中國環境科學研究院
Chinese Research Academy of Environmental Sciences

Co-processing of non-recyclable Plastic Wastes in China

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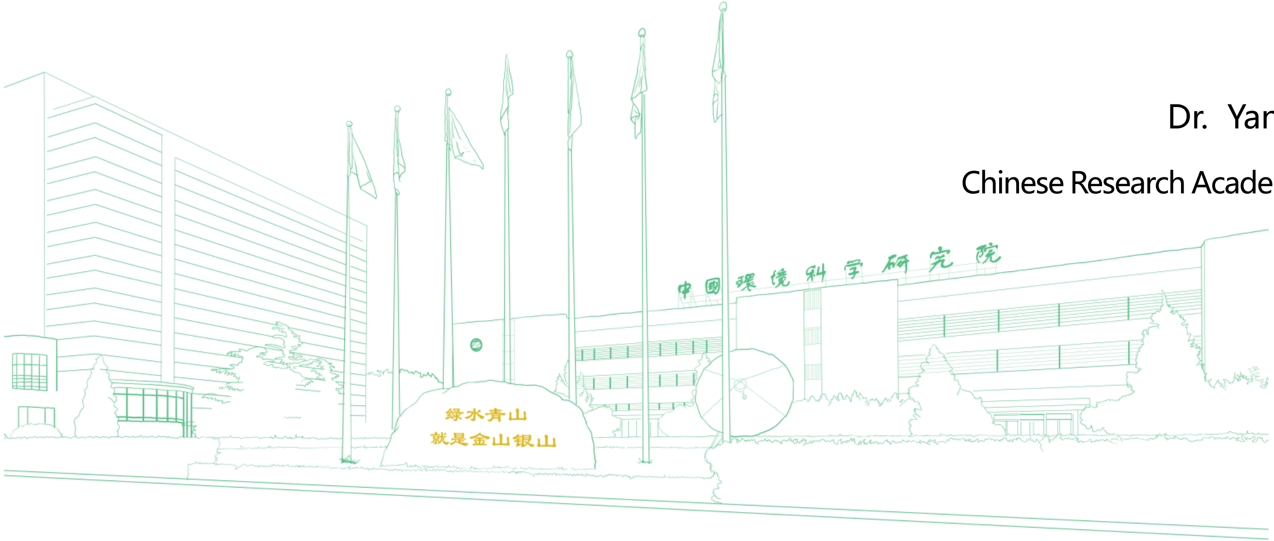

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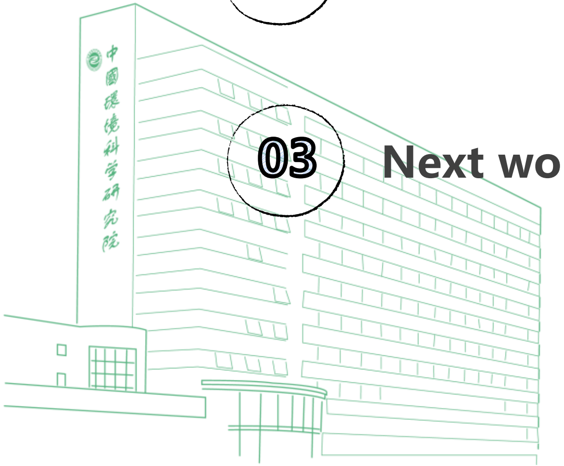
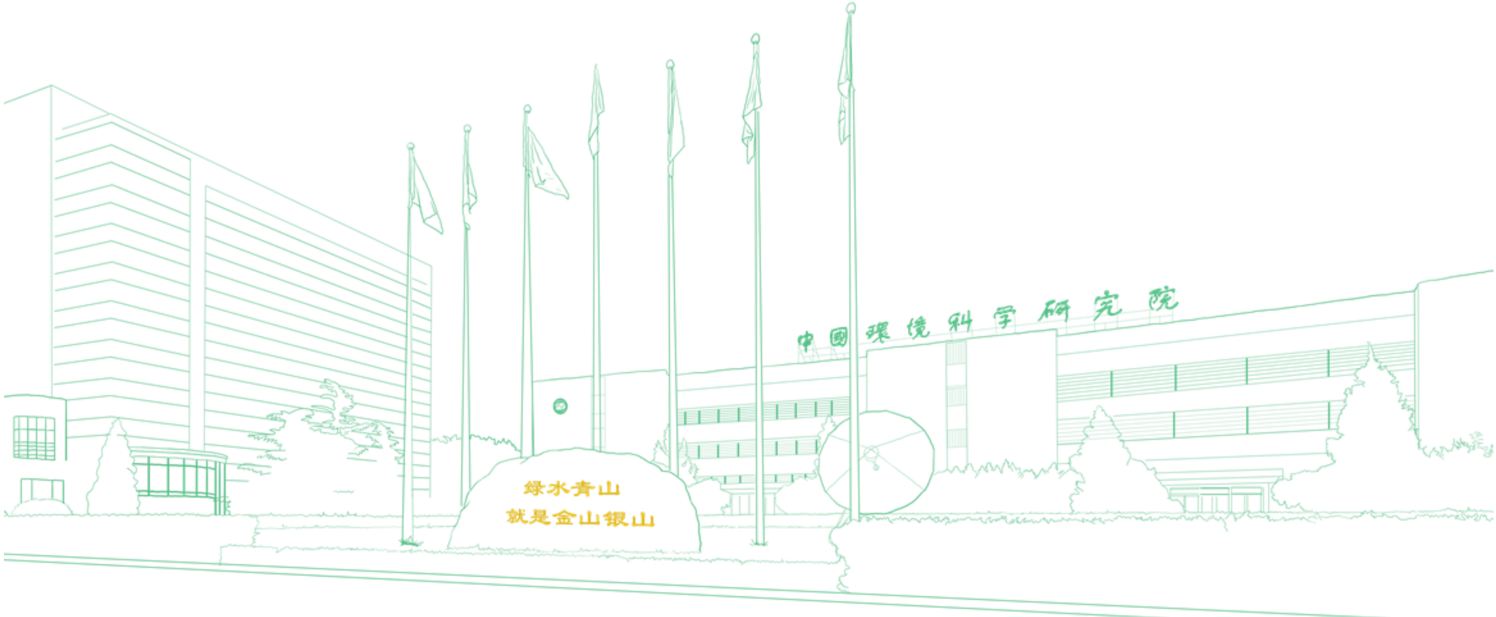


01 Co-processing test of Floating Material from Yangtze River and RDF



Introduction of Floating Materials from Yangtze River

Source

- **Rain Wash:** Solid wastes along the river are washed into the river by rain.
- **Human Throwing :** People like fishermen and tourists throw the wastes into the river.

⇨ Floating Materials

Gathering

- During the flood season and the impoundment of the Three Gorges Dam , a large amount of floating materials from the upper Yangtze River are carried down by floods and gathered in the waters near the upstream of the Three Gorges Dam.

Introduction of Floating Materials from Yangtze River

Amount

- 80，000 – 100，000 t/a.

Composition

- Non-recyclable plastic wastes (Plastic bags, Plastic bottles, shoes,etc.);
- Crop straws and branches;
- Other floating materials (animal bodies, navigation marks, etc.).

Introduction of Floating Materials from Yangtze River

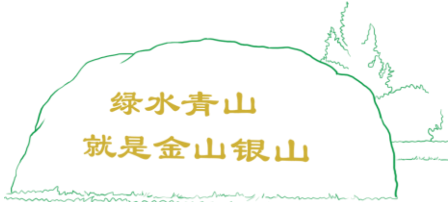
Collection

- Floating materials are collected by float-garbage ship and manual work.

Introduction of Floating Materials from Yangtze River

Treatment and disposal

- Floating materials have been co-processed in Huaxin (Zigui) cement plant since 2010, all floating materials upstream of Three Gorges Dam were co-processed in this plant.
- Floating materials are transported to the drying workshop of Huaxin (Zigui) cement plant from the dock and are dried by the waste heat of the cement kiln, then are shredded by a appropriative shredder and fed into the cement kiln by a belt conveyor.



Introduction of Floating Materials from Yangtze River

shredder

floating material after shredding

belt weight meter

belt

receiver hopper


airtight door

feeding duct

Introduction of RDF

Source

- **RDF:** produced from MSW pretreatment plant in Zigui
- **MSW:** generated by the villages along side Yangzi River

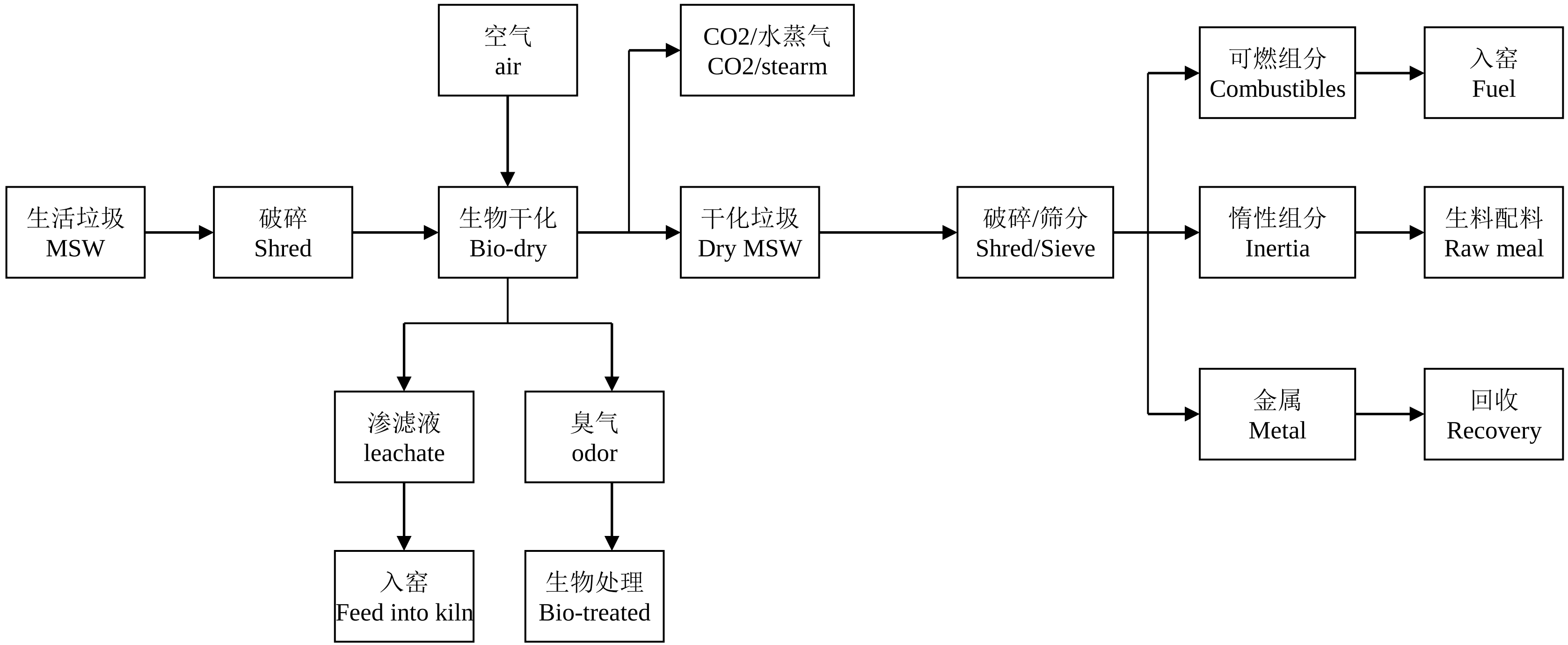
Amount

- 12,000 t/a.

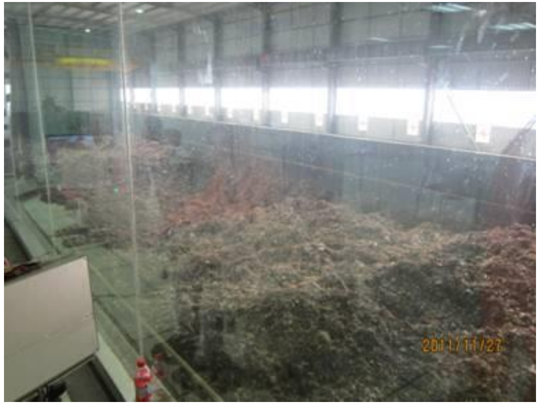
Composition

- Non-recyclable plastic wastes (Plastic bags);

RDF making process



RDF making process



Bio-dry

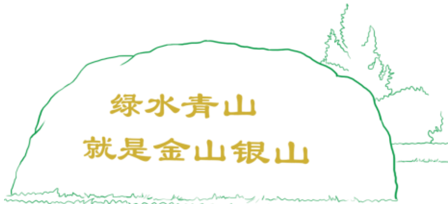
Shred, Sieve

Odor bio-treatment facility

RDF

Co-processing test of Floating Material from Yangtze River and RDF

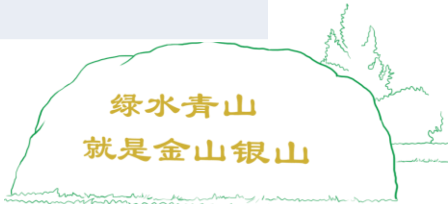
- **Demonstrate pilot—Huaxin (Zigui) cement plant**
  - Cement production capacity: 4000t/d;
  - Co-processed wastes and capacity: RDF (240t/d) and floating material (200t/d) .
- **Objectives**
  - To compare the overall performance (process parameters, emissions, product quality etc.) under Baseline condition (feeding only coal as the fuel source) with Co-processing condition (feeding floating material and RDF as fuel).
  - To make an estimate of the cost-efficiency of using floating material/RDF compared with coal only, and an estimate of how much coal is saved with the different alternative fuel sources.



Co-processing test of Floating Material from Yangtze River and RDF

Test plan

Phase	Operating procedures
Baseline condition (1st Day)	● Stop feeding RDF and floating material at 0:00， and ensure that only coal and raw material are fed into the cement kiln before 10:00. ● During 10:00-18:00, take the samples of flue gas, coal, raw material, clinker and kiln dust. And record the related data.
Co-processing floating material condition (2nd Day)	● Coal, raw material and floating material start to be fed into cement kiln at 8:00. Stabilize kiln work condition at 8:00-10:00; ● During 10:00-18:00, take the samples of flue gas, coal, raw material, floating material ,clinker, kiln dust and bypass dust. And record the related data.
Co-processing RDF condition (3rd Day)	● Coal, raw material and RDF start to be fed into cement kiln at 8:00. Stabilize kiln work condition at 8:00-10:00; ● During 10:00-18:00, take the samples of flue gas, coal, raw material, RDF, clinker, kiln dust and bypass dust. And record the related data.



Test plan

Analysis Items (waste and coal)

Item	Sample point	Frequency	Samples	Analysis requirement	Analysis objective
S	floating material /RDF/coal	2+2+6	10	2 samples for each waste plastic , 2 samples for coal in each condition	Monitor the physical and chemical characteristics of non-recyclable plastic wastes/RDF and compare them with coal
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+6	10		
Cl		2+2+6	10		
heat value		2+2+6	10		
F		2+2+6	10		
water		2+2+6	10		
ash		2+2+6	10		
plastic content	floating material /RDF	2+2	4	2 samples for each plastic waste	

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Test plan

Analysis Items (flue gas)

Item	Sample point	Frequency	Samples	Analysis requirement	Analysis objective
flow volume	flue gas	2+2+2	6	three conditions,2 samples for each condition	To compare the gas emissions between Baseline condition and Co-processing condition of floating material and RDF
O_2		2+2+2	6		
water		2+2+2	6		
temperature		2+2+2	6		
dust		2+2+2	6		
SO_2		2+2+2	6		
CO		2+2+2	6		
CO_2		2+2+2	6		
fluoride		2+2+2	6		
HF		2+2+2	6		
HCl		2+2+2	6		
NOx		2+2+2	6		
NH_3		2+2+2	6		
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+2	6		
TOC		2+2+2	6		
Dioxin		2+2+2	6		

Test plan

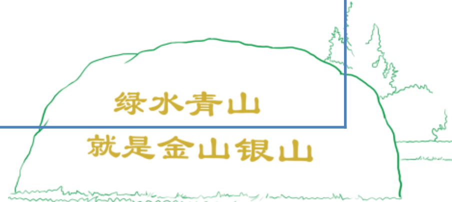
Analysis Items (Solid products)

Item	Sample point	Frequency	Samples	Analysis requirement	Analysis objective
clinker quality	clinker	1+1+1	3	three conditions,1 sample for each condition	To compare the product quality and hazard characteristics between Baseline condition and Co-processing condition of floating material and RDF.
heavy metal leaching		1+1+1	3		
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+2	6	three conditions,2 samples for each condition	
Cl		2+2+2	6		
Dioxin	kiln dust	1+1+1	3	three conditions,1 sample for each condition	
Cl		2+2+2	6	three conditions,2 samples for each condition	
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+2	6		
Dioxin	bypass dust	2+2	4	two conditions, 1 samples for fine and coarse dust	
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn、Ba、Ag、Se)		4+4	8	two conditions, 2 samples for fine and coarse dust	
Cl		4+4	8		
Cl	Raw material	2+2+2	6	three conditions,2 samples for each condition	
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+2	6		

Test plan

Data recording requirements

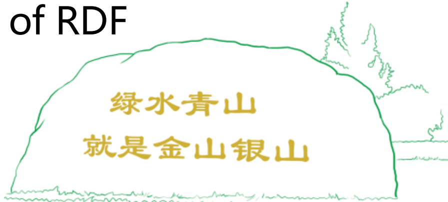
<table>
<tr><th>Item</th><th>Unit</th><th>Recording requirements</th><th>Recording objective</th></tr>
<tr><td>Coal feeding rate (Kiln head and kiln inlet)</td><td>t/h</td><td>Record once per hour</td><td>Estimate how much coal is saved with the different alternative fuel sources</td></tr>
<tr><td>Raw material feeding rate</td><td>t/h</td><td>Record once per hour</td><td rowspan="5">Estimate the process parameters under Baseline condition and Co-processing condition of floating material and RDF.</td></tr>
<tr><td>Producing rate of clinker</td><td>t/h</td><td>Record once per hour</td></tr>
<tr><td>floating material feeding rate</td><td>t/h</td><td rowspan="2">Record once per hour</td></tr>
<tr><td>RDF feeding rate</td><td>t/h</td></tr>
<tr><td>Generate rate of bypass dust</td><td>t/h</td><td>Record once per hour</td></tr>
</table>



Test process in Huaxin (Zigui) cement plant

Floating materials storage place

Storage warehouse of RDF



Plastic wastes feeding

Feeding point of plastic wastes

Conveyor belt

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Floating material sampling





RDF sampling

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Sampling of solid samples

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Sampling of flue gas

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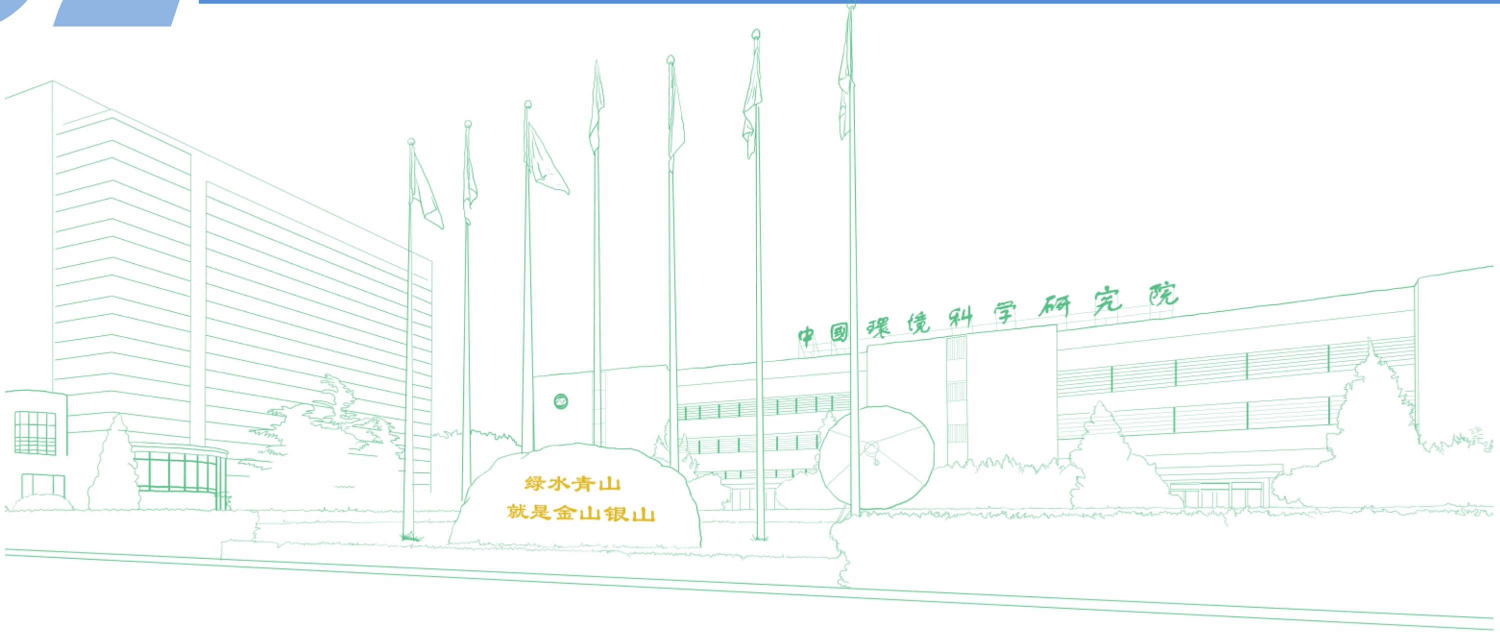
02 Co-processing test of non-recyclable Plastic Wastes in Jilin



Co-processing test of non-recyclable Plastic Wastes in Jilin

- **Demonstrate pilot—BBMG(Jilin) cement plant**
  - Location: near to Songhua River.
  - Cement production capacity: 5000t/d.
- **Plastic wastes co-processed**
  - **Plastic wastes from paper recycling plant**
    - The waste packaging along side Songhua Rive is collected and transported to the waste paper recycling plant, in this plant the waste packaging is soaked in water and the plastics were separated from paper.
    - Amount: 20 t/d.
  - **Plastic wastes from landfill mining**
    - Sorted from old and decayed MSW
    - Amount: 1,500,000 m3
    - Composition: Non-recyclable plastic wastes (Plastic bags);

Plastic wastes co-processed

PW from paper recycling plant

PW from landfill mining

Meeting and Visiting

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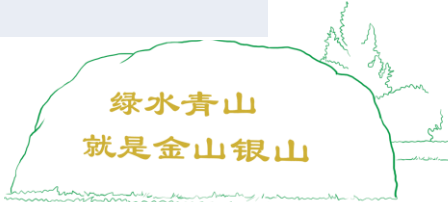
Co-processing test of non-recyclable Plastic Wastes in Jilin

Test plan

Phase	Operating procedures
Baseline condition (1st Day)	● Stop feeding any PW at 0:00， and ensure that only coal and kiln feed are fed into the cement kiln before 10:00. ● During 10:00-18:00, take the samples of flue gas, coal, kiln feed, clinker, kiln dust. Record the related data.
Co-processing PW from landfill mining condition (2nd Day)	● Coal, kiln feed and PW from landfill mining start to be fed into cement kiln at 8:00. Stabilize kiln work condition at 8:00-10:00; ● During 10:00-18:00, take the samples of flue gas, coal, kiln feed, floating material, clinker kiln dust. Record the related data.
Co-processing PW from paper recycling condition (3rd Day)	● Coal, kiln feed and PW from paper recycling start to be fed into cement kiln at 8:00. Stabilize kiln work condition at 8:00-10:00; ● During 10:00-18:00, take the samples of flue gas, coal, kiln feed, RDF, clinker kiln dust. Record the related data.



Test plan in BBMG(Jilin)

Analysis Items (feed materials)

Item	Sample point	Frequency	Samples	Analysis requirement
S	2 plastic wastes /coal/	2+2+6	10	2 samples for each plastic waste , 2 samples for coal in each condition
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+6	10	
Cl		2+2+6	10	
heat value		2+2+6	10	
F		2+2+6	10	
water		2+2+6	10	
ash		2+2+6	10	
plastic content	2 plastic wastes	2+2	4	2 samples for each plastic waste

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Test plan in BBMG(Jilin)

Analysis Items (flue gas)

Item	Sample point	Frequency	Samples	Analysis requirement
flow volume	flue gas	2+2+2	6	three conditions,2 samples for each condition
O_2		2+2+2	6	
water		2+2+2	6	
temperature		2+2+2	6	
dust		2+2+2	6	
SO_2		2+2+2	6	
CO		2+2+2	6	
CO_2		2+2+2	6	
fluoride		2+2+2	6	
HF		2+2+2	6	
HCl		2+2+2	6	
NOx		2+2+2	6	
NH_3		2+2+2	6	
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+2	6	
TOC		2+2+2	6	
Dioxin		2+2+2	6	

Test plan in BBMG(Jilin)

Analysis Items (Solid products)

Item	Sample point	Frequency	Samples	Analysis requirement
clinker quality	clinker	1+1+1	3	three conditions,1 sample for each condition
heavy metal leaching		1+1+1	3	
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+2	6	three conditions,2 samples for each condition
Cl		2+2+2	6	
Dioxin	kiln dust	1+1+1	3	three conditions,1 sample for each condition
Cl		2+2+2	6	three conditions,2 samples for each condition
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+2	6	
Cl	kiln feed	2+2+2	6	three conditions,2 samples for each condition
heavy metals (Hg、Tl、Cd、Pb、As、Cr、Be、Sn、Sb、Co、V、Ni、Mn、Cu、Mo、Zn)		2+2+2	6	

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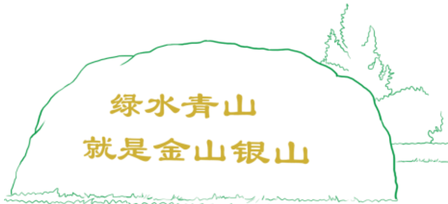
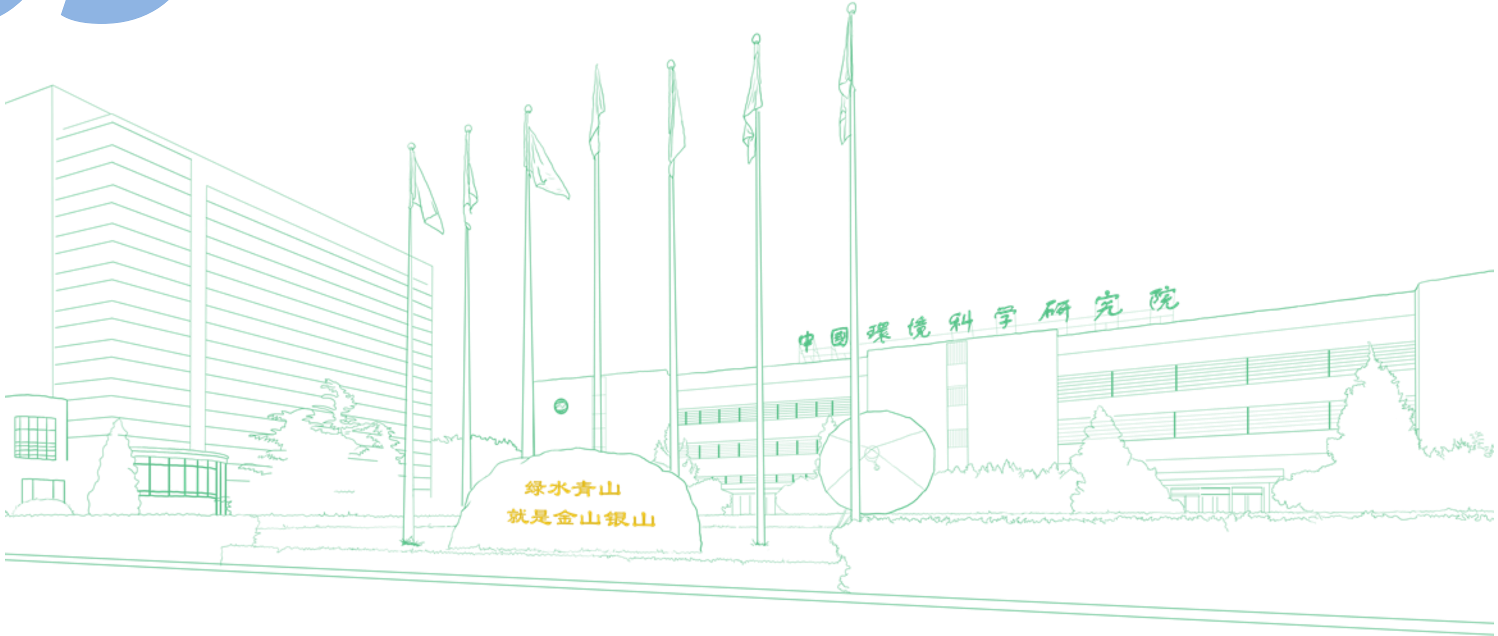
Test plan in BBMG(Jilin)

Data recording requirements

Item	Unit	Recording requirements
Coal feeding rate (Kiln head and kiln inlet)	t/h	Record once per hour
Kiln feed feeding rate	t/h	Record once per hour
Hourly yield of clinker	t/h	Record once per hour
PW feeding rate	t/h	Record once per hour

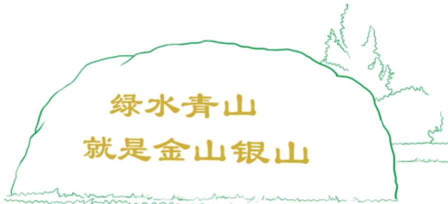


03 Next work plan of OPTOCE project in China



Next work plan of OPTOCE project in China

- Finish the report of Huaxin (Zigui) cement plant in this month.
- Conduct the other pilot demonstration test in BBMG (Jilin) cement plant which co-processing the plastic wastes from paper recycling plant and landfill mining and finish the report.
- Complete the project.



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Thanks for your listening!

Yan Dahai