6,7,8-HxCDF	ng/Kg	<0.01
7	1,2,3,7,8,9-HxCDF	ng/Kg	<0.01
8	1,2,3,4,6,7,8-HpCDF	ng/Kg	<0.01
9	1,2,3,4,7,8,9-HpCDF	ng/Kg	<0.01
10	OCDF	ng/Kg	<0.01
11	2,3,7,8-TCDO	ng/Kg	<0.01
12	1,2,3,7,8-PeCDD	ng/Kg	<0.01
13	1,2,3,4,7,8-HxCDD	ng/Kg	<0.01
14	1,2,3,6,7,8-HxCDD	ng/Kg	<0.01
15	1,2,3,7,8,9-HxCDD	ng/Kg	<0.01
16	1,2,3,4,5,7,8-HpCDD	ng/Kg	<0.01
17	OCDD	ng/Kg	<0.01
Total Furans & Dioxin		**ng/Kg**	**<0.14**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C328656

B.4 Stack Emission for PM. NOx. SOx. Waste: 100% Metallized Plastic

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 114115/08/VLL/000/03
Issued Date: 2009-04-22
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2009-03-07 **Sample Collection Date**: 2009-12-26
Analysis starting date : 2008-03-09 **Analysis Completion date**: 2009-03-15
Quantity received: 2 No. Thimibes and 1 No. 50ml Plastic Container:
Sample collected at Stack OF PLASMA PYROLYSIS SYSTEM:
Fuel Used: Plastic Material:
Tests required PCDD and PCDF. O_2, CO_2, CO, SO_2, Oxide of Nitrogen Particulate Matter and HCL:
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2123361

TEST RESULTS

S. No.	PARAMETER	UOM	METHOD OF TESTING	RESULT
1	Stack Height	m		10
2	Diameter of Stack	m		0.0762
3	Flue Gas Temperature	ºC		41
4	Velocity	m/sec		10.8
5	Volumetric flow rate	Nm/sec		0.04857
6	Oxygen	%	Flue Gas Analyzer	14.6
7	Carbon Dioxide	%	Flue Gas Analyzer	5.3
8	Carbon Monoxide	mg/Nm²	Flue Gas Analyzer	35
9	Sulphur Dioxide	mg/Nm²	Flue Gas Analyzer	60.3
10	Oxide of Nitrogen	mg/Nm²	Flue Gas Analyzer	111.24
11	Particulate Matter	mg/Nm²	USEPA method-5	38.2
12	HCL	mg/Nm²	USEPA method-28	30.2

Instrument Used: Stack Monitoring Kit: Flue Gas Analyzer and ion Selective Electrode Analyzer

E Shyam Sundar
Assoc. Vice President (EMI)

C328690

B.5 Stack Emission. Waste: 50% Polyethylene + 50% PVC

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/02A
Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2009-03-06 **Sample Collection Date**: 2008-02-27
Analysis starting date : 2008-03-13 **Analysis Completion date**: 2009-03-20
Quantity received: 1No. Dragger tube, Filter paper, Line washings,
Sample collected at **Stack Attached to PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic waste:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2123361

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
EMISSION RATES			
1	Diameter of stack	m	0.0762
2	Flue gas temperature	ºC	42
3	Velocity	m/sec	9.1
4	Volumetric flow rate	Nm²/sec	0.039
EMISSION RATES			
1	2,3,7,8-TCDF	ng/Nm², **TEQ**	0.005401
2	1,2,3,7,8-PeCDF	ng/Nm², **TEQ**	0.009669
3	2,3,4,7,8-PeCDF	ng/Nm², **TEQ**	0.000000
4	1,2,3,4,7,8-HxCDF	ng/Nm², **TEQ**	0.024167
5	1,2,3,6,7,8-HxCDF	ng/Nm², **TEQ**	0.024162
6	2,3,4,6,7,8-HxCDF	ng/Nm², **TEQ**	0.030487
7	1,2,3,7,8,9-HxCDF	ng/Nm², **TEQ**	0.012182
8	1,2,3,4,6,7,8-HpCDF	ng/Nm², **TEQ**	0.009168
9	1,2,3,4,7,8,9-HpCDF	ng/Nm², **TEQ**	0.002382
10	OCDF	ng/Nm², **TEQ**	0.000589
11	2,3,7,8-TCDO	ng/Nm², **TEQ**	0.006326
12	1,2,3,7,8-PeCDD	ng/Nm², **TEQ**	0.000000
13	1,2,3,4,7,8-HxCDD	ng/Nm², **TEQ**	0.001375
14	1,2,3,6,7,8-HxCDD	ng/Nm², **TEQ**	0.003219
15	1,2,3,7,8,9-HxCDD	ng/Nm², **TEQ**	0.005013
16	1,2,3,4,5,7,8-HpCDD	ng/Nm², **TEQ**	0.010848
17	OCDD	ng/Nm², **TEQ**	0.001193
Total Furans & Dioxin		**ng/Nm², TEQ corrected to 11% O2 Concerntration**	**0.14078**

Method of Testing: As per USEPA 23 A & 1613
Remarks: All the values are corrected to 11% O_2 concerntration as per CPCB Guidelines HAZWAMS/30/2005-06.
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C328658

B.6 Scrubber Water, Waste: 50% Polyethylene + 50% PVC

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/02B
Issued Date: 2009-01-27
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SCRUBBER WATER

Sample Registration Date: 2008-12-27 **Sample Collection Date**: 2009-02-27
Analysis starting date : 2008-12-03 **Analysis Completion date**: 2009-01-18
Quantity received: 1No. X 500 gm in glass bottle,
Sample collected at Stack Attached to **SCRUBBER OF PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	pg/L	<0.01
2	1,2,3,7,8-PeCDF	pg/L	7.15
3	2,3,4,7,8-PeCDF	pg/L	78.44
4	1,2,3,4,7,8-HxCDF	pg/L	12.32
5	1,2,3,6,7,8-HxCDF	pg/L	15.72
6	2,3,4,6,7,8-HxCDF	pg/L	17.61
7	1,2,3,7,8,9-HxCDF	pg/L	2.07
8	1,2,3,4,6,7,8-HpCDF	pg/L	0.91
9	1,2,3,4,7,8,9-HpCDF	pg/L	0.47
10	OCDF	pg/L	0.14
11	2,3,7,8-TCDO	pg/L	6.83
12	1,2,3,7,8-PeCDD	pg/L	3.39
13	1,2,3,4,7,8-HxCDD	pg/L	1.89
14	1,2,3,6,7,8-HxCDD	pg/L	3.61
15	1,2,3,7,8,9-HxCDD	pg/L	2.86
16	1,2,3,4,5,7,8-HpCDD	pg/L	2.00
17	OCDD	pg/L	0.16
Total Furans & Dioxin		**pg/L**	**157.58**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C328660

B.7 Primary Residue. Waste: 50% Polyethylene + 50% PVC

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/02C
Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: RESIDUE

Sample Registration Date:	2008-03-06	Sample Collection Date:	**2009-02-27**
Analysis Starting date	2008-03-10	Analysis Completion date:	2009-03-20

Quantity received: 1No. X 500 gm in glass bottle,
Sample coded as Residue collected on 2009-20-27
Fuel Used: Plastic Material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD LAB REF: EC/2123966

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	ng/Kg	0.78
2	1,2,3,7,8-PeCDF	ng/Kg	0.34
3	2,3,4,7,8-PeCDF	ng/Kg	2.94
4	1,2,3,4,7,8-HxCDF	ng/Kg	0.34
5	1,2,3,6,7,8-HxCDF	ng/Kg	0.40
6	2,3,4,6,7,8-HxCDF	ng/Kg	0.32
7	1,2,3,7,8,9-HxCDF	ng/Kg	0.07
8	1,2,3,4,6,7,8-HpCDF	ng/Kg	0.13
9	1,2,3,4,7,8,9-HpCDF	ng/Kg	<0.01
10	OCDF	ng/Kg	<0.01
11	2,3,7,8-TCDO	ng/Kg	<0.01
12	1,2,3,7,8-PeCDD	ng/Kg	0.62
13	1,2,3,4,7,8-HxCDD	ng/Kg	0.04
14	1,2,3,6,7,8-HxCDD	ng/Kg	0.05
15	1,2,3,7,8,9-HxCDD	ng/Kg	0.05
16	1,2,3,4,5,7,8-HpCDD	ng/Kg	0.05
17	OCDD	ng/Kg	<0.01
Total Furans & Dioxin		**ng/Kg**	**6.13**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

B129413

B.8 Stack Emission for PM, NOx, SOx, etc. Waste: 50% Polyethylene + 50% PVC

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 114114/08/VLL/000/04
Issued Date: 2009-04-22
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2009-03-07 **Sample Collection Date**: 2009-12-27
Analysis starting date : 2008-03-09 **Analysis Completion date**: 2009-03-15
Quantity received: 2 No. Thimibes and 1 No. 50ml Plastic Container:
Sample collected at Stack OF PLASMA PYROLYSIS SYSTEM:
Fuel Used: Plastic Material:
Tests required PCDD and PCDF. O_2, CO_2, CO, SO_2, Oxide of Nitrogen Particulate Matter and HCL:
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2123361

TEST RESULTS

S. No.	PARAMETER	UOM	METHOD OF TESTING	RESULT
1	Stack Height	m		10
2	Diameter of Stack	m		0.0762
3	Flue Gas Temperature	ºC		41
4	Velocity	m/sec		9.1
5	Volumetric flow rate	Nm/sec		0.0395
6	Oxygen	%	Flue Gas Analyzer	13.6
7	Carbon Dioxide	%	Flue Gas Analyzer	4.9
8	Carbon Monoxide	mg/Nm²	Flue Gas Analyzer	20
9	Sulphur Dioxide	mg/Nm²	Flue Gas Analyzer	55.6
10	Oxide of Nitrogen	mg/Nm²	Flue Gas Analyzer	127.7
11	Particulate Matter	mg/Nm²	USEPA method-5	19.9
12	HCL	mg/Nm²	USEPA method-28	41.3

Instrument Used: Stack Monitoring Kit: Flue Gas Analyzer and ion Selective Electrode Analyzer

E Shyam Sundar
Assoc. Vice President (EMI)

C328692

B.9 Stack Emission, Waste: Soiled Polyethylene

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/03A
Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2009-03-09 **Sample Collection Date**: 2008-02-28
Analysis starting date : 2008-03-13 **Analysis Completion date**: 2009-03-20
Quantity received: 1No. Dragger tube, Filter paper, Line washings,
Sample collected at **Stack Attached to SCRUBBER OF PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic waste:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2123351

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
EMISSION RATES			
1	Diameter of stack	m	0.0762
2	Flue gas temperature	ºC	45
3	Velocity	m/sec	8.8
4	Volumetric flow rate	Nm²/sec	0.0379
EMISSION RATES			
1	2,3,7,8-TCDF	ng/Nm², TEQ	0.005408
2	1,2,3,7,8-PeCDF	ng/Nm², TEQ	0.000000
3	2,3,4,7,8-PeCDF	ng/Nm², TEQ	0.000000
4	1,2,3,4,7,8-HxCDF	ng/Nm², TEQ	0.011532
5	1,2,3,6,7,8-HxCDF	ng/Nm², TEQ	0.015649
6	2,3,4,6,7,8-HxCDF	ng/Nm², TEQ	0.017822
7	1,2,3,7,8,9-HxCDF	ng/Nm², TEQ	0.004087
8	1,2,3,4,6,7,8-HpCDF	ng/Nm², TEQ	0.004992
9	1,2,3,4,7,8,9-HpCDF	ng/Nm², TEQ	0.000502
10	OCDF	ng/Nm², TEQ	0.000121
11	2,3,7,8-TCDO	ng/Nm², TEQ	0.000000
12	1,2,3,7,8-PeCDD	ng/Nm², TEQ	0.000000
13	1,2,3,4,7,8-HxCDD	ng/Nm², TEQ	0.000817
14	1,2,3,6,7,8-HxCDD	ng/Nm², TEQ	0.001958
15	1,2,3,7,8,9-HxCDD	ng/Nm², TEQ	0.001434
16	1,2,3,4,5,7,8-HpCDD	ng/Nm², TEQ	0.002331
17	OCDD	ng/Nm², TEQ	0.000215
Total Furans & Dioxin		**ng/Nm², TEQ corrected to 11% O2 Concerntration**	**0.06697**

Method of Testing: As per USEPA 23 A & 1613
Remarks: All the values are corrected to 11% O_2 concerntration as per CPCB Guidelines HAZWAMS/30/2005-06.
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C328664

B.10 Scrubber Water, Waste: Soiled Polyethylene

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/03B
Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SCRUBBER WATER

Sample Registration Date: 2008-03-06 **Sample Collection Date**: 2009-02-27
Analysis starting date : 2008-03-10 **Analysis Completion date**: 2009-03-20
Quantity received: 1No. XL gm in glass bottle,
Sample collected at **SCRUBBER OF PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	pg/L	<0.01
2	1,2,3,7,8-PeCDF	pg/L	17.59
3	2,3,4,7,8-PeCDF	pg/L	112.94
4	1,2,3,4,7,8-HxCDF	pg/L	26.92
5	1,2,3,6,7,8-HxCDF	pg/L	37.82
6	2,3,4,6,7,8-HxCDF	pg/L	44.84
7	1,2,3,7,8,9-HxCDF	pg/L	13.07
8	1,2,3,4,6,7,8-HpCDF	pg/L	10.74
9	1,2,3,4,7,8,9-HpCDF	pg/L	1.48
10	OCDF	pg/L	0.32
11	2,3,7,8-TCDO	pg/L	14.55
12	1,2,3,7,8-PeCDD	pg/L	19.67
13	1,2,3,4,7,8-HxCDD	pg/L	5.0
14	1,2,3,6,7,8-HxCDD	pg/L	9.59
15	1,2,3,7,8,9-HxCDD	pg/L	7.65
16	1,2,3,4,5,7,8-HpCDD	pg/L	4.81
17	OCDD	pg/L	0.41
Total Furans & Dioxin		**pg/L**	**327.4**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C328666

B.11 Primary Residue, Waste : Soiled Polyethylene

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
Ph. 040-7264141, Fax: 040-7263657, URL: www.vimta.com

TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/03C
Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: RESIDUE

Sample Registration Date:	2009-03-06	Sample Collection Date:	**2009-02-27**
Analysis Starting date	2009-03-10	Analysis Completion date:	2009-03-20

Quantity received: 1No. X 500 gm in glass bottle,
Sample coded as Residue collected on 2009-20-28
Fuel Used: Plastic Material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD LAB REF: EC/2123966

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	ng/Kg	1.03
2	1,2,3,7,8-PeCDF	ng/Kg	0.49
3	2,3,4,7,8-PeCDF	ng/Kg	5.06
4	1,2,3,4,7,8-HxCDF	ng/Kg	0.62
5	1,2,3,6,7,8-HxCDF	ng/Kg	0.86
6	2,3,4,6,7,8-HxCDF	ng/Kg	0.93
7	1,2,3,7,8,9-HxCDF	ng/Kg	0.22
8	1,2,3,4,6,7,8-HpCDF	ng/Kg	0.30
9	1,2,3,4,7,8,9-HpCDF	ng/Kg	0.03
10	OCDF	ng/Kg	<0.01
11	2,3,7,8-TCDO	ng/Kg	0.92
12	1,2,3,7,8-PeCDD	ng/Kg	0.57
13	1,2,3,4,7,8-HxCDD	ng/Kg	0.05
14	1,2,3,6,7,8-HxCDD	ng/Kg	0.12
15	1,2,3,7,8,9-HxCDD	ng/Kg	0.09
16	1,2,3,4,5,7,8-HpCDD	ng/Kg	0.09
17	OCDD	ng/Kg	<0.01
Total Furans & Dioxin		**ng/Kg**	**11.38**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

328668

B.12 Stack Emissionfor PM, NOx, Sox, etc. Waste: Soiled Ployethylene

VIMTA LABS
Determining Quality

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TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 114115/08/VLL/000/05
Issued Date: 2009-04-22
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2009-03-06 **Sample Collection Date**: 2009-12-28
Analysis starting date : 2008-03-09 **Analysis Completion date**: 2009-03-15
Quantity received: 1 No. X 1L in glass bottle:
Sample collected at SCRUBBER OF PLASMA PYROLYSIS SYSTEM:
Fuel Used: Plastic Material:
Tests required PCDD and PCDF. O_2, CO_2, CO, SO_2, Oxide of Nitrogen Particulate Matter and HCL:
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	METHOD OF TESTING	RESULT
1	Stack Height	m		10
2	Diameter of Stack	m		0.0762
3	Flue Gas Temperature	ºC		45
4	Velocity	m/sec		9.0
5	Volumetric flow rate	Nm/sec		0.0397
6	Oxygen	%	Flue Gas Analyzer	10.6
7	Carbon Dioxide	%	Flue Gas Analyzer	4.2
8	Carbon Monoxide	mg/Nm²	Flue Gas Analyzer	12
9	Sulphur Dioxide	mg/Nm²	Flue Gas Analyzer	57.8
10	Oxide of Nitrogen	mg/Nm²	Flue Gas Analyzer	131.7
11	Particulate Matter	mg/Nm²	USEPA method-5	19.9
12	HCL	mg/Nm²	USEPA method-28	44.3

Instrument Used: Stack Monitoring Kit: Flue Gas Analyzer and ion Selective Electrode Analyzer

E Shyam Sundar
Assoc. Vice President (EMI)

C328694

B.13 Stack Emission, Waste: Multi-layer Plastic

VIMTA LABS
Determining Quality

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TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/04A
Issued Date: 2009-01-27
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2009-03-09 **Sample Collection Date**: 2008-02-28
Analysis starting date : 2008-03-13 **Analysis Completion date**: 2009-03-20
Quantity received: 1No. Dragger tube, Filter paper, Line washings,
Sample collected at **Stack Attached to SCRUBBER OF PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic waste:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2123361

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
EMISSION RATES			
1	Diameter of stack	m	0.0762
2	Flue gas temperature	ºC	45
3	Velocity	m/sec	8.8
4	Volumetric flow rate	Nm²/sec	0.0379
EMISSION RATES			
1	2,3,7,8-TCDF	**ng/Nm²,TEQ**	0.0000000
2	1,2,3,7,8-PeCDF	**ng/Nm², TEQ**	0.01896258
3	2,3,4,7,8-PeCDF	**ng/Nm², TEQ**	0.000000
4	1,2,3,4,7,8-HxCDF	**ng/Nm², TEQ**	0.000000
5	1,2,3,6,7,8-HxCDF	**ng/Nm², TEQ**	0.000000
6	2,3,4,6,7,8-HxCDF	**ng/Nm², TEQ**	0.072774981
7	1,2,3,7,8,9-HxCDF	**ng/Nm², TEQ**	0.030353178
8	1,2,3,4,6,7,8-HpCDF	**ng/Nm², TEQ**	0.024494162
9	1,2,3,4,7,8,9-HpCDF	**ng/Nm², TEQ**	0.004342936
10	OCDF	**ng/Nm², TEQ**	0.001338045
11	2,3,7,8-TCDO	**ng/Nm², TEQ**	0.000000
12	1,2,3,7,8-PeCDD	**ng/Nm², TEQ**	0.000000
13	1,2,3,4,7,8-HxCDD	**ng/Nm², TEQ**	0.007943626
14	1,2,3,6,7,8-HxCDD	**ng/Nm², TEQ**	0.015290295
15	1,2,3,7,8,9-HxCDD	**ng/Nm², TEQ**	0.00738773
16	1,2,3,4,5,7,8-HpCDD	**ng/Nm², TEQ**	0.01294353
17	OCDD	**ng/Nm², TEQ**	0.001152852
Total Furans & Dioxin		**ng/Nm², TEQ corrected to 11% O_2 Concerntration**	**0.19700**

Method of Testing: As per USEPA 23 A & 1613
Remarks: All the values are corrected to 11% O_2 concerntration as per CPCB Guidelines HAZWAMS/30/2005-06.
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C328672

B. 14 Scrubber water, Waste: Multi-layer Plastic

VIMTA LABS
Determining Quality

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TEST REPORT

Issued to:

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Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/04B
Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SCRUBBER WATER

Sample Registration Date: 2008-03-06 **Sample Collection Date**: 2009-02-02
Analysis starting date : 2008-03-10 **Analysis Completion date**: 2009-03-20
Quantity received: 1No. XL gm in glass bottle,
Sample collected at **SCRUBBER OF PLASMA PYROLYSIS SYSTEM**:
Fuel Used: Plastic material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	pg/L	8.95
2	1,2,3,7,8-PeCDF	pg/L	14.07
3	2,3,4,7,8-PeCDF	pg/L	148.0
4	1,2,3,4,7,8-HxCDF	pg/L	32.53
5	1,2,3,6,7,8-HxCDF	pg/L	43.33
6	2,3,4,6,7,8-HxCDF	pg/L	40.95
7	1,2,3,7,8,9-HxCDF	pg/L	12.69
8	1,2,3,4,6,7,8-HpCDF	pg/L	11.66
9	1,2,3,4,7,8,9-HpCDF	pg/L	1.57
10	OCDF	pg/L	0.42
11	2,3,7,8-TCDO	pg/L	22.11
12	1,2,3,7,8-PeCDD	pg/L	33.53
13	1,2,3,4,7,8-HxCDD	pg/L	3.97
14	1,2,3,6,7,8-HxCDD	pg/L	6.52
15	1,2,3,7,8,9-HxCDD	pg/L	5.92
16	1,2,3,4,5,7,8-HpCDD	pg/L	3.66
17	OCDD	pg/L	0.29
Total Furans & Dioxin		**pg/L**	**390.17**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C328672

B.15 Primary Residue, Waste: Multi-layer Plastic

VIMTA LABS
Determining Quality

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TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/04C
Issued Date: 2009-04-09
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: RESIDUE

Sample Registration Date:	2009-03-06	Sample Collection Date:	**2009-02-27**
Analysis Starting date	2009-03-10	Analysis Completion date:	2009-03-20

Quantity received: 1No. X 500 gm in glass bottle,
Sample coded as Residue collected on 2009-03-10
Fuel Used: Plastic Material:
Tests required PCDD and PCDF.
SAMPLE COLLECTED BY VIMTA LABS LTD LAB REF: EC/2123966

TEST RESULTS

S. No.	PARAMETER	UOM	RESULT
DIOXIN AND FURANS			
1	2,3,7,8-TCDF	ng/Kg	<0.01
2	1,2,3,7,8-PeCDF	ng/Kg	0.01
3	2,3,4,7,8-PeCDF	ng/Kg	0.18
4	1,2,3,4,7,8-HxCDF	ng/Kg	0.05
5	1,2,3,6,7,8-HxCDF	ng/Kg	0.06
6	2,3,4,6,7,8-HxCDF	ng/Kg	0.06
7	1,2,3,7,8,9-HxCDF	ng/Kg	0.01
8	1,2,3,4,6,7,8-HpCDF	ng/Kg	0.03
9	1,2,3,4,7,8,9-HpCDF	ng/Kg	<0.01
10	OCDF	ng/Kg	<0.01
11	2,3,7,8-TCDO	ng/Kg	<0.01
12	1,2,3,7,8-PeCDD	ng/Kg	<0.01
13	1,2,3,4,7,8-HxCDD	ng/Kg	<0.01
14	1,2,3,6,7,8-HxCDD	ng/Kg	<0.01
15	1,2,3,7,8,9-HxCDD	ng/Kg	<0.01
16	1,2,3,4,5,7,8-HpCDD	ng/Kg	<0.01
17	OCDD	ng/Kg	<0.01
Total Furans & Dioxin		**ng/Kg**	**0.04**

Method of Testing: As per USEPA 1613
Remarks: All the value are corrected to Toxic Equivalency Quotient (TEQ).
Instrument used: Auto Spec Premier (HRGC/HRMS). Detection Limit: 0.01pg.

E Shyam Sundar
Assoc. Vice President (EMI)

C328674

B.16 Stack Emission for PM, NOx, SOx, etc. Waste: Multi-layer plastic

VIMTA LABS
Determining Quality

Regd. Office & Laboratory: 142, IDA, Cheriapally, Hyderabad-500051, India
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TEST REPORT

Issued to:

INSTITUTE FOR PLASMA REASEARCH
Facilitation Centre for Industrial Plasma Technologies
B-15-17/P, GIDC Electronics Estate
Gandhi Nagar- 382044 Gujarat
INDIA

Report No: 13965/08/VLL/000/01A
Issued Date: 2009-04-22
Your Ref: Your Work Order
Date: 2008-09-12

Kind Attn. Dr. S.K. NEMA

Sample Particulars: SOURCE MONITRING SAMPLE

Sample Registration Date: 2009-03-07 **Sample Collection Date**: 2009-12-02
Analysis starting date : 2008-03-09 **Analysis Completion date**: 2009-03-15
Quantity received: 1 No. X 1L in glass bottle:
Sample collected at STACK OF PLASMA PYROLYSIS SYSTEM:
Fuel Used: Plastic Material:
Tests required PCDD and PCDF. O_2, CO_2, CO, SO_2, Oxide of Nitrogen Particulate Matter and HCL:
SAMPLE COLLECTED BY VIMTA LABS LTD. LAB REF: EC/2141075

TEST RESULTS

S. No.	PARAMETER	UOM	METHOD OF TESTING	RESULT
1	Stack Height	m		10
2	Diameter of Stack	m		0.0762
3	Flue Gas Temperature	ºC		41
4	Velocity	m/sec		9.1
5	Volumetric flow rate	Nm/sec		0.0395
6	Oxygen	%	Flue Gas Analyzer	13.6
7	Carbon Dioxide	%	Flue Gas Analyzer	4.9
8	Carbon Monoxide	mg/Nm²	Flue Gas Analyzer	20
9	Sulphur Dioxide	mg/Nm²	Flue Gas Analyzer	55.6
10	Oxide of Nitrogen	mg/Nm²	Flue Gas Analyzer	127.7
11	Particulate Matter	mg/Nm²	USEPA method-5	19.9
12	HCL	mg/Nm²	USEPA method-28	41.3

Instrument Used: Stack Monitoring Kit: Flue Gas Analyzer and ion Selective Electrode Analyzer

E Shyam Sundar
Assoc. Vice President (EMI)

C328696

B.17 Stack Emission, Waste: 50% Polyethylene + 50% PVC

NATIONAL INSTITUTE FOR INTERDISCIPLINARY SCIENCE & TECHNOLOGY
(Formerly-REGIONAL RESEARCH LABORATORY)
COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Industrial Estate P. O., Pappanamacode, Thiruvananthapuram, India - 695019

Analytical Results
2,3,7,8-congener group of dioxins and furans
In flue gas by HRGC-LRMS

COMPOUND NAME	Minimum Detection Limit In KONIK HRGC-LMRS (ng/ml)	WHO-TEF 2005	Flue Gas -2 TEQ (ng/Nm³)
SAMPLING DATE: 09.05.09			
2,3,7,8-TCDD	0.1	1	0
1,2,3,7,8-PeCDD	0.1	1	0
1,2,3,4,7,8-HxCDD	0.1	0.1	0
1,2,3,6,7,8-HxCDD	0.2	0.1	0
1,2,3,7,8,9-HxCDD	0.2	0.1	0
1,2,3,4,6,7,8-HpCDD	0.2	0.01	0
1,2,3,4,6,7,8,9-OCDD	0.5	0.0001	0
2,3,7,8-TCDF	0.1	**0.1**	**0.02***
1,2,3,7,8-PeCDF	0.1	0.05	0
2,3,4,7,8-PeCDF	0.1	0.5	0
1,2,3,4,7,8-HxCDF	0.1	0.1	0
1,2,3,6,7,8-HxCDF	0.1	0.1	0
2,3,4,5,7,8-HxCDF	0.1	0.1	0
1,2,3,7,8,9-HxCDF	0.1	0.1	0
1,2,3,4,6,7,8-HpCDF	0.2	0.01	0
1,2,3,4,7,8,9-HpCDF	0.2	0.1	0
1,2,3,4,6,7,8,9-OCDF	0.5	0.0001	0
TOTAL TEQ (ng/Nm³)			**0.02**

***The value has been arrived by spiking 0.5ng standard to the sample.**

SIGNIFICANT FINDINGS

- Dioxins were found in the emission (flue gas) samples. Among Furan congeners,
- Only TCDF was found at a very low level.
- Flue gas samples were collected from the plasma based medical waste destruction system at FCIPT, Gandhinagar, Gujarat as per the USEPA standard method 23 and analysed according to the method 8280B

(ISO 9001 Certified Institute)
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B.18 Stack Emission, Waste: 50% Polyethylene + 50% PVC

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(Formerly-REGIONAL RESEARCH LABORATORY)
COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Industrial Estate P. O., Pappanamacode, Thiruvananthapuram, India - 695019

Analytical Results
2,3,7,8-congener group of dioxins and furans
In flue gas by HRGC-LRMS

COMPOUND NAME	Minimum Detection Limit In KONIK HRGC-LMRS (ng/ml)	WHO-TEF 2005	Flue Gas -5 TEQ (ng/Nm³)
SAMPLING DATE: 13.05.09			
2,3,7,8-TCDD	0.1	1	0
1,2,3,7,8-PeCDD	0.1	1	0
1,2,3,4,7,8-HxCDD	0.1	0.1	0
1,2,3,6,7,8-HxCDD	0.2	0.1	0
1,2,3,7,8,9-HxCDD	0.2	0.1	0
1,2,3,4,6,7,8-HpCDD	0.2	0.01	0
1,2,3,4,6,7,8,9-OCDD	0.5	0.0001	0
2,3,7,8-TCDF	0.1	**0.1**	0
1,2,3,7,8-PeCDF	0.1	0.05	0
2,3,4,7,8-PeCDF	0.1	0.5	0
1,2,3,4,7,8-HxCDF	0.1	0.1	0
1,2,3,6,7,8-HxCDF	0.1	0.1	0
2,3,4,5,7,8-HxCDF	0.1	0.1	0
1,2,3,7,8,9-HxCDF	0.1	0.1	0
1,2,3,4,6,7,8-HpCDF	0.2	0.01	0
1,2,3,4,7,8,9-HpCDF	0.2	0.1	0
1,2,3,4,6,7,8,9-OCDF	0.5	0.0001	0
TOTAL TEQ (ng/Nm³)			**0**

SIGNIFICANT FINDINGS

- Dioxins and Furans were found in the emission (flue gas) samples.
- Flue gas samples were collected from the plasma based medical waste destruction system at FCIPT, Gandhinagar, Gujarat as per the USEPA standard method 23 and analysed according to the method 8280B

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B.19 Stack Emission, Waste: 100% Multi-layer Plastic

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COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Industrial Estate P. O., Pappanamacode, Thiruvananthapuram, India - 695019

Analytical Results
2,3,7,8-congener group of dioxins and furans
In flue gas by HRGC-LRMS

COMPOUND NAME	Minimum Detection Limit In KONIK HRGC-LMRS (ng/ml)	WHO-TEF 2005	Flue Gas -7 TEQ (ng/Nm³)
SAMPLING DATE: 14.05.09			
2,3,7,8-TCDD	0.1	1	**0.005***
1,2,3,7,8-PeCDD	0.1	1	0
1,2,3,4,7,8-HxCDD	0.1	0.1	0
1,2,3,6,7,8-HxCDD	0.2	0.1	0
1,2,3,7,8,9-HxCDD	0.2	0.1	0
1,2,3,4,6,7,8-HpCDD	0.2	0.01	0
1,2,3,4,6,7,8,9-OCDD	0.5	0.0001	0
2,3,7,8-TCDF	0.1	**0.1**	0
1,2,3,7,8-PeCDF	0.1	0.05	0
2,3,4,7,8-PeCDF	0.1	0.5	0
1,2,3,4,7,8-HxCDF	0.1	0.1	0
1,2,3,6,7,8-HxCDF	0.1	0.1	0
2,3,4,5,7,8-HxCDF	0.1	0.1	0
1,2,3,7,8,9-HxCDF	0.1	0.1	0
1,2,3,4,6,7,8-HpCDF	0.2	0.01	0
1,2,3,4,7,8,9-HpCDF	0.2	0.1	0
1,2,3,4,6,7,8,9-OCDF	0.5	0.0001	0
TOTAL TEQ (ng/Nm³)			**0.005**

***The value has been arrived by spiking 0.5ng standard to the sample.**

SIGNIFICANT FINDINGS

- Only TCDD was found at a very low level.
- Flue gas samples were collected from the plasma based medical waste destruction system at FCIPT, Gandhinagar, Gujarat as per the USEPA standard method 23 and analysed according to the method 8280B

(ISO 9001 Certified Institute)
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B.20 Stack Emission, Waste: 100% Metallized Plastic

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COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Industrial Estate P. O., Pappanamacode, Thiruvananthapuram, India - 695019

Analytical Results
2,3,7,8-congener group of dioxins and furans
In flue gas by HRGC-LRMS

COMPOUND NAME	Minimum Detection Limit In KONIK HRGC-LMRS (ng/ml)	WHO-TEF 2005	Flue Gas -8 TEQ (ng/Nm³)
SAMPLING DATE: 15.05.09			
2,3,7,8-TCDD	0.1	1	**0.005***
1,2,3,7,8-PeCDD	0.1	1	0
1,2,3,4,7,8-HxCDD	0.1	0.1	0
1,2,3,6,7,8-HxCDD	0.2	0.1	0
1,2,3,7,8,9-HxCDD	0.2	0.1	0
1,2,3,4,6,7,8-HpCDD	0.2	0.01	0
1,2,3,4,6,7,8,9-OCDD	0.5	0.0001	0
2,3,7,8-TCDF	0.1	**0.1**	0
1,2,3,7,8-PeCDF	0.1	0.05	0
2,3,4,7,8-PeCDF	0.1	0.5	0
1,2,3,4,7,8-HxCDF	0.1	0.1	0
1,2,3,6,7,8-HxCDF	0.1	0.1	0
2,3,4,5,7,8-HxCDF	0.1	0.1	0
1,2,3,7,8,9-HxCDF	0.1	0.1	0
1,2,3,4,6,7,8-HpCDF	0.2	0.01	0
1,2,3,4,7,8,9-HpCDF	0.2	0.1	0
1,2,3,4,6,7,8,9-OCDF	0.5	0.0001	0
TOTAL TEQ (ng/Nm³)			**0.005**

***The value has been arrived by spiking 0.5ng standard to the sample.**

SIGNIFICANT FINDINGS

- Only TCDD was found at a very low level.
- Flue gas samples were collected from the plasma based medical waste destruction system at FCIPT, Gandhinagar, Gujarat as per the USEPA standard method 23 and analysed according to the method 8280B

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Annexure C : The Gazette of India on Emission Norms

रजिस्ट्री सं० डी० एल०-33004/99

REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण

EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (i)

PART II—Section 3—Sub-section (i)

प्राधिकार से प्रकाशित

PUBLISHED BY AUTHORITY

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पर्यावरण और वन मंत्रालय

अधिसूचना

नई दिल्ली, 21 जुलाई, 2010

सा.का.नि. 608(अ).—केन्द्रीय सरकार, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 6 और धारा 25 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, पर्यावरण (संरक्षण) नियम, 1986 का और संशोधन करने के लिए निम्नलिखित नियम बनाती है, अर्थात् :—

1. (1) इन नियमों का संक्षिप्त नाम पर्यावरण (संरक्षण) (चौथा संशोधन) नियम, 2010 है ।

(2) ये राजपत्र में उनके प्रकाशन की तारीख को प्रवृत्त होंगे ।

2. पर्यावरण (संरक्षण) नियम, 1986 की अनुसूची I में, क्रम संख्या 68 और इससे संबंधित प्रविष्टियों के स्थान पर निम्नलिखित क्रम संख्या और प्रविष्टियां अन्तःस्थापित की जाएंगी, अर्थात् :—

क्रम सं.	उद्योग	पैरामीटर	मानक
(1)	(2)	(3)	(4)
"68	कार्बनिक रसायन उत्पादक उद्योग	**क-बहिस्राव मानक**	
			सांद्रण सीमा मि.ग्रा./लीटर में, पी एच और बायोएस्से परीक्षण को छोड़कर
		अनिवार्य पैरामीटर	
		पी एच	6.5-8.5
		बी ओ डी 3 दिन, 27°C	100
		तेल एवं ग्रीस	10
		बायोएस्से टेस्ट +	100 प्रतिशत बहिस्राव में 96 घंटे के बाद 90 प्रतिशत मछलियां अवशेष
		अतिरिक्त पैरामीटर	
		नाईट्रेट (N के रूप में)	10
		आर्सेनिक (As के रूप में)	0.2
		क्रोमियम (हैक्सावेलेंट)	0.1
		क्रोमियम (कुल)	1.0
		सीसा (Pb के रूप में)	0.1
		साइनाईड (CN के रूप में)	0.2

(1)	(2)	(3)		(4)
		जस्ता (Zn के रूप में)	5.0	
		पारद् (Hg के रूप में)	0.01	
		तांबा (Cu के रूप में)	2.0	
		निकिल (Ni के रूप में)	2.0	
		फिनॉलिक्स (C_6H_5OH के रूप में)	5.0	
		सल्फाईड	2.0	

+ बायोएस्से परीक्षण IS:6582-1971 के अनुसार संचालित किया जाए ।

टिप्पण :

(i) इस समूह में हेलोएलिफेटिक, प्लास्टीसाईजर, ऐरोमेटिकस (एल्कोहल, फिनॉल्स, इस्टर, तेजाब और लवण, एल्डीहाइड और किटॉन), प्रतिस्थापित ऐरोमेटिकस, एलिफेटिक (एल्कोहल, ईस्टरस, तेजाब, एल्डीहाइड, किटॉन, अमीनस् और एमाइड्स) और डिटर्जेन्ट उद्योग सम्मिलित रहेंगे ।

(ii) यद्यपि रासायनिक आक्सीजन मांग (COD) के सन्निगम यहां उल्लिखित नहीं है, किन्तु COD को मानीटर किया जायेगा । यदि उपचारित बहिस्राव में COD की मात्रा 250 मि.ग्रा./लीटर से अधिक है तो उच्च COD का बहिस्राव करने वाली संबंधित औद्योगिक इकाईयों को ऐसे COD के लिये जिम्मेदार रसायनों की पहचान करनी होगी । यदि ये खतरनाक रसायन उत्पादन, भंडारण तथा आयात नियम, 1989 के अधीन विषैले रसायन के रूप में पाये जाते हैं तब संबंधित उद्योग तृतीय उपचार संयंत्र लगाएंगे ।

(iii) उपर्युक्त मानक, लघु श्रेणी के डिटर्जेन्ट सूरण इकाईयों में लागू नहीं होंगे ।

ख. भस्मीकरण संयंत्र के लिये उत्सर्जन मानक

		जब तक अन्यथा उल्लिखित न हो, सांद्रण सीमा मि.ग्रा./नार्मल घन मी. में	जब तक अन्यथा उल्लिखित न हो, सैम्पलिंग अवधि मिनटों में
विविक्त पदार्थ	50	30 अथवा अधिक (सैम्पलिंग के लिए लगभग 300 लीटर उत्सर्जन)	
HCl	50	30	
SO_2	200	30	
CO	100	दैनिक औसत	
कुल जैविक कार्बन	20	30	
कुल डायक्सीन्स एवं फयूरान्स*	मौजूदा भस्मीकरण संयंत्र	0.2 ngTEQ/Nm³	8 घंटे
	नए भस्मीकरण संयंत्र	0.1 ngTEQ/Nm³	8 घंटे
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + Cd + Th + Hg और उनके यौगिक		1.5	2 घंटे

(1)	(2)	(3)	(4)
		• विद्यमान संयंत्र द्वारा डायक्सीन्स एवं फयूरान्स के लिए 0.1 ngTEQ/Nm³ मानदंड का अनुपालन तारीख 1 जनवरी, 2014 के भीतर करेंगे ।	
		टिप्पण :	
		(i) सभी मानीटर किए गए मानों को 11% ऑक्सीजन के अनुसार शुष्क आधार पर ठीक किया जाए ।	
		(ii) उत्सर्जित गैस में कार्बन डाईआक्साइड की सांद्रणता 7% से कम नहीं होगी ।	
		(iii) यदि भस्मीकरण हेतु अपशिष्ट में हेलोजिनेटिड कार्बनिक अपशिष्ट वजन में 1% से कम हो तो, ट्विन चैम्बर भस्मीकरण संयंत्र में सभी सुविधाओं को इस तरह डिजाइन किया जाएगा ताकि प्राइमरी चैम्बर में 850 ± 25°C और सेकेण्डरी कम्बशन चैम्बर 950°C का न्यूनतम तापमान बनाया जा सके जिसके साथ सेकेण्डरी कम्बशन चैम्बर में गैस अवरोधक समय दो सेकेण्ड से कम नहीं होगा ।	
		अथवा	
		एकल चैम्बर भस्मीकरण संयंत्र में गैसीय संकटमय अपशिष्ट हेतु सभी सुविधाओं को इस तरह डिजाईन किया जाएगा ताकि कम्बशन चैम्बर में 950°C न्यूनतम तापमान बनाया रखा जा सके जिसके साथ गैस अवरोधक समय दो सेकेण्ड से कम नहीं होगा ।	
		(iv) यदि भस्मीकरण हेतु अपशिष्ट में हेलोजिनेटिड कार्बनिक अपशिष्ट, वजन में 1% से अधिक हो तो केवल ट्विन चैम्बर भस्मीकरण संयंत्र में अपशिष्ट का भस्मीकरण किया जाएगा तथा सभी सुविधाओं को इस तरह डिजाइन किया जाएगा ताकि प्राइमरी चैम्बर में 850 ± 25°C और सेकेण्डरी कम्बशन चैम्बर 1100°C न्यूनतम तापमान बनाए रखा जा सके जिसके साथ सेकेण्डरी कम्बशन चैम्बर में गैस अवरोधक समय दो सेकेण्ड से कम नहीं होगा ।	
		(v) उत्सर्जन मार्जन के लिए जो मार्जक हैं उनका उपयोग क्वेन्चर के रूप में नहीं किया जाएगा ।	
		(vi) भस्मीकरण संयंत्रों (अर्थात् कम्बशन चैम्बर्स) को ऐसे तापमान, अवरोधन समय और उथल-पुथल के साथ चलाया जाएगा ताकि अपशिष्ट और भस्मीकरण राख में कुल कार्बनिक कार्बन (TOC) यौगिक 3% से कम हो और उनके भस्मीकरण क्षय की मात्रा का शुष्क भार 5% से कम हो । गैर-अनुपालन के मामले में यथास्थिति राख और अपशिष्ट का दुबारा भस्मीकरण किया जाएगा ।	
		(vii) भस्मीकरण संयंत्र के लिये चिमनी की न्यूनतम ऊंचाई तीस मीटर अवश्य रहेगी ।	
		ग. भस्मीकरण संयंत्र के लिये बहि:स्राव मानक	
		(i) मार्जक और तल धुलाई अपजल से उत्पन्न बहि:स्राव ढकी हुई नाली या पाईप नेटवर्क के माध्यम से बहाया जाएगा और इसका शोधन ऊपर 'क' भाग में उल्लिखित बहि:स्राव मानकों के अनुरूप किया जाएगा ।	
		(ii) तल धुलाई अपजल में कुल घुलित कणों (TDS) की मात्रा कच्चे जल में विद्यमान TDS की मात्रा के ऊपर 1000 मि.ग्रा./लीटर से अधिक नहीं होगी ।	
		घ. वर्षा जल	
		(i) वर्षा जल को मार्जक जल और/अथवा तल धुलाई अपजल के साथ मिलने के लिए अनुमति नहीं दी जाएगी ।	
		(ii) वर्षा जल को वर्षा जल के 10 मिनट (घंटे का औसत) की संग्रहण क्षमता के एचडीपीई परत वाले गड्ढे के माध्यम से अलग नाली से बहाया जाएगा ।"	

[फा. सं. एम्यू.-15017/30/2009-सीपीडब्ल्यू]

रजनीश दुबे, संयुक्त सचिव

टिप्पण.—मूल नियम, भारत के राजपत्र में सं. का.आ. 844(अ), तारीख 19 नवम्बर, 1986 द्वारा प्रकाशित किए गए थे; और तत्पश्चात् सं. का.आ. 433(अ), तारीख 18 अप्रैल, 1987; उसके पश्चात् सा.का.नि. 176(अ), तारीख 2 अप्रैल 1996 द्वारा संशोधित किए गए और अभी हाल में सा.का.नि. 97(अ), तारीख 18 फरवरी, 2009; सा.का.नि. 149(अ), तारीख 4 मार्च, 2009; सा.का.नि. 512(अ), तारीख 9 जुलाई, 2009; सा.का.नि. 543(अ), तारीख 22 जुलाई, 2009; सा.का.नि. 595(अ), तारीख 21 अगस्त, 2009; सा.का.नि. 794(अ), तारीख 4 नवम्बर, 2009; सा.का.नि. 826(अ), तारीख 16 नवम्बर, 2009; सा.का.नि. 1(अ), तारीख 1 जनवरी, 2010; सा.का.नि. 61(अ), तारीख 5 फरवरी, 2010 और सा.का.नि. 485(अ), तारीख 9 जून, 2010 द्वारा उनका संशोधन किया गया ।

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 21st July, 2010

G.S.R. 608(E).—In exercise of the powers conferred by Section 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely :—

1. (1) These rules may be called the Environment (Protection) (Fourth Amendment) Rules, 2010.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986, in Schedule-I, in serial number 68 and the entries relating thereto, the following serial number and entries shall be substituted, namely :—

Sl. No.	Industry	Parameter	Standard
(1)	(2)	(3)	(4)
"68.	Organic Chemicals Manufacturing Industry	**A. Effluent Standards**	
			Limiting concentration in mg/l, except for pH and Bioassay test
		Compulsory parameters	
		pH	6.5-8.5
		BOD 3 days, 27°C	100
		Oil & Grease	10
		Bioassay test +	Minimum 90% survival after 96 hours in 100% effluent
		Additional parameters	
		Nitrate (as N)	10
		Arsenic (as As)	0.2
		Chromium (Hexavalent)	0.1
		Chromium Total	1.0
		Lead (as Pb)	0.1
		Cyanide (as CN)	0.2
		Zinc (as Zn)	5.0
		Mercury (as Hg)	0.01
		Copper (as Cu)	2.0
		Nickel (as Ni)	2.0
		Phenolics (as C_6H_5OH)	5.0
		Sulphide	2.0
		+ The Bioassay test shall be conducted as per IS : 6582-1971.	
		Note :	
		(i) Industries covered under this group include halo aliphatics, plasticizers, aromatics (alcohols, phenols, esters, acids and salts, aldehydes and ketones), substituted aromatics, aliphatics (alcohols, esters, acids, aldehydes, ketones, amines and amides) and detergents.	
		(ii) Though norms for COD are not mentioned here but, COD shall be monitored. If the COD in treated effluent exceeds 250 mg/l, the concerned industrial units discharging such effluent shall be required to identify chemicals responsible for high COD in effluent. In case, these are found to be toxic as defined under the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989, the concerned industry shall install tertiary treatment system.	
		(iii) The above mentioned standards shall not be applicable to small scale detergent formulating units.	

(1)	(2)	(3)	(4)
		B. Emission Standards for Incinerator	
		Limiting concentration in mg/Nm³, unless otherwise stated	Sampling Duration in minutes unless otherwise stated
		Particulate Matter 50	30 or more (for sampling about 300 litres of emission)
		HCl 50	30
		SO_2 200	30
		CO 100	daily average
		Total Organic Carbon 20	30
		Total Dioxins and Furans* Existing Incinerator 0.2 ngTEQ/Nm³	8 hours
		New Incinerator 0.1 ngTEQ/Nm³	8 hours
		Sb + As + Pb + Cr + Co + Cu + Mn +Ni + V + Cd + Th + Hg and their compounds 1.5	2 hours

*The existing plant shall comply with norms for Dioxins and Furans as 0.1 ngTEQ/Nm³ by 1st January, 2014.

Note :

(i) All monitored values shall be corrected to 11% oxygen on dry basis.

(ii) The CO_2 concentration in tail gas shall not be less than 7%.

(iii) In case, halogenated organic waste is less than 1% by weight in input waste, all the facilities in twin chamber incinerator shall be designed so as to achieve a minimum temperature of 850 ± 25°C in primary chamber and 950°C in secondary combustion chamber and with a gas residence time in secondary combustion chamber not less than two seconds.

or

all the facilities in single chamber incinerator for gaseous hazardous waste shall be designed so as to achieve a minimum temperature of 950°C in the combustion chamber with a gas residence time not less than two seconds.

(iv) In case halogenated organic waste is more than 1% by weight in input waste, waste shall be incinerated only in twin chamber incinerators and all the facilities shall be designed to achieve a minimum temperature of 850 ± 25°C in primary chamber and 1100°C in secondary combustion chamber with a gas residence time in secondary combustion chamber not less than two seconds.

(v) Scrubber meant for scrubbing emissions shall not be used as quencher.

(vi) incineration plants shall be operated (i.e. combustion chambers) with such temperature, retention time and turbulence, as to achieve Total Organic Carbon (TOC) content in the incineration ash and residue less than 3%, and their loss on ignition is less than 5% of the dry weight. In case of non-conformity, ash and residue, as the case may be shall be re-incinerated.

(vii) The incinerator shall have a chimney of at least thirty meters height.

C. Effluent Standards for Incinerator

Note :

(i) Effluent from scrubber(s) and floor washing shall flow through closed conduit or pipe network and be treated to comply with the effluent standards mention at 'A' above.

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(1)	(2)	(3)	(4)
		(ii)	The built up in Total Dissolved Solids (TDS) in waste water of floor washings shall not exceed 1000 mg/l over and above the TDS of raw water used.
		D. Storm water	
		Note :	
		(i)	Storm water shall not be allowed to mix with scrubber water and/or floor washings.
		(ii)	Storm water shall be channellized through separate drains passing through a HDPE lined pit having holding capacity of 10 minutes (hourly average) of rainfall.".

[F.No. Q-15017/30/2009-CPW]

RAJNEESH DUBE, Jt. Secy.

Note.—The principal rules were published in the Gazette of India *vide* number S.O. 844(E), dated 19th November, 1986; and subsequently amended *vide* S.O. 433(E), dated 18th April, 1987; subsequently Schedule VII published *vide* G.S.R. 176(E), dated 2nd April, 1996; and recently amended *vide* G.S.R. 97(E), dated the 18th February, 2009; G.S.R. 149(E), dated the 4th March, 2009; G.S.R. 512(E), dated the 9th July, 2009; G.S.R. 543(E), dated the 22nd July, 2009; G.S.R. 595(E), dated the 21st August, 2009; G.S.R. 794(E), dated the 4th November, 2009; G.S.R. 826(E), dated the 16th November, 2009; G.S.R. 1(E), dated the 1st January, 2010; G.S.R. 61(E), dated the 5th February, 2010 and G.S.R. 485(E), dated the 9th June, 2010.

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