5-Year R&D of 1 ton/hr Torrefaction Pilot Plant at SCG

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Cementhai Holding, Co., Ltd. – SCG Investment

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1. Introduction to SCG

- Established in 1913
- 3 core business units

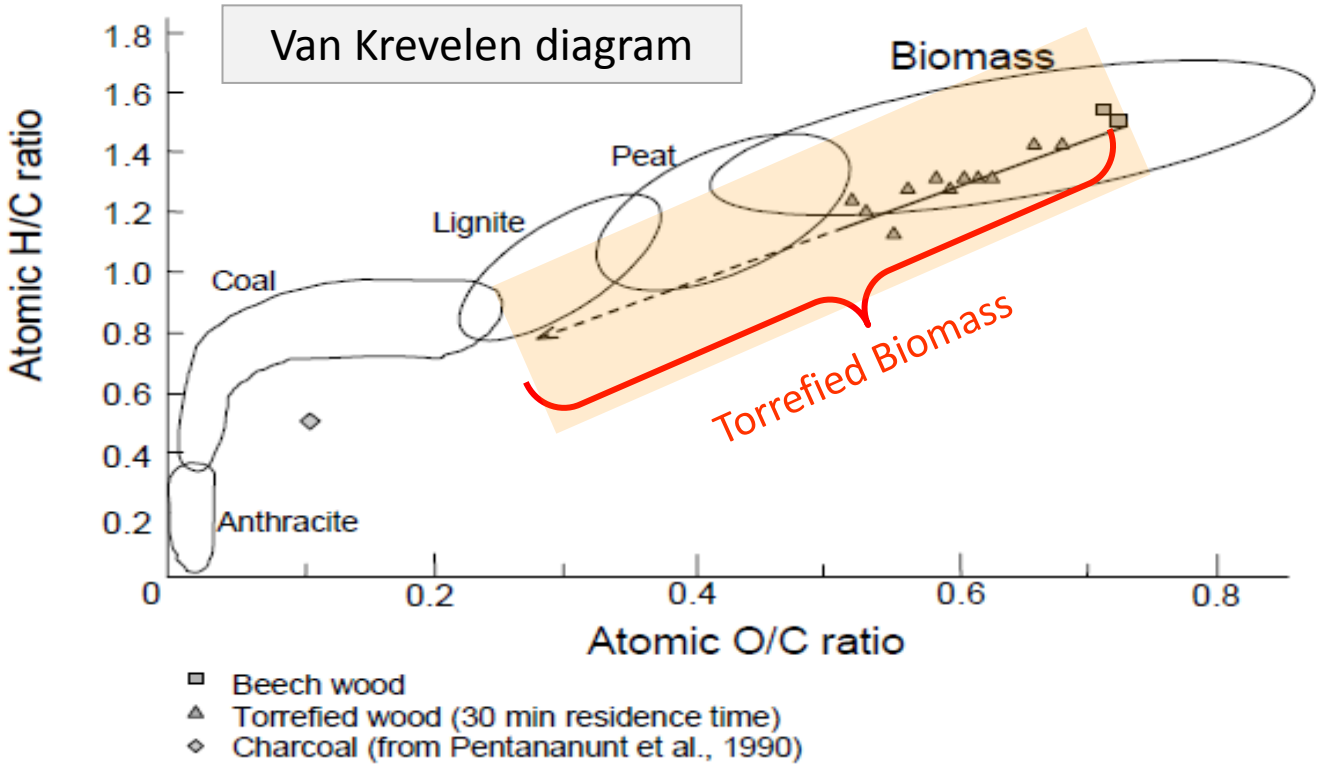
Cement-building materials

Chemical

Packaging

Visit www.scg.co.th for more information

2. Overview of Torrefaction : Advantage



Advantage of Torrefaction Process – Upgrading biomass into coal-like property

Mark, J.P., 2005 " Thermodynamics analysis of biomass gasification and Torrefaction "

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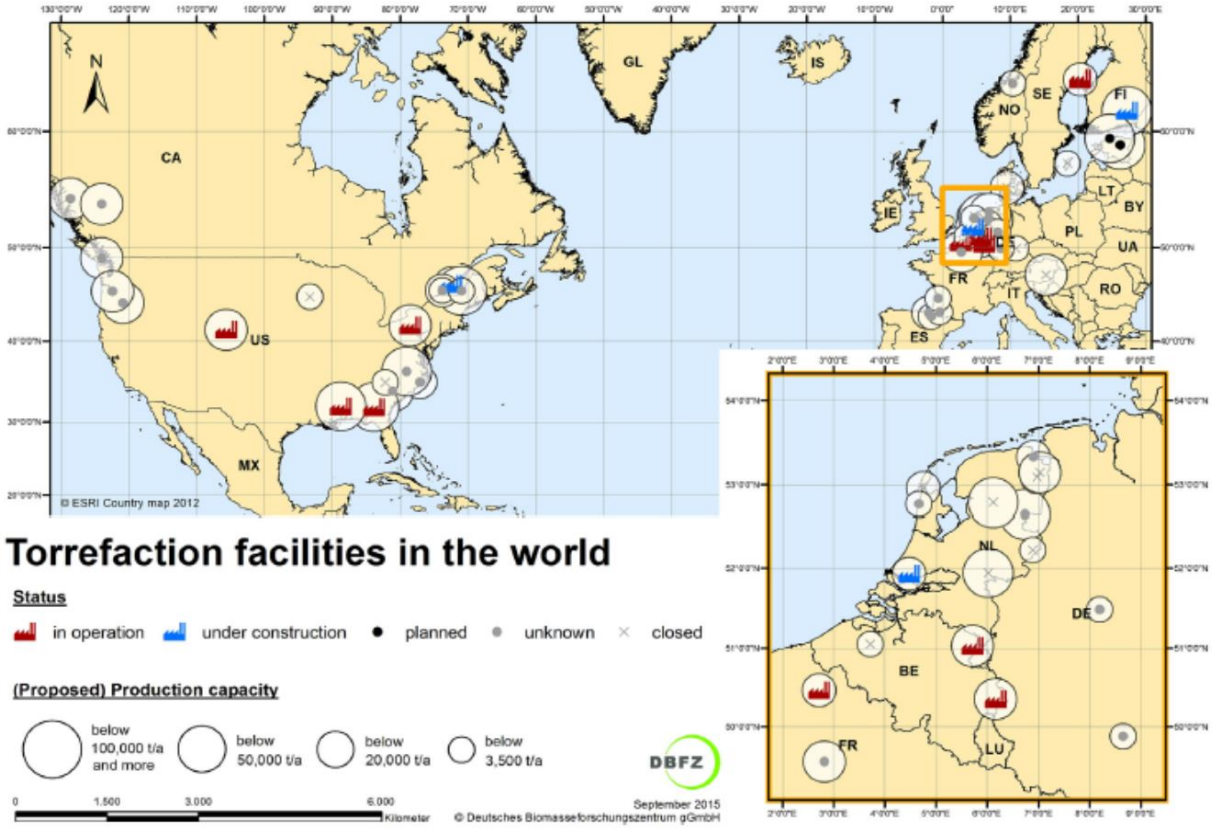
2. Overview of Torrefaction : Current Situation



SCG first stepped into torrefaction technology in 2009.

We are the first pioneer of South East Asia in this technology!

Worldwide activity of biomass torrefaction facilities with different status

Thran, D., et al. 2016. Biomass and Bioenergy, Vol. 89, p.184-200

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3. SCG Torrefaction Process Development : Milestones

		Period (Months)	Activities	Key Achievement / Event
1	July 09 – June 10	11	Characterization of selected Thai biomasses	Laboratory scale experiment at JGSEE
2	Nov 10 – Apr 11	4	Prototype development	Technical information for 1 ton/hr pilot plant design
3	Mar 11 –June 11	5	Engineering design	Engineering drawing for construction
4	June 11– Nov 12	18	Pilot plant construction	CHC Pilot Plant (version 1)
5	Dec 12 – Jan 13	2	1st operation for process testing	Operation failure, explosion caused damage to reactor
6	Feb 13 – Sep 13	6	Improvement for process safety	Installation of the redesigned reactor (version 1.1)
7	Oct 13 – Feb 14	5	2nd operation for process testing	Operation failure, due to instability of HGG2
8	Feb 14 – Sep 14	7	Re-design for process improvement	New design of piping system and new equipment in HGG2 (version 1.2)
9	Nov 14 – Apr 15	6	Installation of the redesigned equipment	Completion of process modification
10	May 15 – Oct 15	6	3nd operation for process testing / Production experiment	Successful operation to produce torrefied product 1.8 ton/hr

5-year development of the SCG Torrefaction process

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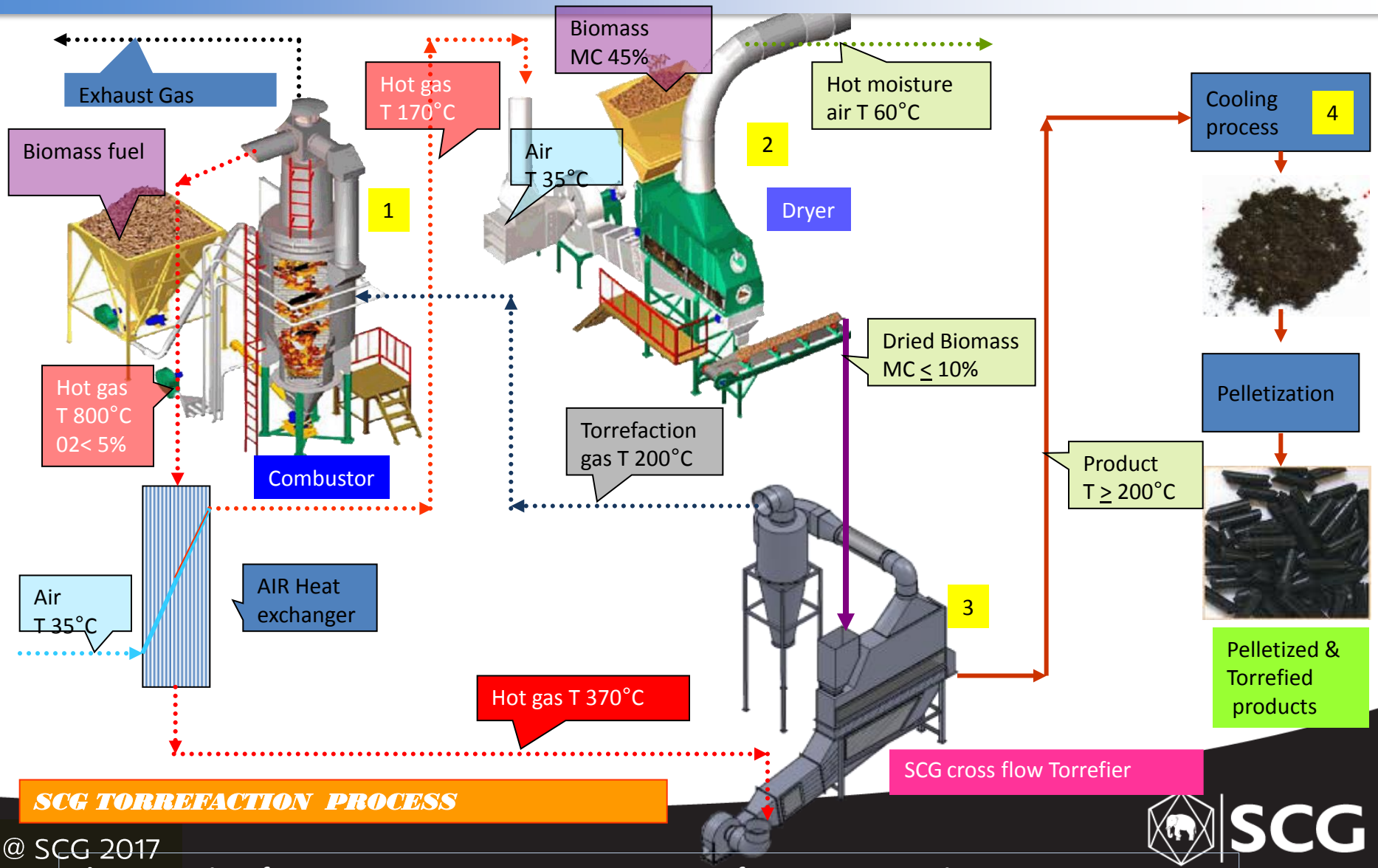
3. SCG Torrefaction Process Development

: Schematic Diagram of SCG Torrefaction Process

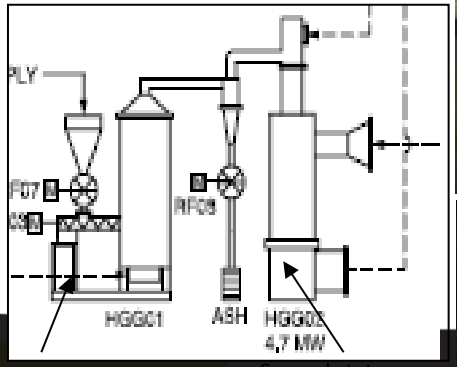


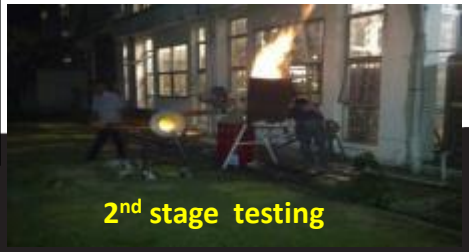
SCG TORREFACTION PROCESS

3. SCG Torrefaction Process Development : Prototype Development

Air flow investigation of reactor prototype for process improvement

Hot gas generator conceptual design experiment





Completed on 26/4/2011

3. SCG Torrefaction Process Development : Pilot Plant Construction

3. SCG Torrefaction Process Development : Torrefaction pilot plant V.1 (2012)

18-month construction (06/2011 - 12/2012)

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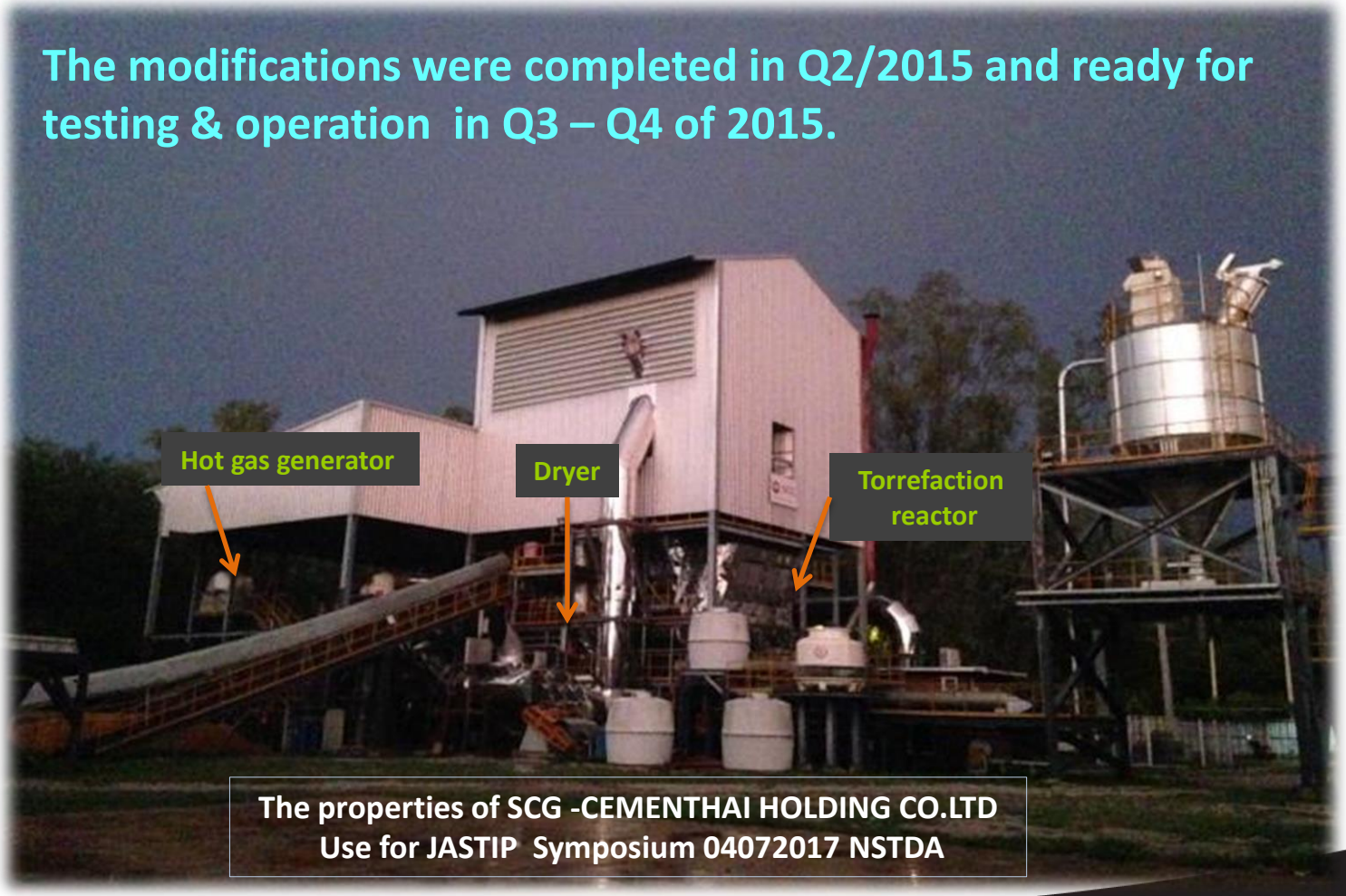
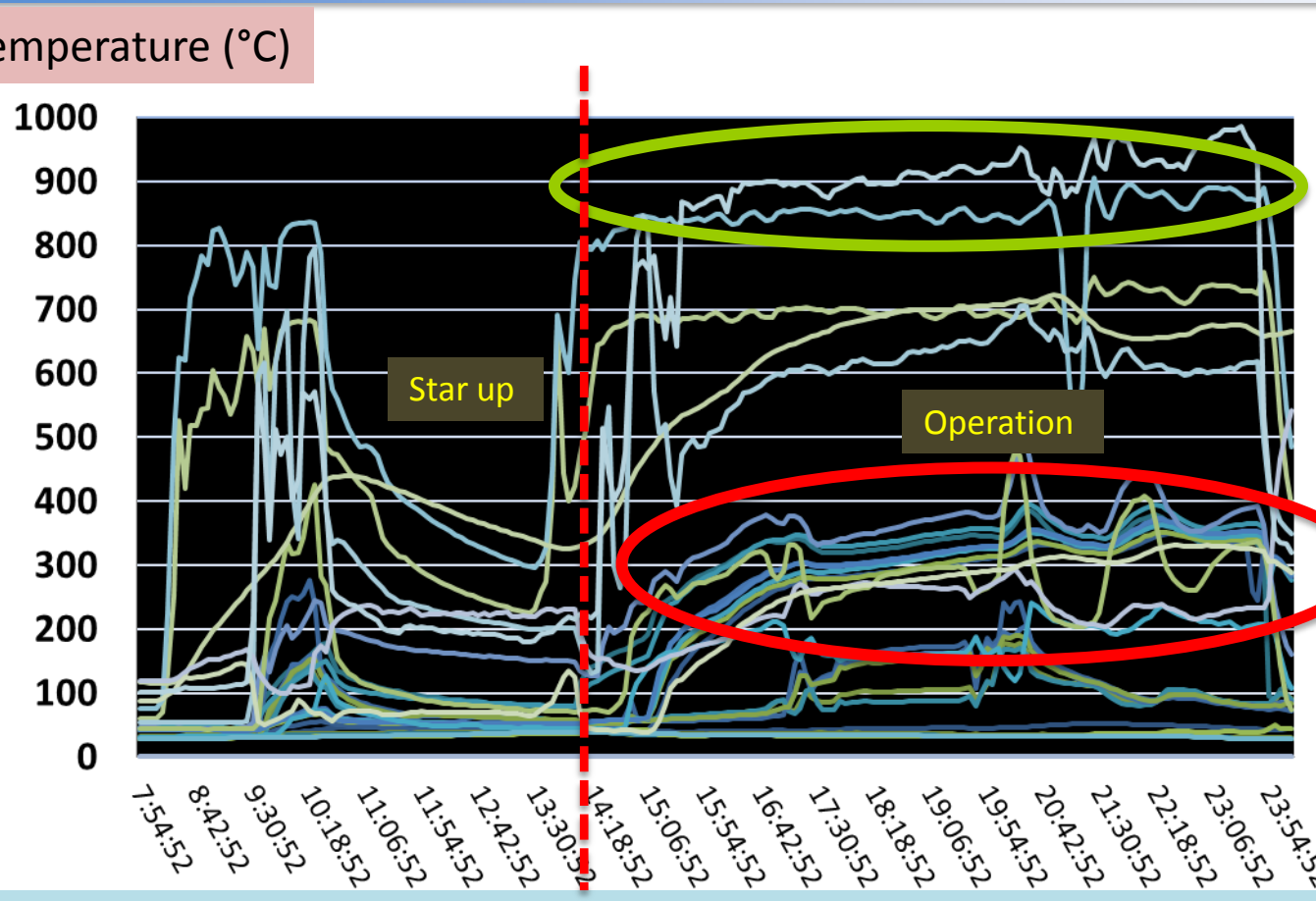
3. SCG Torrefaction Process Development : Torrefaction pilot plant V.2 (2015)



3. SCG Torrefaction Process Development : Process Temperature Monitoring

Approved results



Temperature of Hot Gas Generator (heat source)

Reactor temperature

- 3 - 6 MW_{th} could be achieved by our hot has generator at 800-1,000°C with less than 5% O_2
- Reactor temperature could be controlled within the range of 250-340°C whereas torrefaction temperature is generally maintained at 250-300°C

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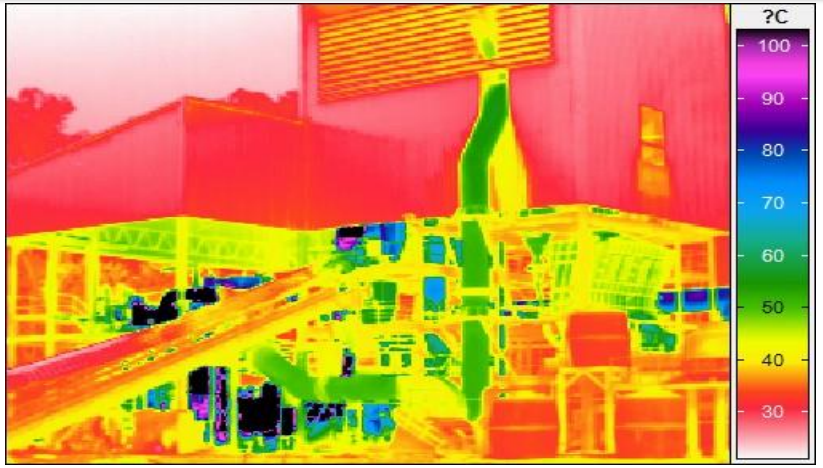
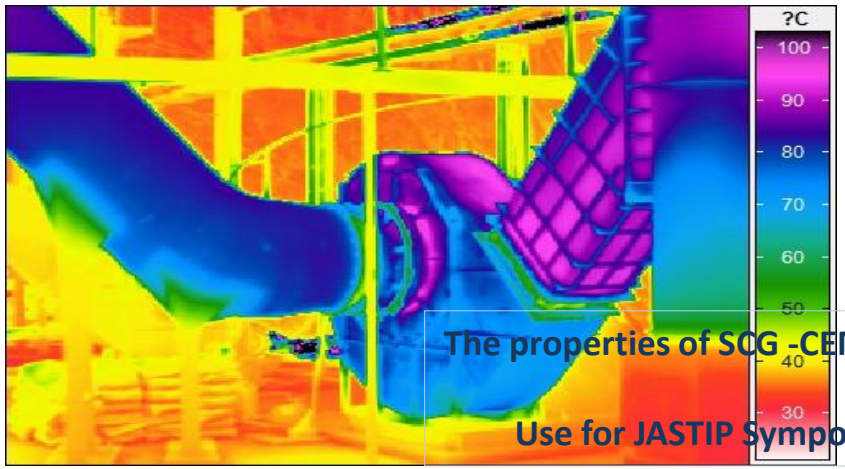
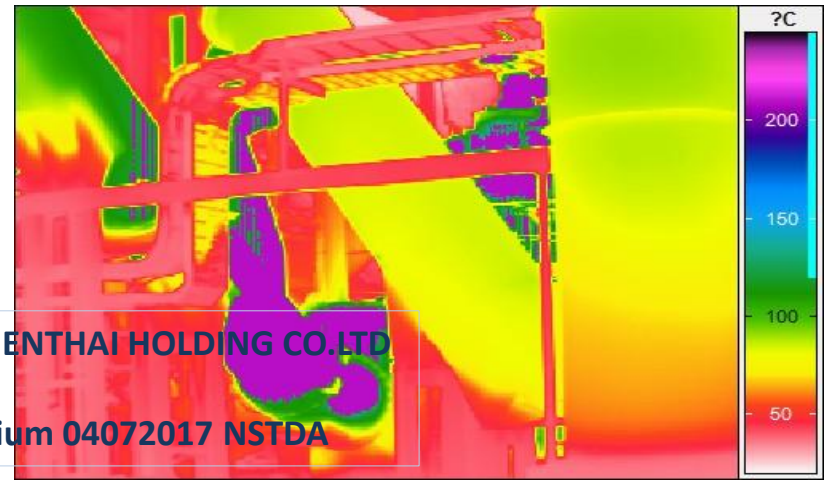
3. SCG Torrefaction Process Development : Thermal Imaging







Thermal images present the surface temperature of equipment for inspecting the thermal expansion and heat loss in the process.

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3. SCG Torrefaction Process Development : Preliminary Results

	Raw Eucalyptus	Torre product @1.8 ton/hr @ 300°C	Torr product @280°C (lab experiment By JGSEE)
C	47.6	63.43	51.7
H	5.47	4.64	5.3
N	0.3	0.24	0.3
O	43.5	29.11	42.7
Ash	3.01	2.52	1.8
O/C	0.91	0.45	0.6
HHV* (MJ/ kg)	18.21	24.23	20.12
Weight loss %	-	19.16	16.18

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4. Conclusions

- The SCG torrefaction technology has successfully been developed. The system mainly consists of hot gas generator, drying process and closed loop torrefaction reactor. All are synchronized and able to operate under controlled conditions.

- Preliminary results show that the SCG Torrefaction Pilot Plant is capable of producing torrefied Eucalyptus chips at 1.8 ton/hr.

- At the torrefaction temperature of 300°C, the process yields 81% of torrefied Eucalyptus chip which high heating value increases approximately 30% .

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5. Next move

- Technical Improvement of previous version for the 2,000-ton torrefied biomass production – in progress

- Economic analysis and technical evaluation of the pilot plant

Acknowledgements

SCG Torrefaction Team

Thank you for your attention

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