Advertisement for Incubation of Technology

Title of the technology	**Plasma Melting Furnace for Pre-Processed PCB Scrap**

Current state of Technology

- ✓ Basic principles observed
- ✓ Technology concept formulated
- ✓ Experimental proof of concept
- ✓ Technology validated in lab

General Information

Thermal plasma treatment of e-waste helps in economical separation and recovery of valuable metals. The waste is heated so as to achieve a high process temperature of the order of 1000 deg. C, which is above the gasification temperature of the organic material but below the melting point of most of the metallic components facilitating their separation.

Features/Specification of system

Parameters	***For Current System***	***For Target System***
Process rate	30 kg/hr	**125 kg/hr**
Feeding	Batch feeding	**Continuous feeding**
Number of torches	One	**Two or more**
Torch movement	stationary	**Programmed Up/down & swing**
Post processing	manual	**Automation implemented**
Stack height	5 m	**30 m**

Working of the System (with schematic block diagram)

- E-waste generally consists of epoxy resin boards having electronic components mounted on it and films of copper, inter-layered inside it.
- The metallic constituents are Iron (Fe) and Aluminium (Al) as structural materials and Copper (Cu) as conductor. The connecting lids contain Gold (Au) and Silver (Ag) coating as contact material.
- Recovery addresses: separation, collection and purification of Au, Ag, Cu, Al, and Fe.
- In a plasma setup the plasma plume is adjusted to achieve a temperature above 1000 deg. C but below the melting point of Fe.
- This causes (a) Al to melt and flow down (b) loosening of epoxy resin (c) gasification of plastic constituents (d) bead formation of Au and Ag constituents
- Al gets separated as it flows down

- Fe which becomes loose but is not melted yet, gets separated by magnet.
- A vibrating bed can expose the Cu films and the connecting Cu parts that can be separated manually.
- The small amount of Au and Ag, usually in the form of beads may be separated using conventional wet chemical process.

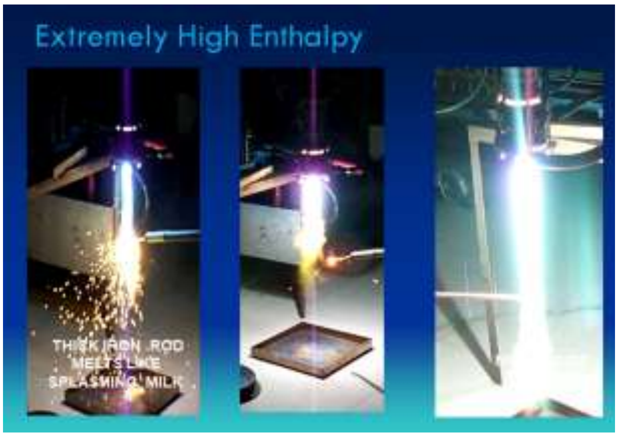
In the present system, the PCBs are directly packed into boxes as shown in A&B in the process flow sheet and sent to the plasma treatment unit [C]. No components are removed. Air plasma, delivered by indigenously developed Hafnium-electrode plasma torch possesses temperature as high as 8000 K, and provides nascent atomic and ionic species of air (primarily of oxygen and nitrogen). In its nascent form, the species are extremely active and interact with available C-H chains to form CO and H_2 gases. Temperature for the process zone is maintained in such a way that substances like aluminum, having low melting point, flow down as slag [D]. In the presence of the active ions and atoms and high temperature, the primary bonds in the PCB material breaks and a loosely bound grainy substance [F] forms. The inner copper layers [G] get exposed and can be easily removed. The other components having high melting point get detached from the board and lie on the chamber floor mixed with grainy substances. Iron [E] is separated using magnet. Loosely bound copper leads (some containing gold and silver) [H] are collected manually. The inner layers of fiberglass remain almost intact [I] and can be segregated easily. Emission is passed through secondary chamber and alkaline venturi scrubber before release to atmosphere.. The gaseous release to the atmosphere satisfies the present CPCB norms.

In the present lab scale system the segregation is manual. The system to be incubated needs two compartments: The first one is plasma treatment chamber with automatic height adjustment of torch and the second one with vibrating bed for removal of Cu films and components from loosened matrix of epoxy resin.

Applications of the System

- Recovery of metal from e-waste with minimal post processing requirement
- Production of syngas from the gasification of C-H content

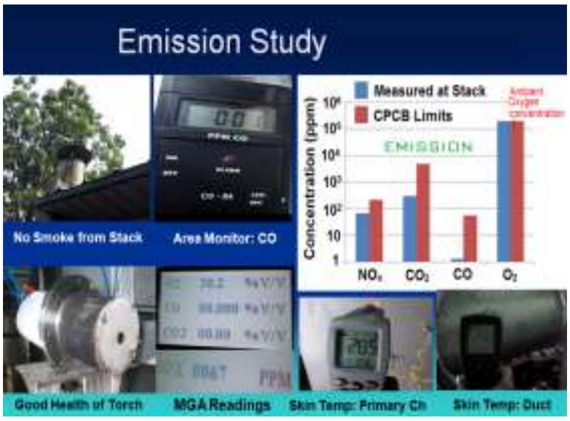
Picture/Photo of the Existing Lab-scale System



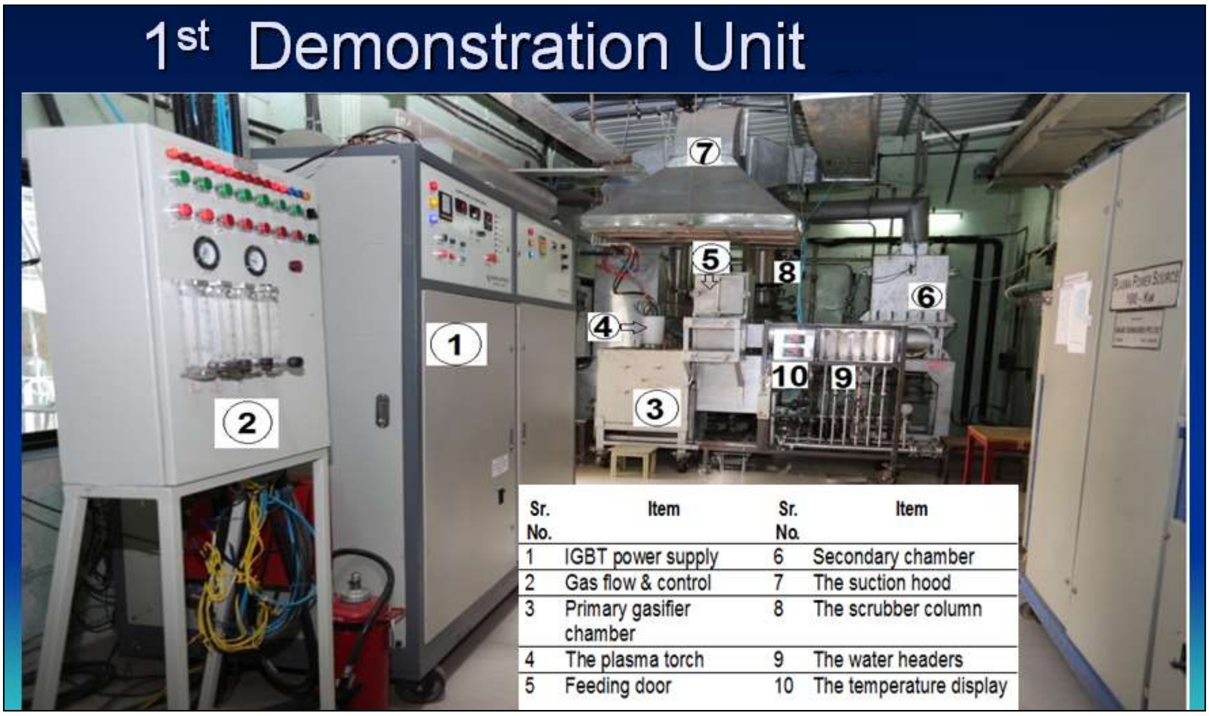
(i) Air plasma torch developed by BARC.

(ii) Typical e-waste Used, Gasification & Slag

(iii) Recovered & Segregated Metals After Gasification



(iv) Environment friendly emission



(v) Demonstration Unit

Whether the parent product/ technology/ process is patented: No

If yes, provide the details – Not applicable

Deliverables –

An industrial scale cost effective environment friendly system will be available for single step recovery of metals from PCBs with minimal effluent generation.

The concept was demonstrated in a lab scale unit developed for gasification study of different types of wastes including municipal solid waste, hazardous waste, rubbers, plastics etc. It operates under batch mode. For industrial scale operation under continuous mode, the feeding system needs suitable engineering modifications and appropriate adaptation with the primary chamber in a judicious manner.

Justification for Incubation –

Bringing the system into industrial scale (operation with continuous production) from the present technological readiness level (in lab scale under batch mode) is expected to face substantial technological challenges. This is due to presence of extremely high temperature and requirement of negative pressure in the process zone. Industrial scale handling of large amount of waste will also require significant process and engineering optimization. Appropriate incubation can develop suitable management system through proper engineering and help the technology to mature to industrial scale under continuous mode operation.

Facility and Infrastructure requirements from Incubatee:

Title Head	**To be provided by Incubatee**
Manpower/ expertise	Engineers (Mechanical, Electrical and Chemical), One certified welder and fitter, One casual labour
Machinery and Equipment	• 40 kW IGBT Power supply • Inlet and outlet water supply header and Air supply headers fitted with valves, rotameters and RTDs. • 3 MHz spark igniter with power supply • Thermocouple sensors. • Flue gas analyzer • Area monitor • Air plasma torches (30 kW)
Economic Viability:	
a. Investment and unit cost of production	~ 90 Lakhs
b. Imported/indigenous market price of equivalent technology/ process/ product, if available.	~10 Crore
Special Requirements:	
Any special requirements for plant, industry, location utilities, handling storage, safety etc.	30 m Stack for emission is compulsory to meet CPCB emission norm.

Note: As per in-house technology incubation policy, the incubatee should be a licensee of the existing technology. Alternatively, the applicant will be required to take the license of the existing technology before entering incubation agreement.

If interested in Incubation, kindly ***download -> fill -> scan -> send*** the application form to -

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