

Alter NRG Plasma Gasification: Environmental Performance

Deep Dive Workshop on Waste-to-Energy Session C
2016 Asia Clean Energy Forum , 7 June 2016



Life WITHOUT
Landfills

ALTER NRG PLASMA GASIFICATION PROCESS – A WASTE REDUCTION TECHNOLOGY

Waste Feedstocks:
Municipal, Hazardous, Industrial, Medical, Mixed Biomass, Construction & Demolition, Coal, Tires, etc.



1000 Tons/day



20 Tons/day
Sludge to landfill



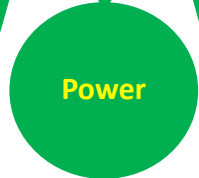
20 Tons/day
Recycled into the Gasifier



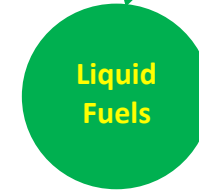
1 Ton/day
For sale to market



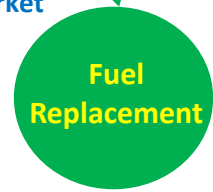
250 Tons/day
For sale to market as aggregate



50 MW Gross
(~41 MW Net to the grid)
For sale to market



800-1200 Barrels/day
For sale to market



10,420 Btu/day
(3.8 MMBtu/year)

IN SUMMARY:

1000 tpd Waste Processed
Using Alter NRG Gasifier



250 tpd Slag for Sale
To the Market as Aggregate

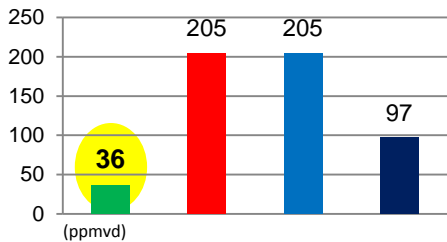


40 tpd Waste for Disposal
20 tpd Particulate Matter + 20 tpd Sludge for Landfill Disposal OR Recycled back into Alter NRG's Gasifier

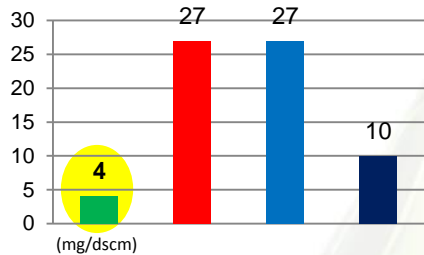
SUPERIOR ENVIRONMENTAL FOOTPRINT

Air Emissions test were independently undertaken and were significantly below legislative laws

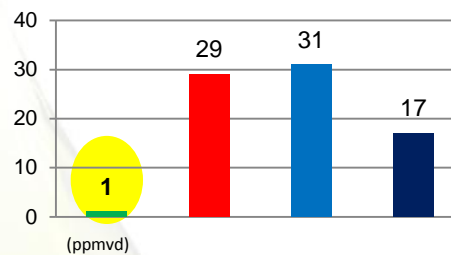
Nitrogen Oxide (NO_x)



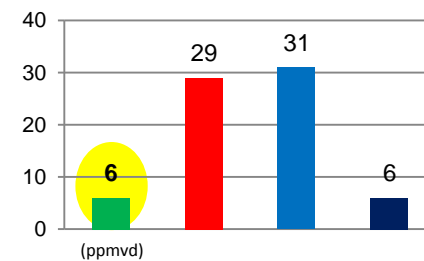
Particulate Matter (PM)



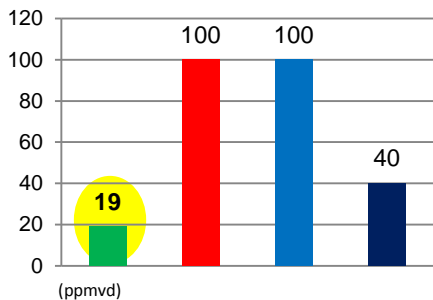
Sulfur Dioxide (SO₂)



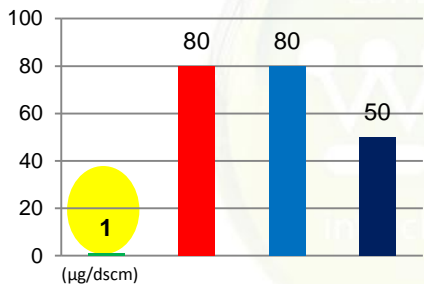
Hydrogen Chloride (HCl)



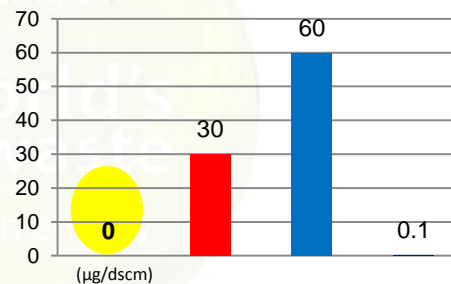
Carbon Monoxide (CO)



Mercury (Hg)



Dioxins and Furans (PCDD/PCDF)



Legend:

- Westinghouse Plasma (Combined Cycle)
- Permitted Incineration Facilities, USA
- US Emissions Guidelines EPA Section 111(d)
- EU Emissions Directive on Waste Incineration (2000/76/EC)

ppmvd: parts per million volumetric dry
 mg/dscm: milligrams per dry standard cubic meter µg/dscm: micrograms per dry standard cubic meter ng/dscm: nanograms per dry standard cubic meter.
 2000/76/EC STP are 0°C and 101.3 kPa at 11% O₂ dry basis

* Values are based on daily averages
 ** Values are based on minimum of 30 minutes and maximum of 8 hours

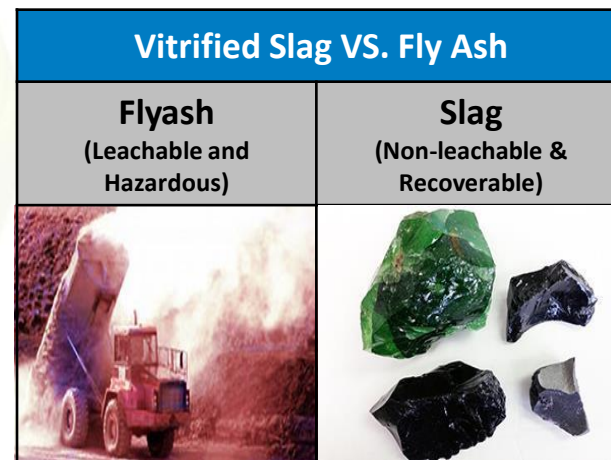
SALEABLE BYPRODUCTS FOR REVENUE GENERATION

Vitrified Slag

- Plasma gasification produces non-leaching vitrified slag used as a construction aggregate, landscaping blocks, rock wool insulation, floor tiles, etc.
- Third party performed leachate tests at the Mihama-Mikata, Pune and Shanghai facility include JLT-46, NEN-7341 and TCLP.
- Test results show that slag components are significantly below test detection limits and considered non-leaching.

NON LEACHING VITRIFIED SLAG: Example - Mihama-Mikata Slag JLT-46 Results				
Heavy Metal	Unit	Method Detection Limit	Average Measured Value of Slag	JLT-46 Limit
Arsenic	mg/L	0.001	<0.001	0.01
Cadmium	mg/L	0.001	<0.001	0.01
Chromium VI	mg/L	0.005	<0.005	0.05
Lead	mg/L	0.001	<0.001	0.01
Mercury	mg/L	0.0001	<0.0001	0.005
Selenium	mg/L	0.001	<0.001	0.01

Notes: mg/L = parts per million (PPM)
 JLT-46 performed by Shimadzu Techno Research, Inc., Kyoto Japan on Mihama-Mikata slag samples received from Kamokon



SMS SLAG TEST REPORT



TEST	PROTOCOL	RESULTS
ARSENIC AS (As)	EPA 2008	0.29 mg/kg
CADMIUM AS (Cd)	EPA 2008	BDL (DL:0.02 mg/kg)
COPPER AS (Cu)	EPA 2008	BDL (DL:0.2 mg/kg)
MERCURY AS (Hg)	EPA 2008	BDL (DL:0.05 mg/kg)
NICKEL AS (Ni)	EPA 2008	BDL (DL:0.2 mg/kg)
LEAD AS (Pb)	EPA 2008	BDL (DL:0.1 mg/kg)
ZINC AS (Zn)	EPA 2008	2.95 mg/kg
HEXAVALENT CHROMIUM AS (Cr6+)	EPA 2008	BDL (DL:0.5 mg/kg)

Note:

- BDL: Below Detection Limit; DL: Detection Limit
- All parameters analyzed from TCLP extracts as per EPA 1311
- S;ag sample from PVGR bottom at SMS Pune Facility
- Test start date: 10/06/2009; Test end date: 20/06/2009

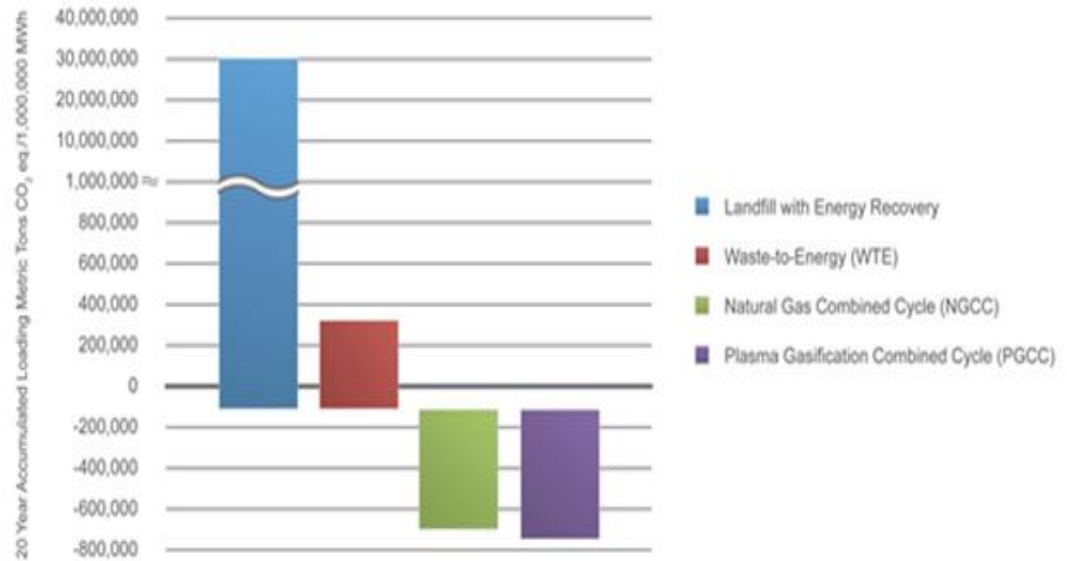
Vitrified Slag VS. Fly Ash

Westinghouse Plasma Gasifier produces non-leaching vitrified slag (used as a construction aggregate, landscaping blocks, rock wool insulation, floor tiles etc.) vs. *leachable* incinerator fly ash



GHG EMISSIONS COMPARISON

- Plasma gasification reduces greenhouse gas emissions (GHG) by over 50% on a lifecycle basis compared to conventional landfilling
- Emission levels from a combined cycle power plant using plasma gasification are similar to those from a natural gas fired power plant
- The use of waste as a feedstock in a plasma gasification power plant eliminates the GHG produced by otherwise landfilled waste and therefore the technology is expected to be RPS and REC eligible



Source: SCIENTIFIC CERTIFICATION SYSTEMS, INC.

A 2010 report by Scientific Certification Systems comparing Landfill, Waste to Energy (incineration) and Plasma Gasification Combined Cycle configurations, concluded that a “Plasma Gasification Combined Cycle (PGCC) system provides the lowest greenhouse gas emissions of the evaluated systems for waste disposal.”

PLASMA GASIFICATION – SUMMARY

- High temperatures and long residence time prevents formation of Dioxins and Furans
- Inert materials are converted to a safe, usable product instead of ash
- Life cycle CO₂ emissions (for a combined cycle operation) are comparable to a natural gas combined cycle power plant
- Air emissions are well below all the most stringent emissions standards

