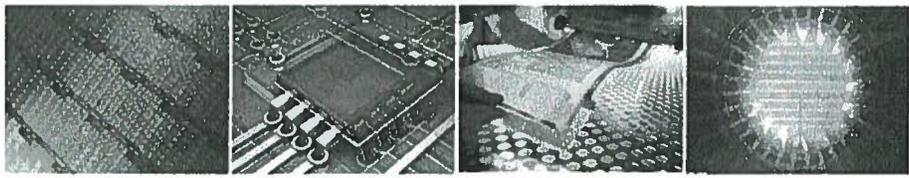


RECEIVED
CITY CLERK
& C OF HONOLULU
2014 JAN 17 PM 1:29

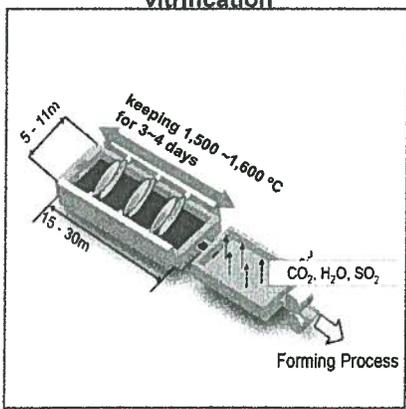
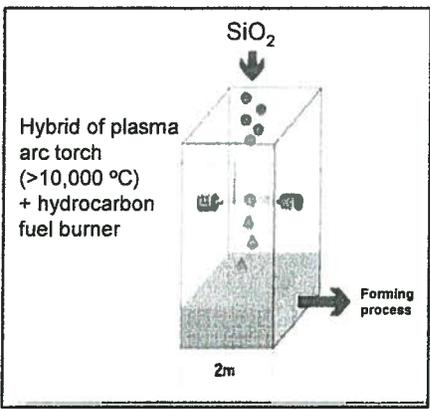


Melting treatment of ash from coal power plant and unburned Municipal Solid Wastes (MSW)

Dept. of Advanced Green Energy and Environment at
Hangong Global University
and
Green Science Corporation
BongJu Lee

HGU 한공대학교

Conventional vs. new melting methods for glass production GREEN SOLUTION

Conventional (Siemens) vitrification	In-flight melting vitrification
	
<p>Require a long time to uniformity the melted glass raw material and to remove the bubbles inside : huge energy loss</p>	

HGU 한공대학교

Submitted at the PWS Committee Meeting on 01/17/14 relating to Discussion Item No. 1
update on the H-POWER ash stream from the Department of Environmental Services
by Councilmember Stanley Chang

Melting ash from coal power plant and unburned MSW



- **Ash from coal power plant is usually buried**
 - 10% of total coal consumed becomes ash
 - 80% of ash is flying ash, which can be used for manufacturing cement and 20% is bottom ash, which is waste and thrown away to ash pond in Korea
- **MSW is usually burned by below 1,000 °C flame**
 - most of unburned MSW is SiO_2 base material
 - unburned MSW is usually buried
- **Ash and unburned MSW can be melted by above 1,500 °C flame**
 - melting SiO_2 requires lots of energy, however, the plasma torch can save much of it
 - temperature of plasma torch flame can be up to 12,000 °C
 - once ash and unburned MSW are melted, the volume of them is reduced to 30~35% of initial volume
 - microwave torch can save more energy than conventional arc torch

What is a Plasma?



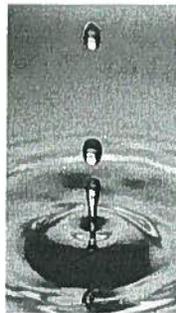
Ice becomes water once it is heated, water does vapor, and plasma when vapor is more heated

Temperature

Ice



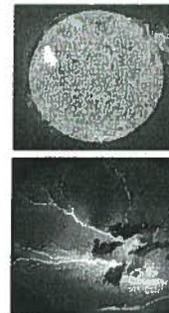
Water



Vapor

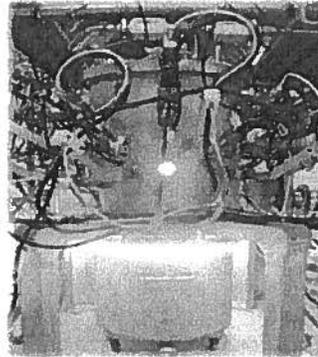
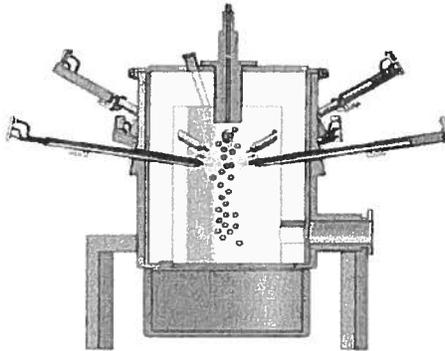


Plasma



In-flight melting method - Asahi glass of Japan

GREEN SCIENCE



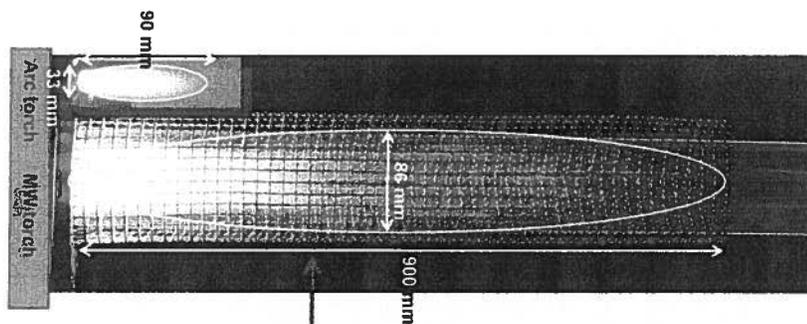
- Utilize Multi-phase AC Arc Torch
 - shorten melting time (de-lattice) due to the high temperature of plasma torch
 - acquire the uniform glassing particles
 - possible for the gas from melting reaction to be removed simultaneously
- Save the energy 60% of one due to conventional Siemens process

한양대학교

Green Science's Microwave Plasma Torch

GREEN SCIENCE

at 10 kW
Arc torch vs. MW plasma torch



Novel "electrode-less" MW plasma torch

한양대학교

Microwave plasma torch vs. Arc plasma torch



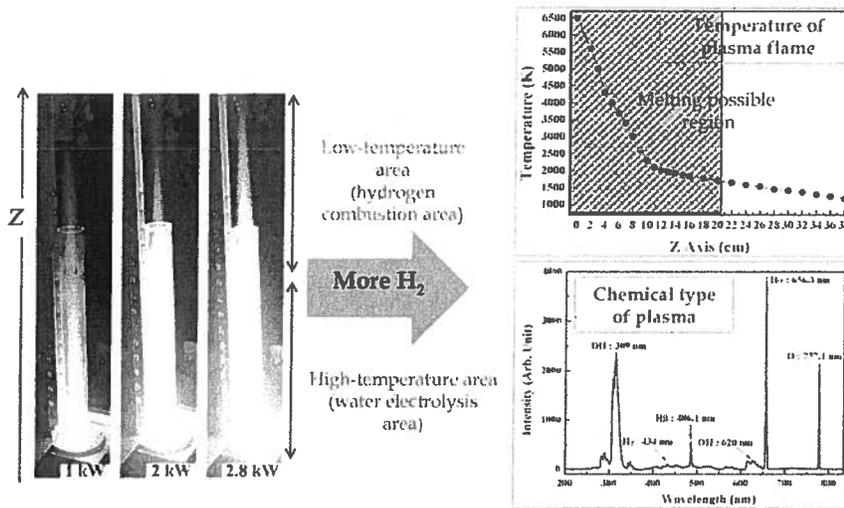
	Microwave plasma Torch	Arc plasma Torch
Max. temperature	> 6,000 °C	> 11,000 °C
Flame volume higher than 2,000 °C	50	1
Efficiency from electricity to torch	> 80%	< 40%
Existence of electrode	No	Yes (must be metal)
Usage of corrosive gases	Yes	No (O*, OH*, F*, etc. erode the electrode)
Hybrid usage with hydrocarbon fuel	Yes (makes bigger plasma flame)	No

- Through-puts to melt ash and unburned MSW of microwave torch is 100 times (size of plasma volume x efficiency) higher than arc torch

© 2010 HJU

HJU 한국과학기술원

Characteristics of pure steam microwave plasma torch

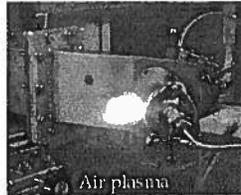


More generation of hydrogen!
Less cost on oxygen separation!

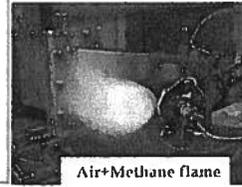
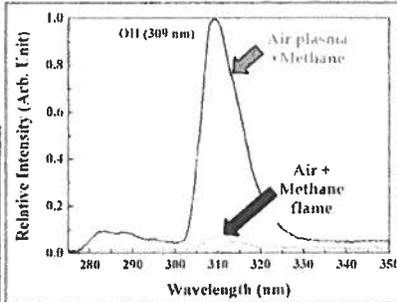
© 2010 HJU

HJU 한국과학기술원

Comparison of reactive catalyzer



Comparison on the intensity of Hydroxyl (OH) line inside flame

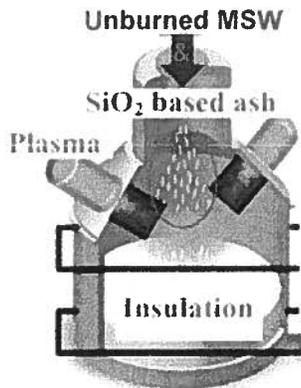


The density of O_2 and H_2 in the atom state is more than 10 times higher



Good for perfect oxidation in pure environment to oxidize

Green Science Corp's in-flight melting



- Utilize the microwave plasma torch instead of multi-phase AC arc torch for in-flight melting method
- Microwave plasma torch vs. Arc torch
 - right melting temperature (~ 6,000 °C vs. 10,000 °C)
 - forming large volume of melting zone because of large volume of flame
- Therefore, energy is saved 60 ~ 70 % compared to multi-phase AC arc torch process
- Comparison for melting ash 80 tons/day below

	Siemens method	In-flight method with arc torch	In-flight method with microwave plasma torch
Energy from Diesel	~ 12,000 kWh	~ 2,000 kWh	~ 1,600 kWh (~ 1,000 gallon)
Electrical energy	0	~ 3,500 kWh	~ 400 kWh
Total	~ 12,000 kWh	~ 5,500 kWh	~ 2,000 kWh

Feasibility study of melting by microwave plasma torch



- **Cost of facility for melting 80 ton/day : ~ USD 3.8 Mil.**
 - 8 torches, melting reactor, and accessories
 - excluding ground and building
- **Daily operating cost**
 - Melting 80 ton/day requires about 2,000 kWh energy
 - 400 kWh from electric energy for plasma and 1,600 kWh (~3,500 liter) from kerosene or LNG
 - All of 2,000 kWh energy can be supplied by only electrical energy, but not kerosene or LNG
 - Energy partition will be determined by the cost of each energy
- **Advantages**
 - Once coal ash and unburned MSW are melted and re-solidification reduces to 30~40% of initial volume of them
 - Re-solidification of melted ash can be used for pebbles under the road, construction, rocks for a seawall, etc.
 - Most valuable product from melted ash is a long glass wool, which can be used for soundproofing, thermal insulating clothes, etc.