Pyrolysis-Gasification of High Moisture-Containing Municipal Soild Wastes in 3 TPD Pilot Plant

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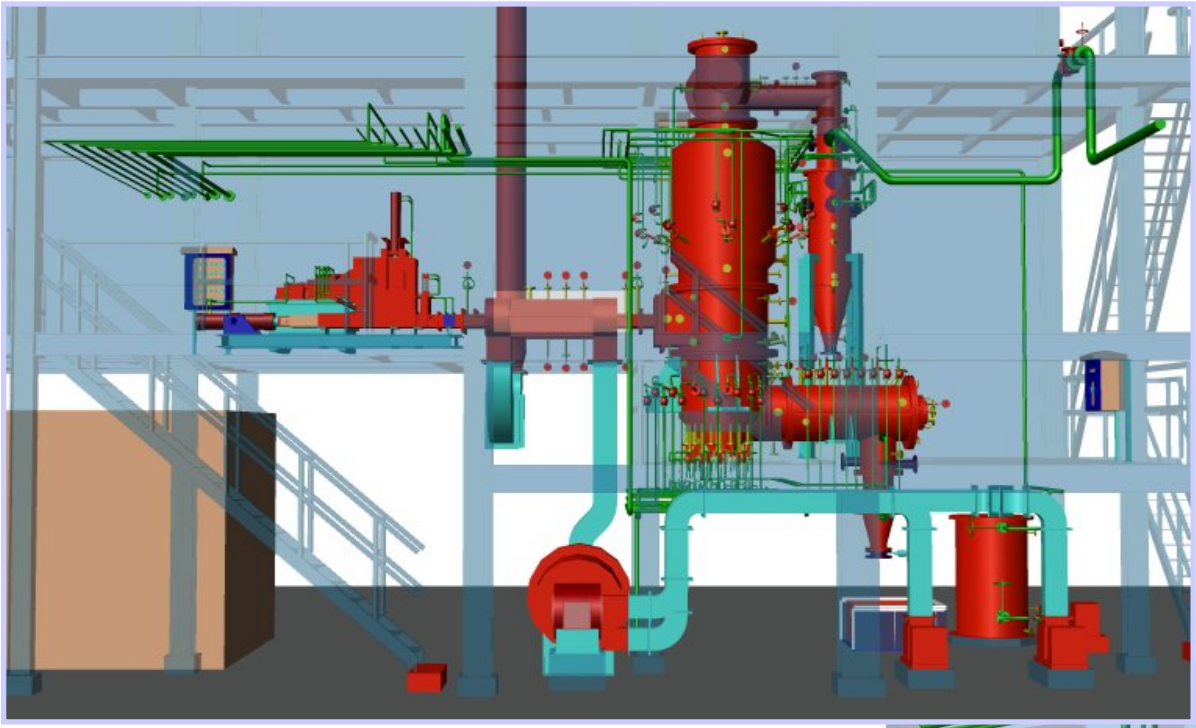
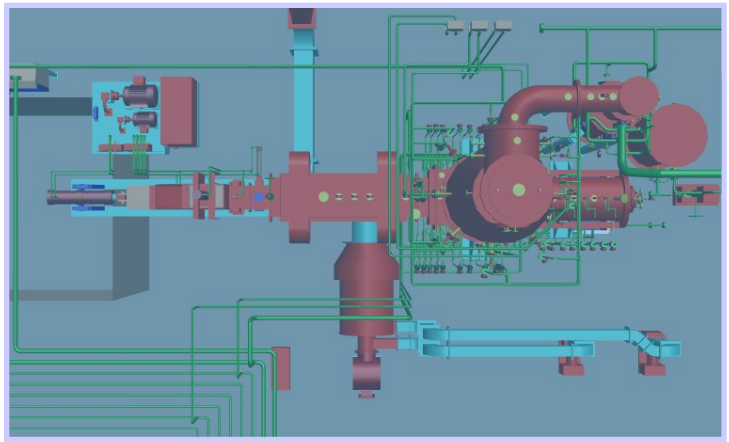
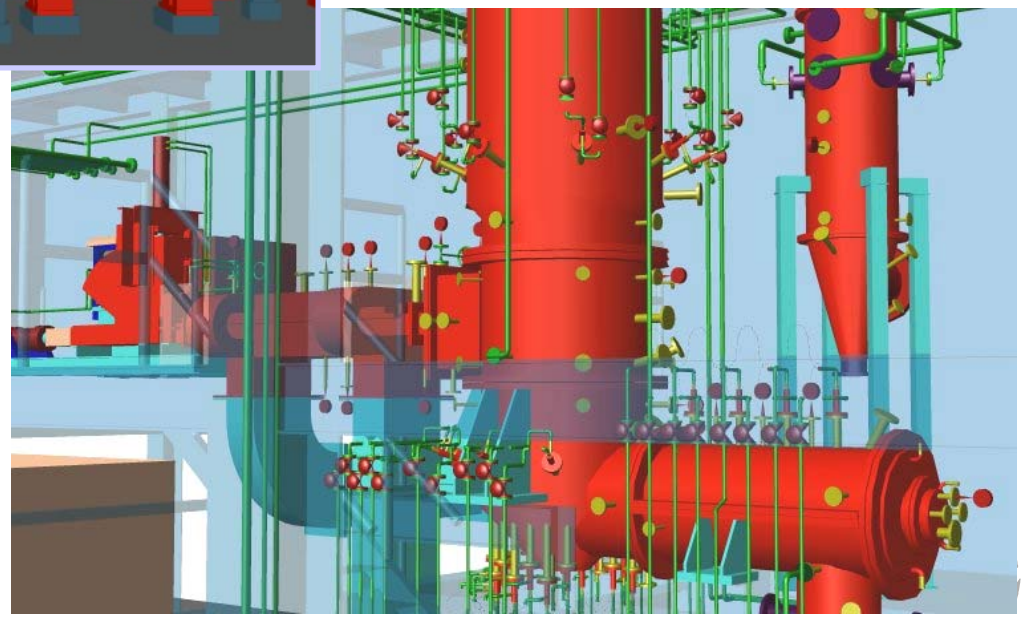
Background

- **Gasification/Melting Technology :**
  - ✓ Solution for environmental problems (dioxin, heavy metal leaching) and energy recycle from wastes
- **Necessity of Pilot Plant :**
  - ✓ Confirm that advanced technologies of pyrolysis /gasification/melting can be applied to Korean MSW of unique feature like high moisture content (above 45%).
  - ✓ Provide data in recovering energy from Korean MSW as an alternative energy source.

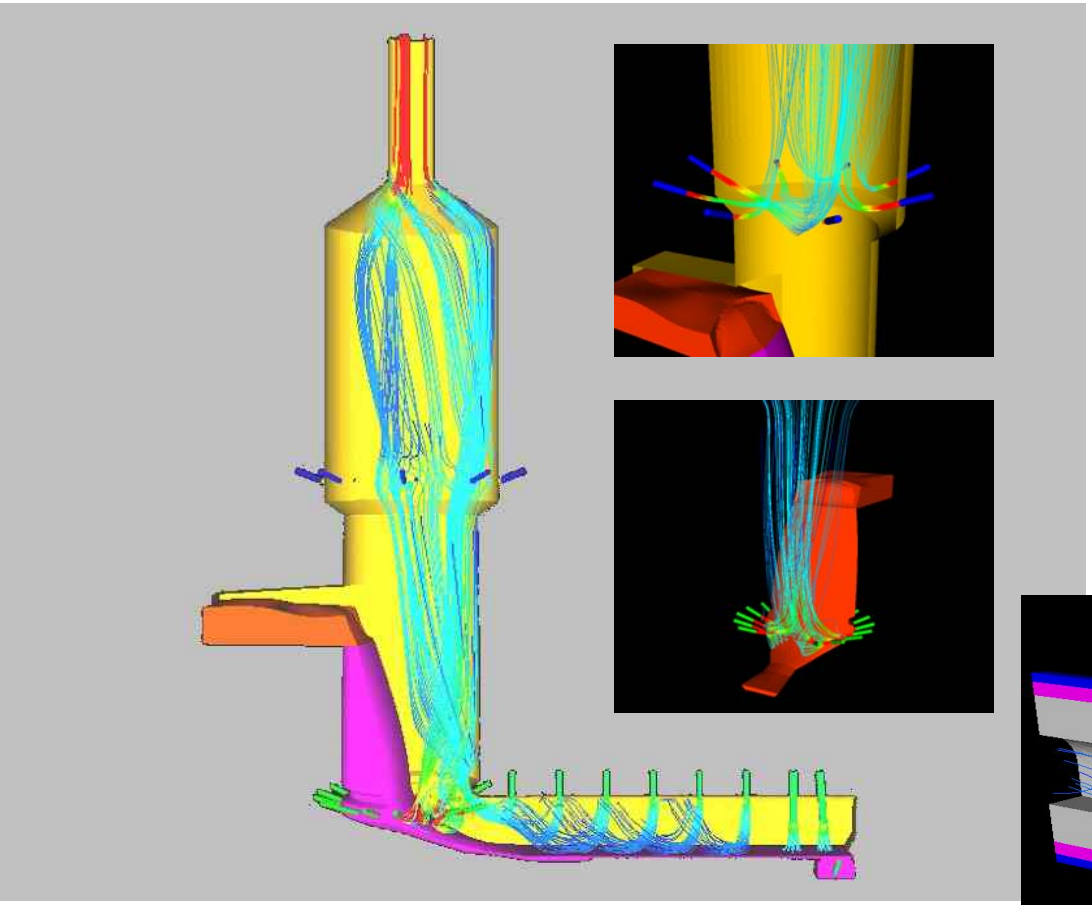
3-D Design View of 3 ton/day MSW Gasification System

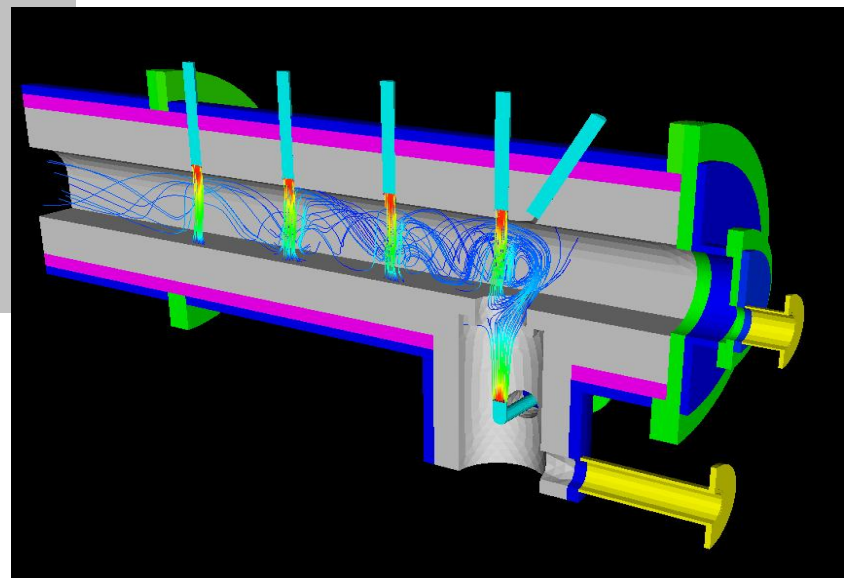






CFD Analysis for Optimal Design



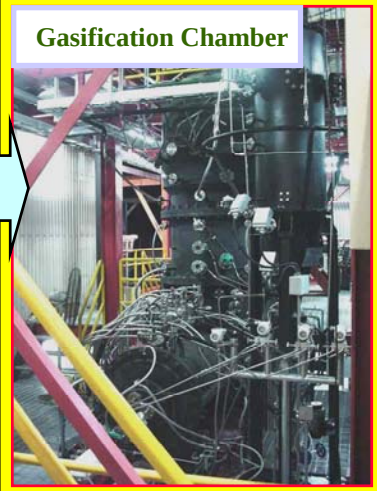


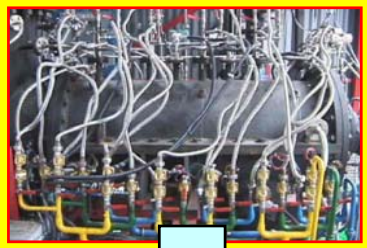
Process Flow of 3 T/D Pilot Plant

Degassing Channel

MSW Press

Gasification Chamber





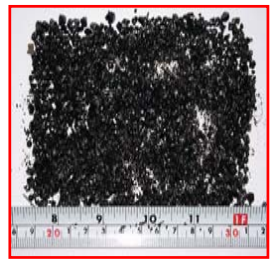
Quick Quencher

Syngas Combustor

Operating Temperature :
1,200～1,600°C

Slag Outlet

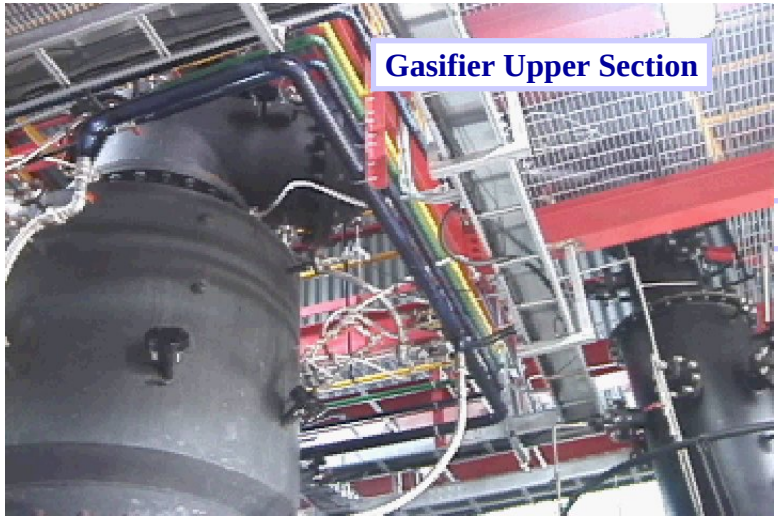
Slag Falling

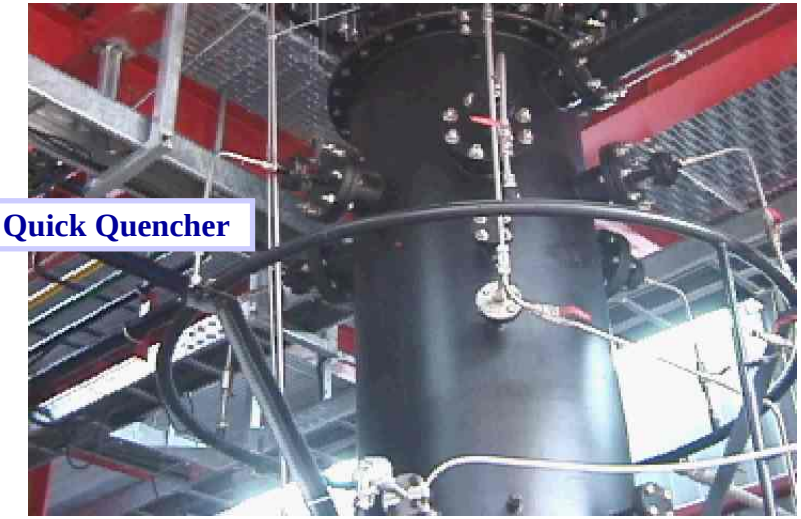


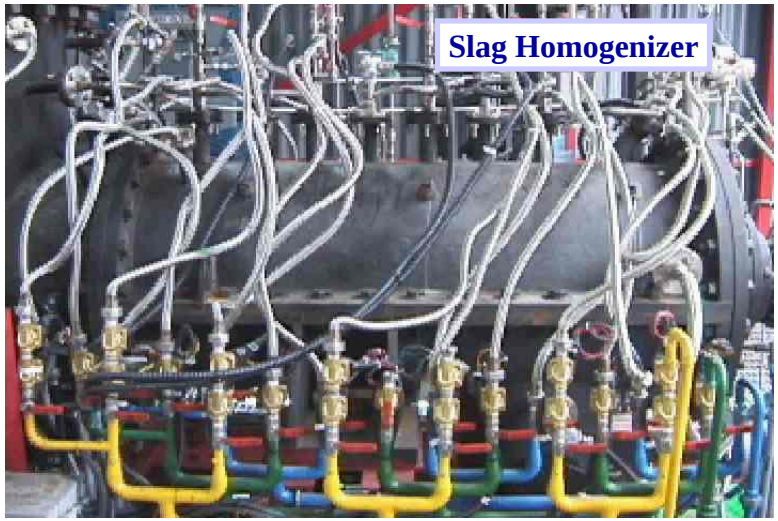
Control Room

Main Equipments Following Process Flow (1)

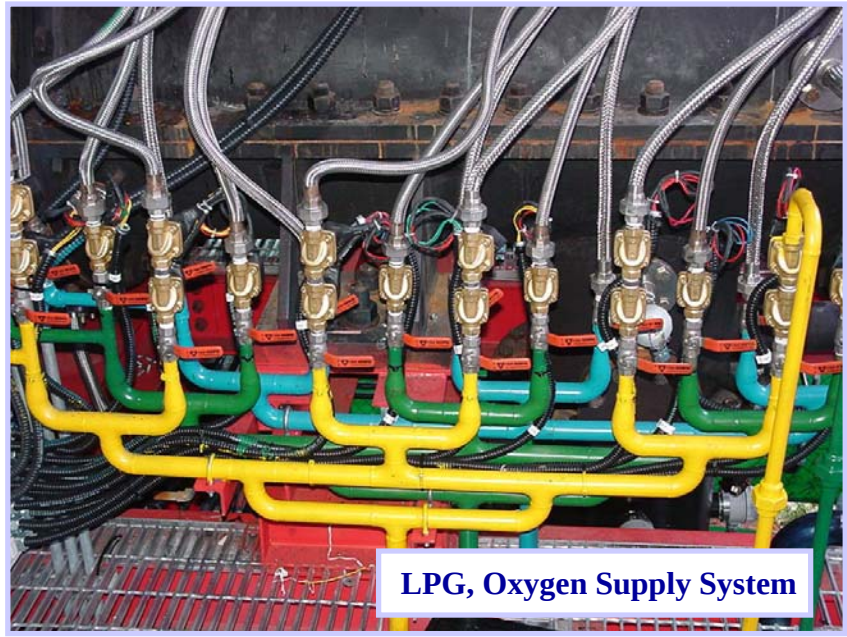
Main Equipments Following Process Flow (2)

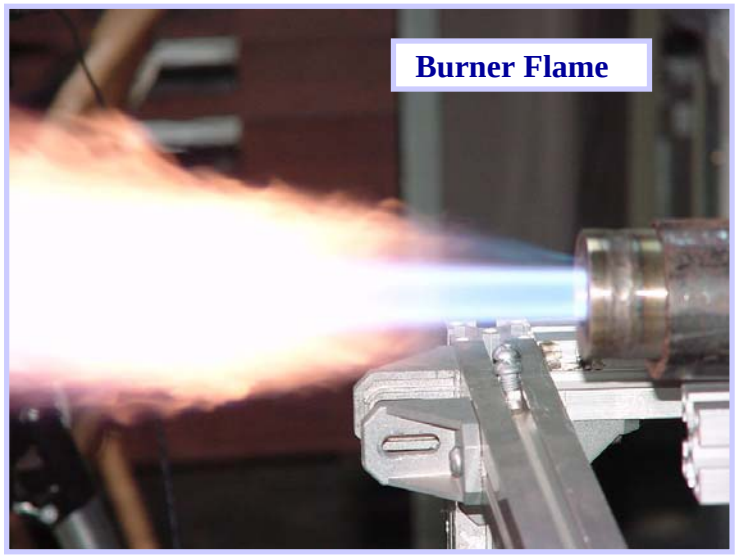






Key Components





MSW Components (wt%)

City	Y-City	K-City
Kitchen food wastes	46.8	29.6
Paper	27.1	33.7
Textiles	5.9	9.7
Vinyls	11.1	19.5
Plastics	2.3	5.6
Glass/Porcelain	6.9	-
Form materials	-	1.9
HHV, kcal/kg	2,176	2,686

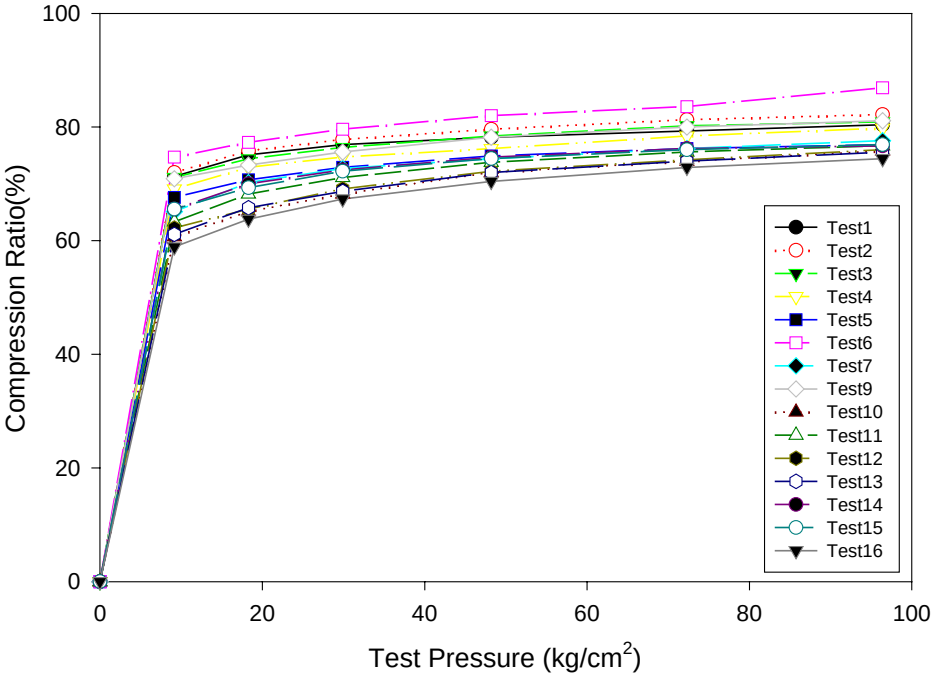
Typical Municipal Solid Wastes in Korea

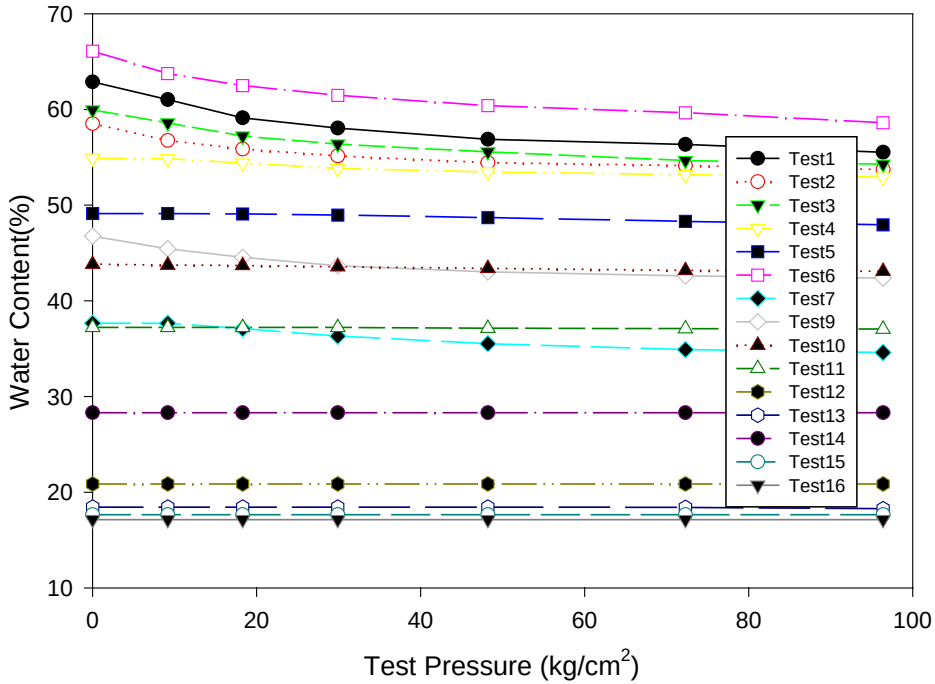
MSW Analysis Results (wt%)

City	Y-City	K-City
Proximate Analysis (as-received)		
Moisture	55.8	50.4
Volatiles	31.3	39.2
Fixed Carbon	6.0	4.9
Ash	6.9	5.5
Ultimate Analysis (dry basis)		
C	34.5	46.2
H	4.3	6.1
O	44.2	36.1
N	1.2	0.6
S	0.2	0.06
Ash	15.6	11.0

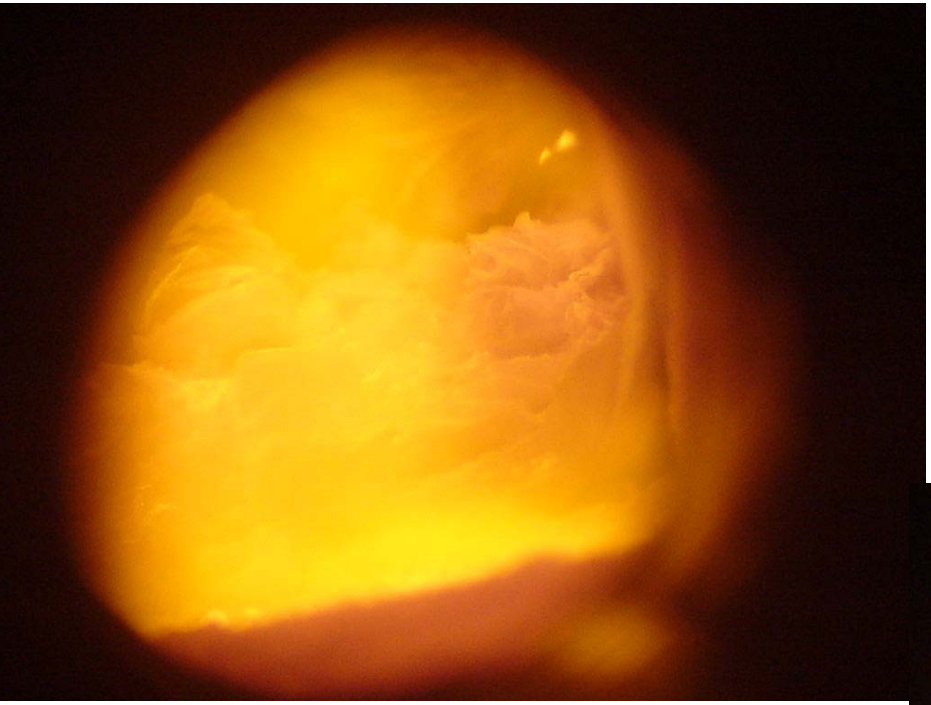
MSW Compression, De-gassing

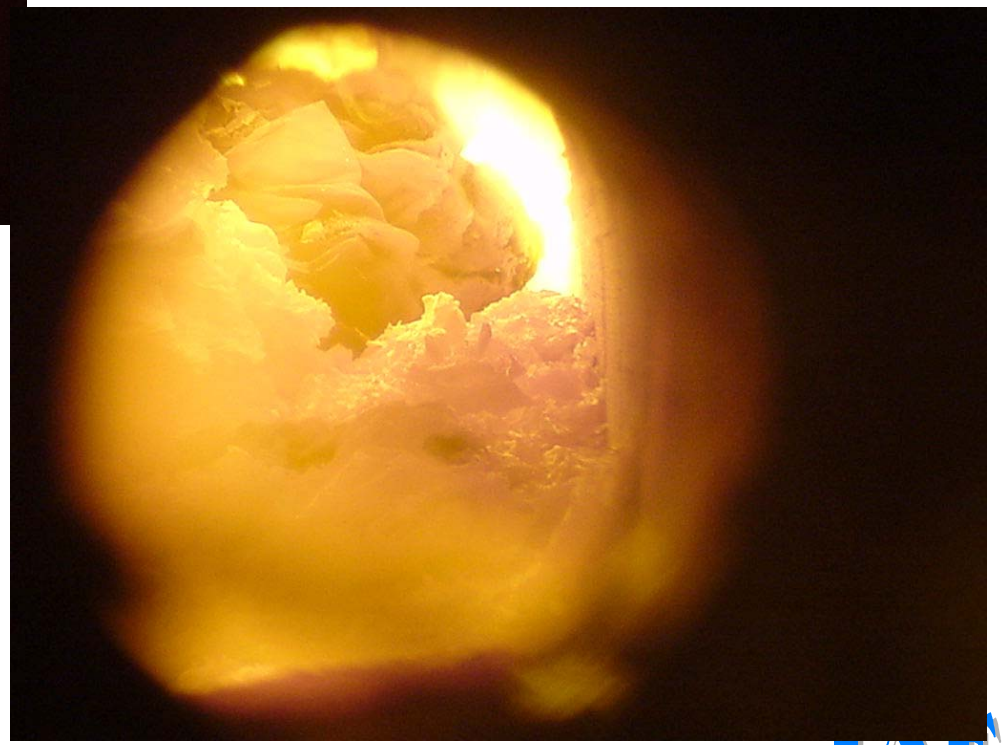
Compression Effects





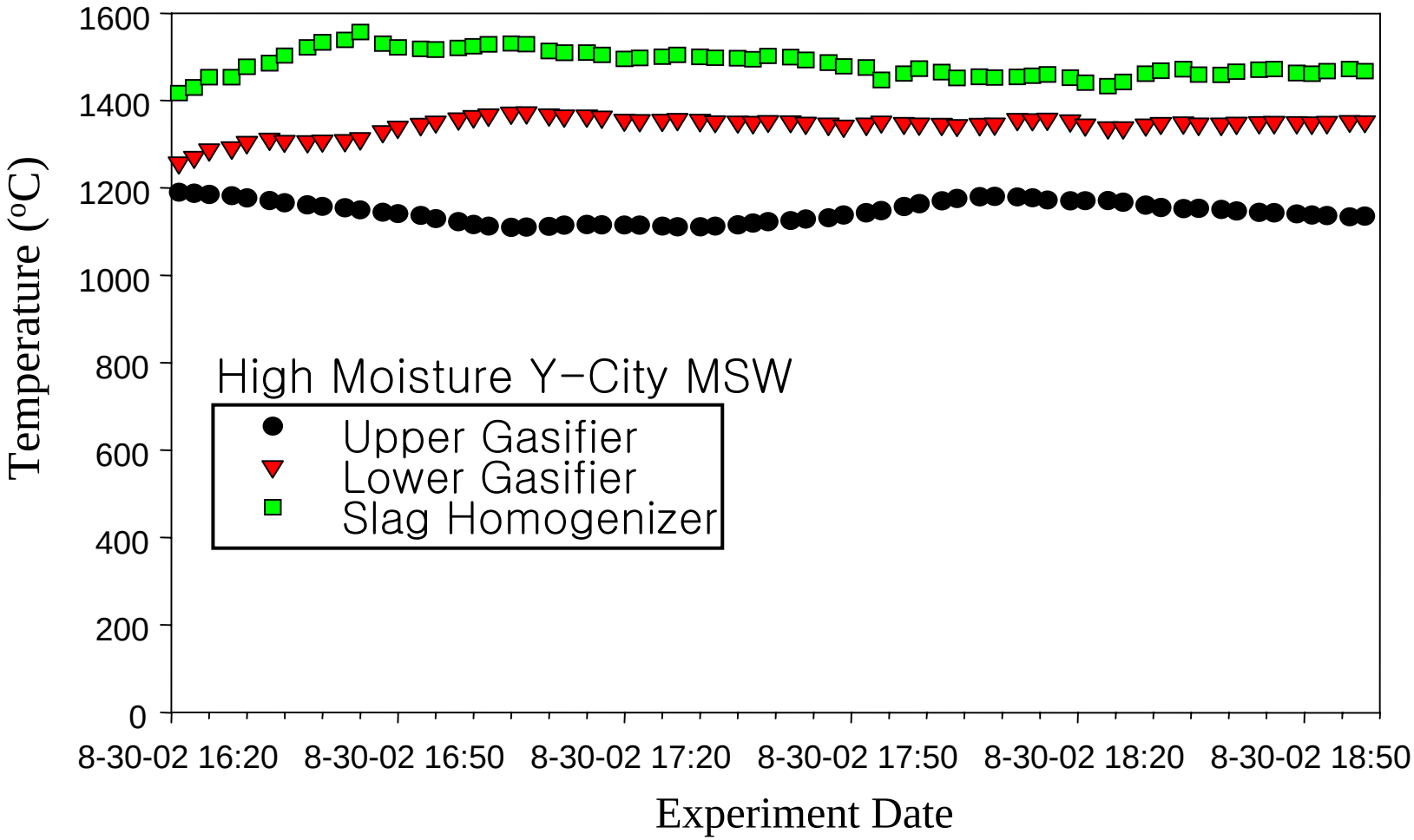
Gasification Zone



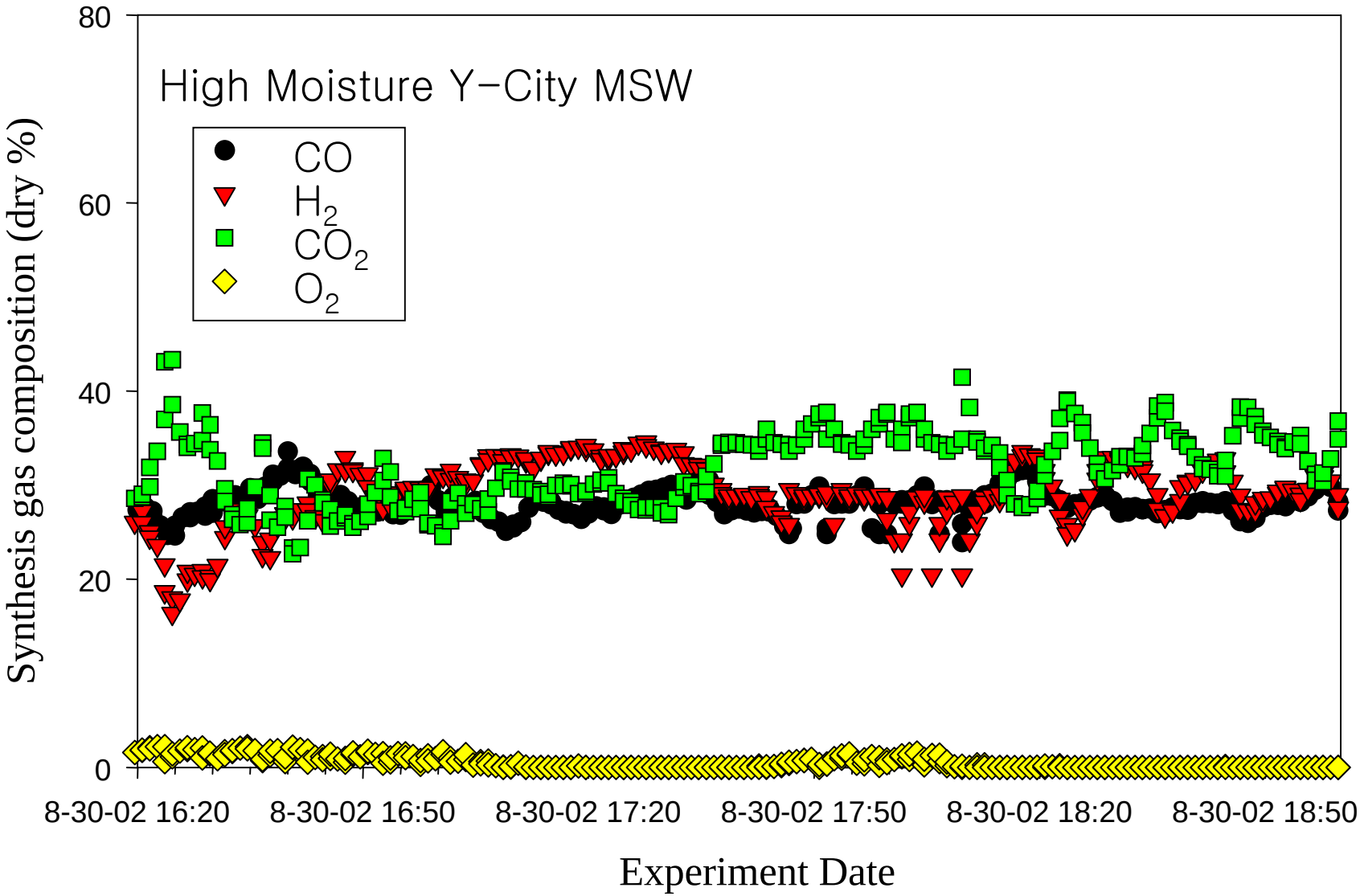


Slag Homogenizer

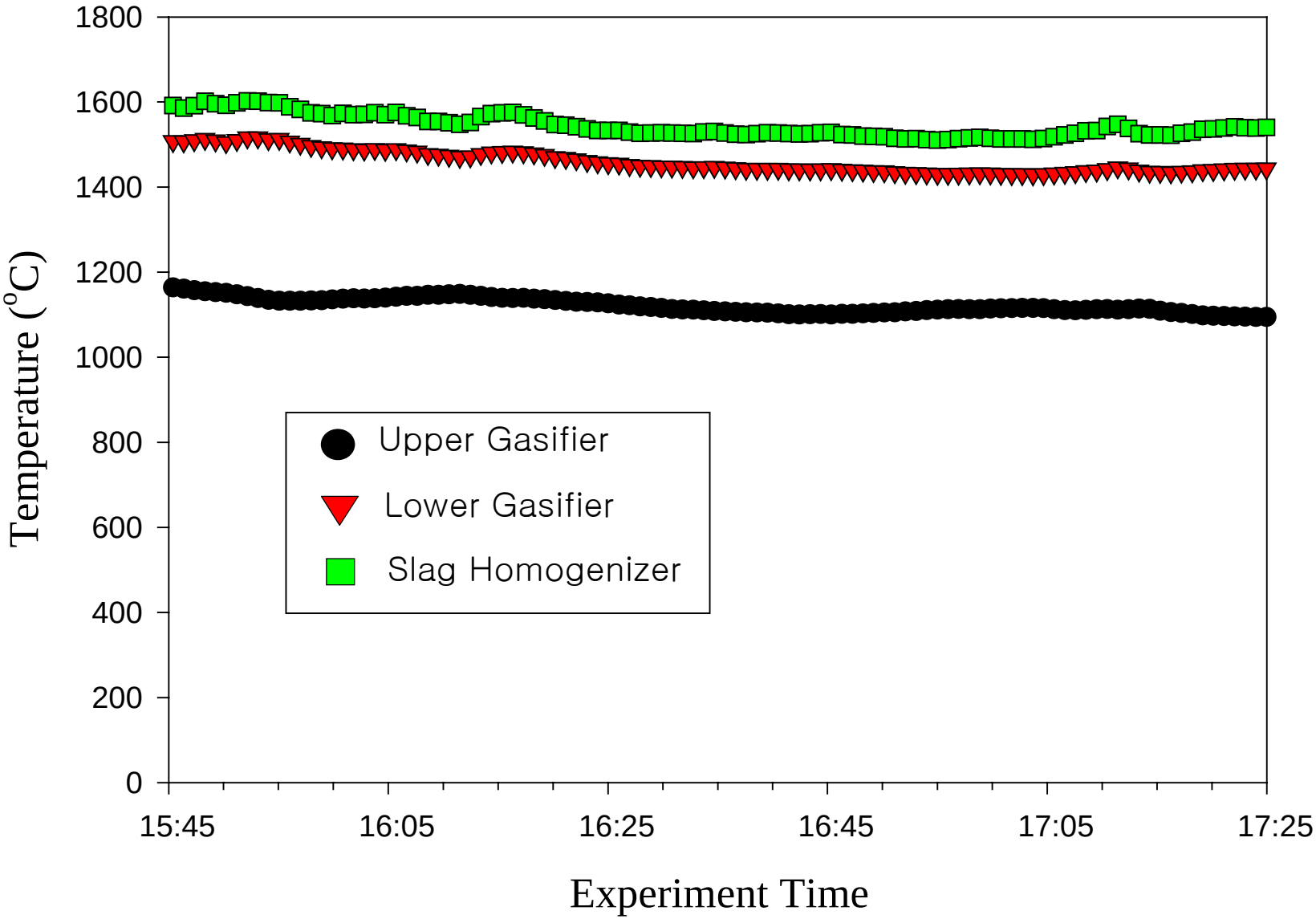
Temperature Profiles Inside Gasifier for Y-City MSW



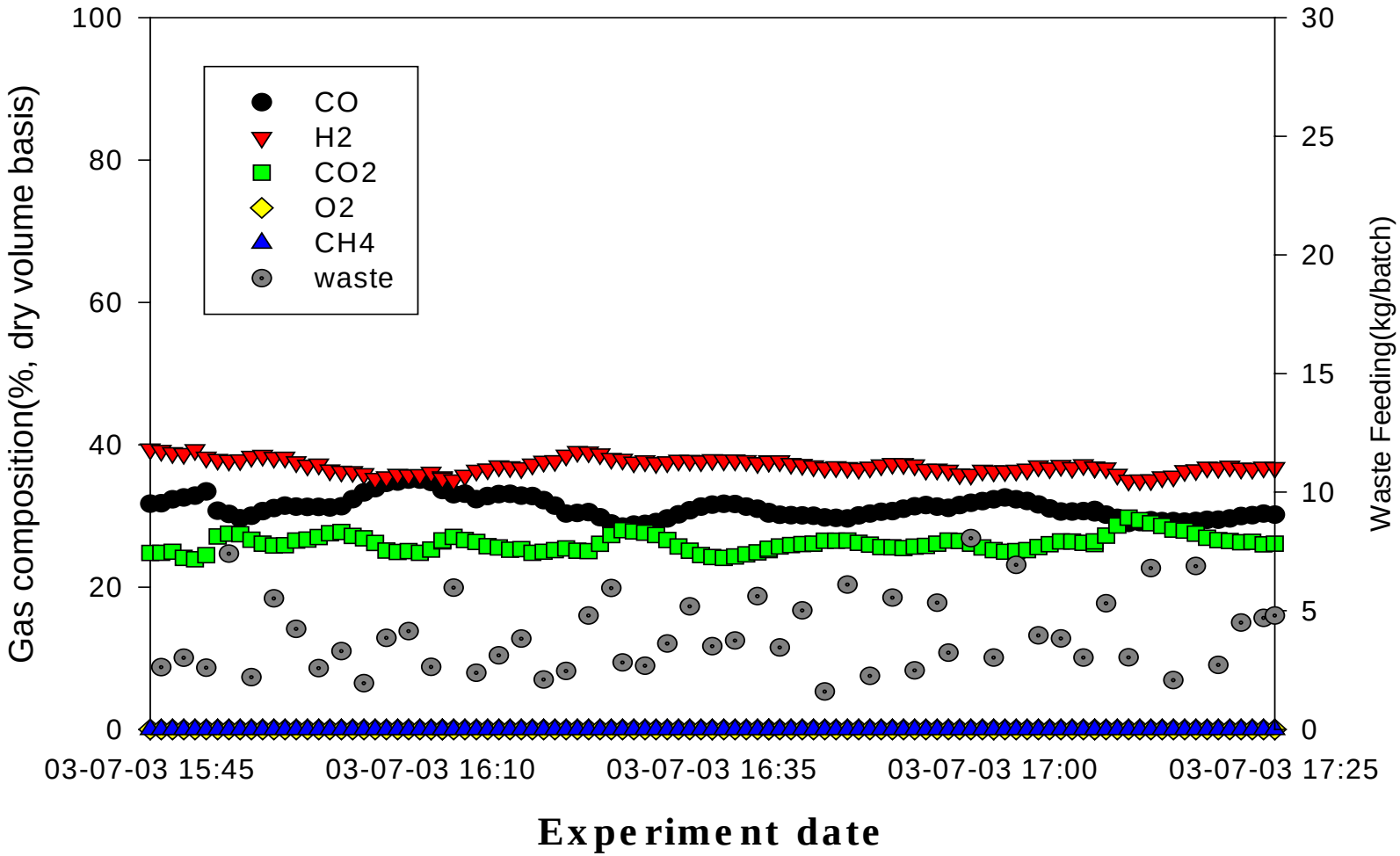
Syngas Composition from Gasification
(55.8 wt% Moisture MSW, Y-City, Korea)



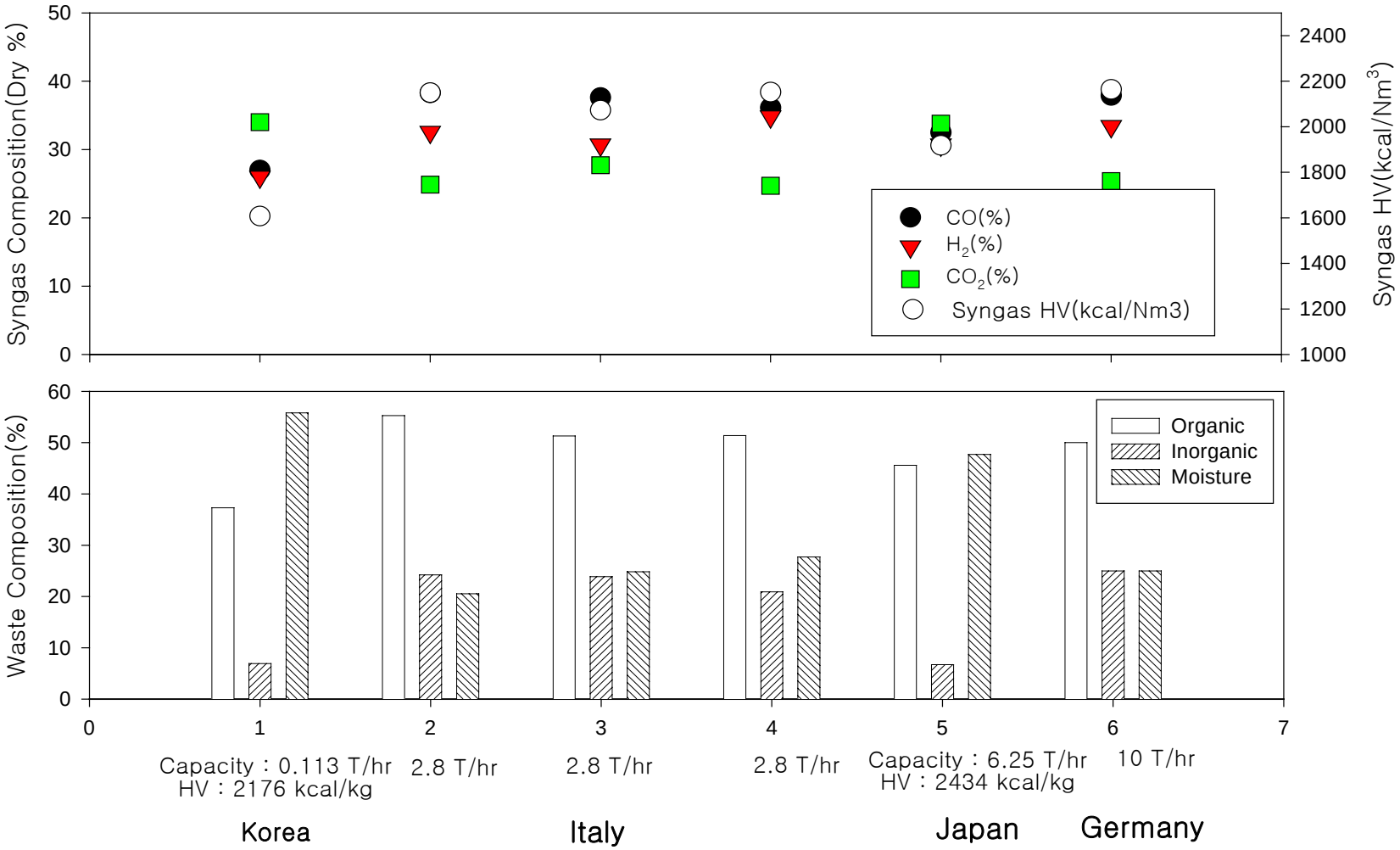
Temperature Profiles Inside Gasifier for K-City MSW



Syngas Composition from Gasification
(50.4 wt% Moisture MSW, K-City, Korea)



Comparison of Syngas Composition / Heating Value from Similar Gasification Types for MSW

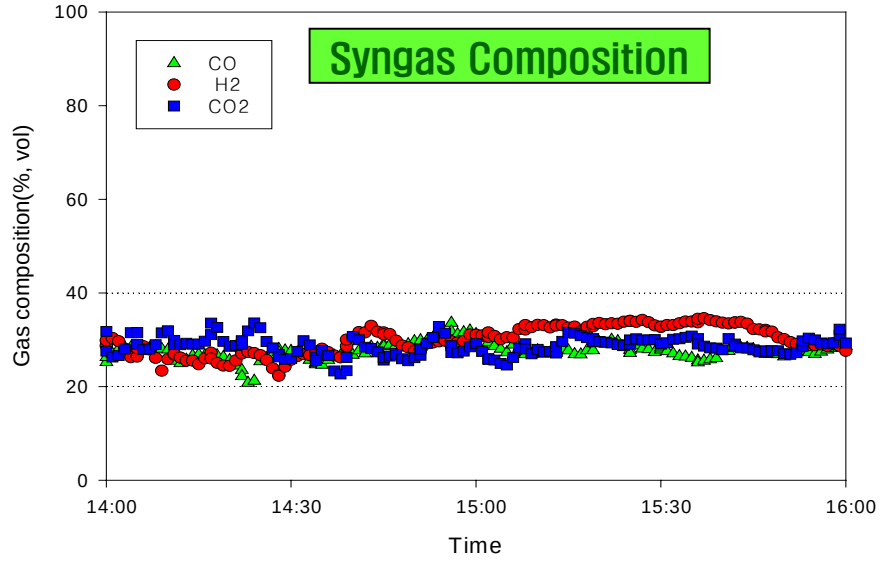


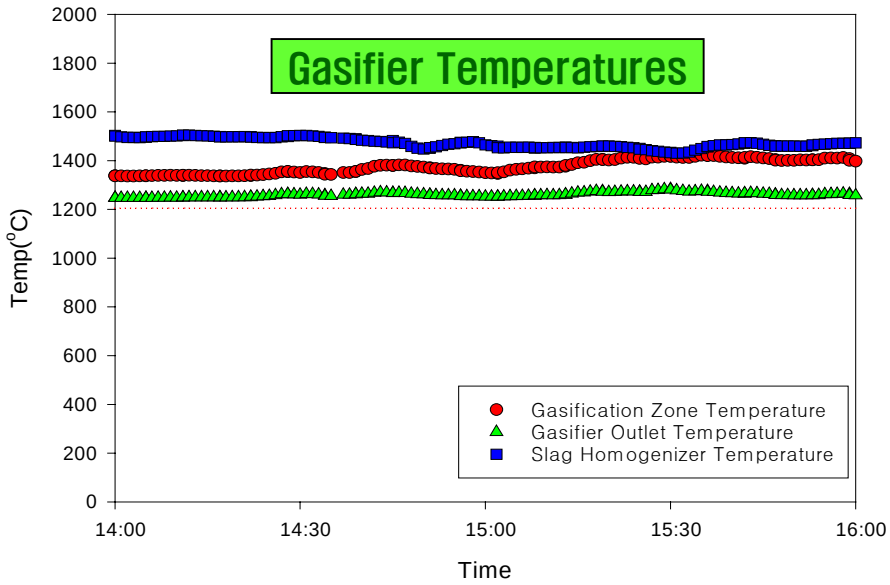
Test Results for Industrial Soild Wastes

Industrial Solid Wastes

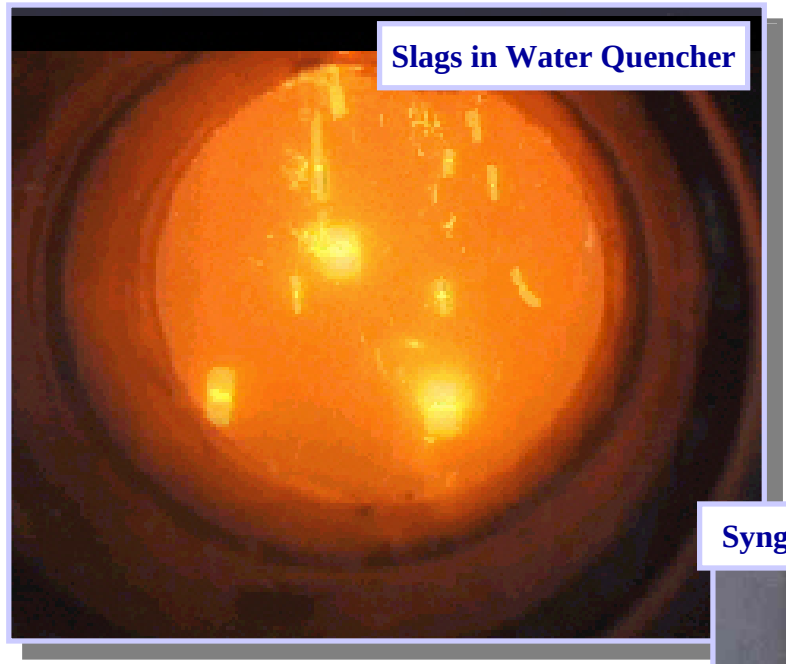
Gasifier / Slag Homogenizer

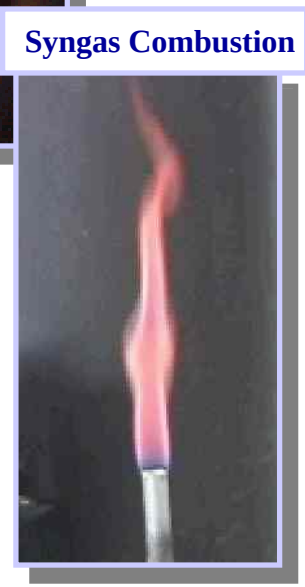
Slag





Slag / Syngas from MSW





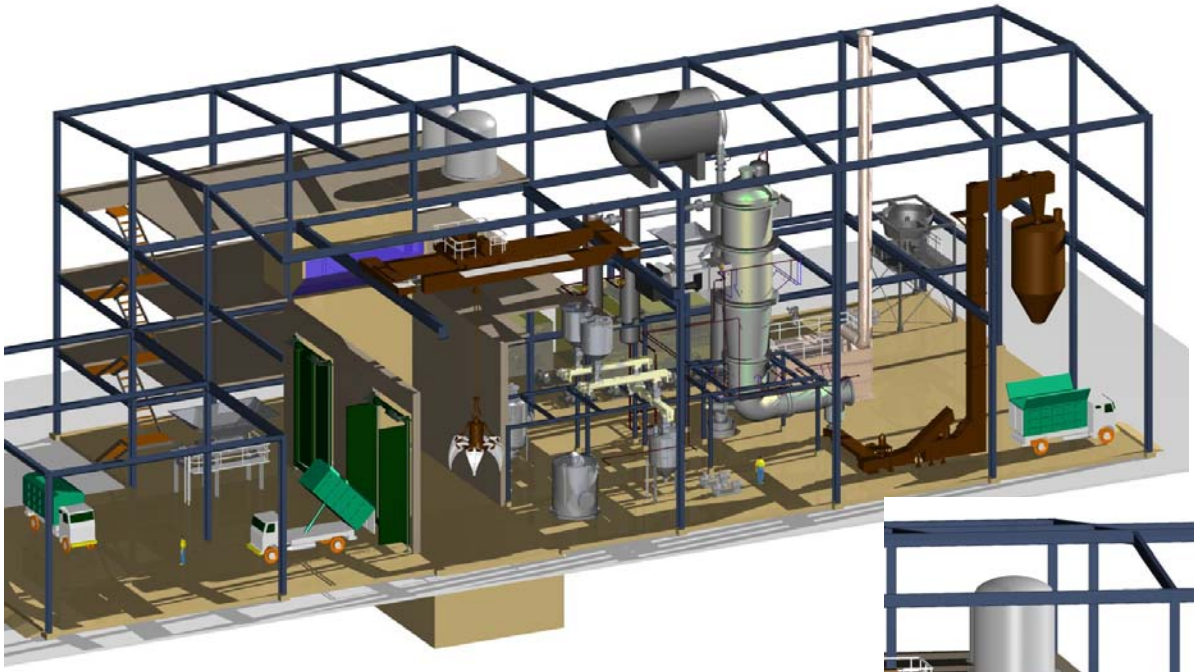
Slag Falling to Water Quencher

Leaching Test Results for Slags from Y-City MSW

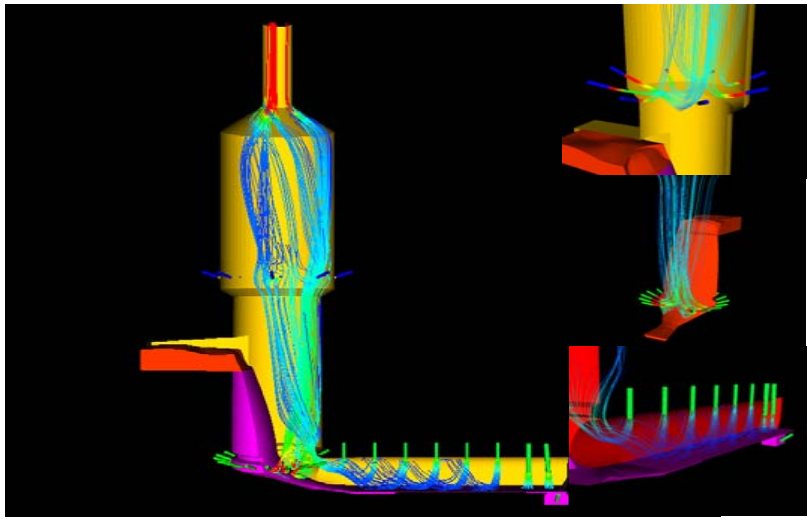
Item	Unit	Result	Korean Environmental Standards
Total Hg	mg/l	n.d.	0.005
Cd	mg/l	n.d.	0.3
Pb	mg/l	0.03	3.0
Cr^{+6}	mg/l	n.d.	1.5
As	mg/l	n.d.	1.5
Se	mg/l	n.d.	-
Total CN	mg/l	n.d.	1.0
Organo-phosphrous	mg/l	n.d.	1.0
Alkyl-mercury	mg/l	n.d.	-
PCB	mg/l	n.d.	-
Trichloroethylene	mg/l	n.d.	0.3

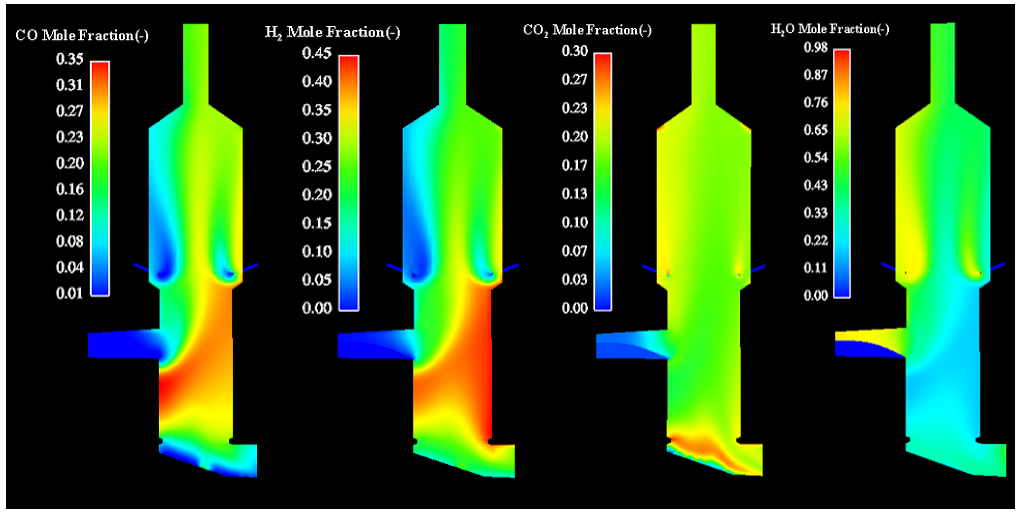
Item	Unit	Result	Korean Environmental Standards
Cyclomethane	mg/l	n.d.	-
Carbontetrachloride	mg/l	n.d.	-
1,2-Cycloethylene	mg/l	n.d.	-
1.1.1-Trichloroethane	mg/l	n.d.	-
Benzene	mg/l	n.d.	-
Zn	mg/l	0.01	-
Ni	mg/l	0.02	-
Total Cr	mg/l	0.03	-
Nitrite Nitrogen	mg/l	n.d.	-
Be	mg/l	n.d.	-
V	mg/l	n.d.	-
Cu	mg/l	0.02	3.0

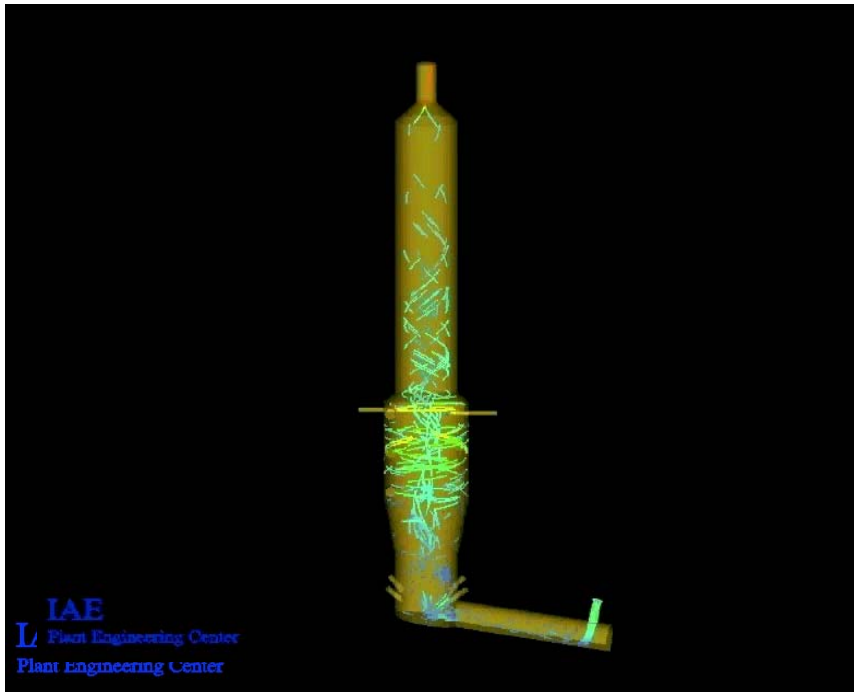
Layout Plan for 50 Ton/Day Industrial Wastes Gasificaiton/Melting Plant



Computational Fluid Dynamic Analysis for 50 Ton/Day Commercial Plant







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Conclusions

- Syngas composition of gasification using the 55.8% moisture-containing MSW showed CO 25-30%, 20-35% hydrogen, and 22-40% CO_2.
- Syngas composition from MSW of K-city containing more papers and less kitchen wastes demonstrated a higher heating value in syngas as 2,125 kcal/Nm^3 with 38% CO and 32% hydrogen contents.
- Gasification of Korean MSW produced a syngas of typical 26-28% CO and hydrogen compositions with a HHV 1,640 kcal/Nm^3, resulting the cold gas efficiency of 53%.
- The energy content in syngas is almost as high as heating value from coal gasification. Therefore, with appropriate cleanup steps, the produced syngas can be utilized as a good alternative energy source.
- Increasing trend of energy content in MSW in Korea to over 3,000 kcal/Nm^3 asks an advanced gasification/melting process for implementing 'wastes to energy' concept.