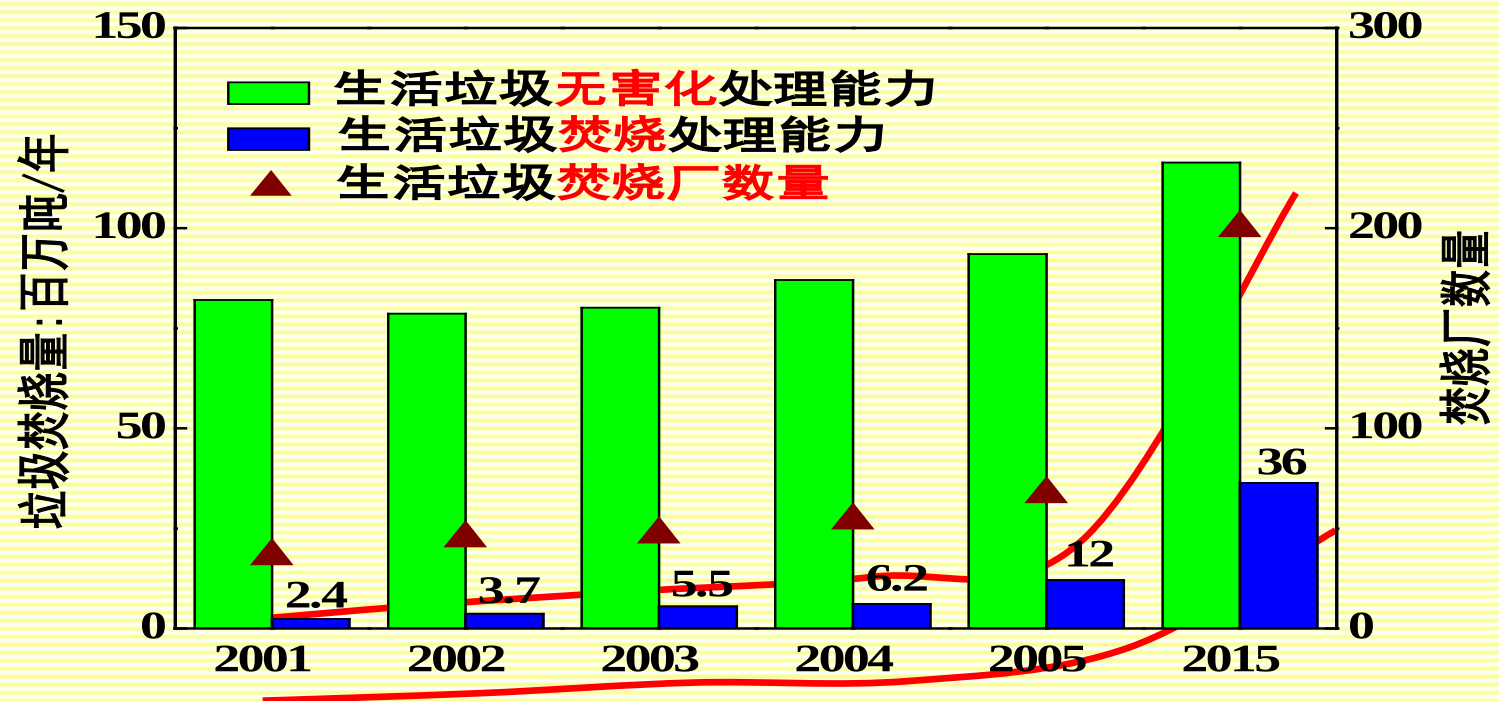

Municipal Solid Waste Fluidized Beds Incineration Technology

Mingjiang Ni

**Institute for Sustainable Energy
Zhejiang University**

The development of MSW incineration in China



- ❖ Of various ways for disposing MSW, Incineration has become one of prior options in many cities in China, especially in developed regions.

The characteristics of MSW in China

- ❖ Mixed collection, source and composition are highly complex
 - ⇒ shape, size, physical & chemical properties
- ❖ High moisture, low heating value
- ❖ Unstable Property

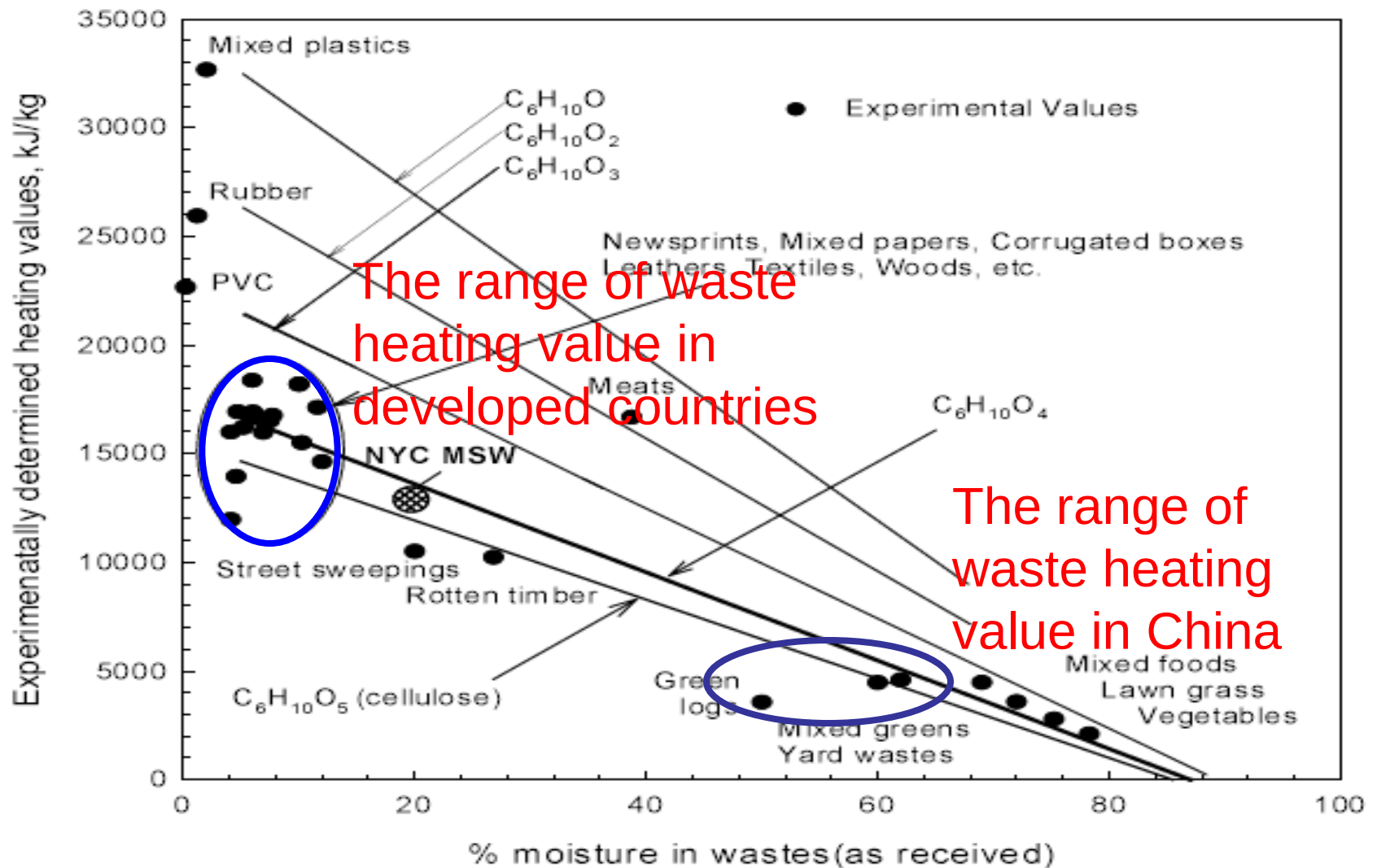
Quite different from that
In developed countries



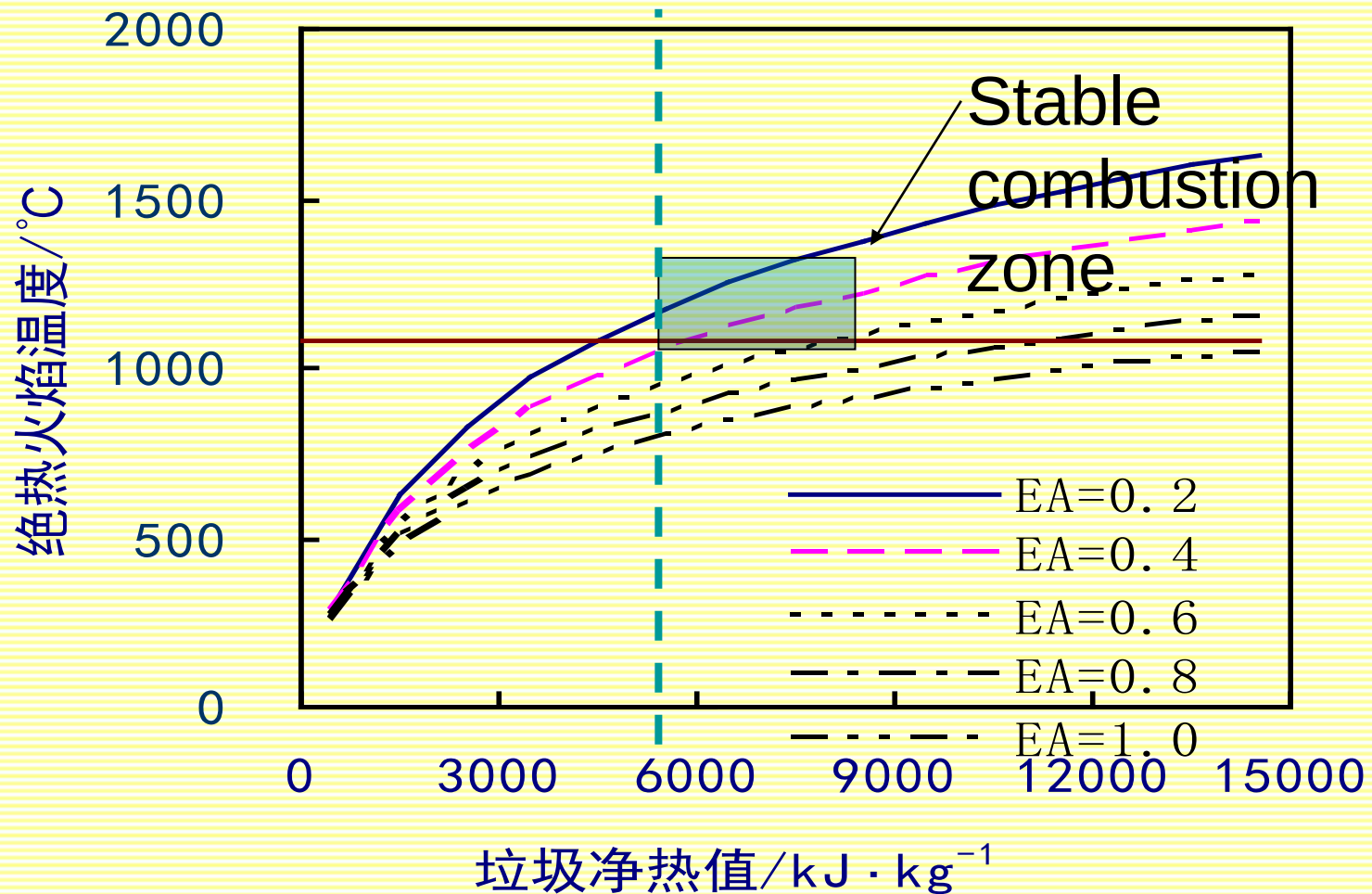
The renewable components in Solid Waste (Hangzhou City)

sample	Paper %	Wood %	Cloth %	Kitchen garbage %	Peel %	Renewable %
1	7.56	8.51	1.62	6.04	3.06	26.79
2	9.07	12.77	2.51	3.8	0.75	28.9
3	11.31	3.25	5.28	10.02	0	29.86
4	8.93	2.97	2.9	14.3	2.94	32.04
5	5.27	5.17	22.25	15.81	0	48.5
6	15.19	5.97	8.24	18.36	5.4	53.16
7	8.18	7.29	4.89	34.92	0	55.28
8	8.81	21.79	6.51	17.95	3.34	58.4
9	11.79	8.82	21.5	9.43	8.17	59.71
10	26.81	2.33	16.27	14.68	1.82	61.91
11	8.16	6.21	7.85	19.56	20.2	61.98
12	36	3.8	2.8	16.3	3.79	62.69
13	13.18	1.28	22.2	33.91	0	70.57

Moisture and heating value



Relationship between flame temperature and heating value



Challenges to us in China

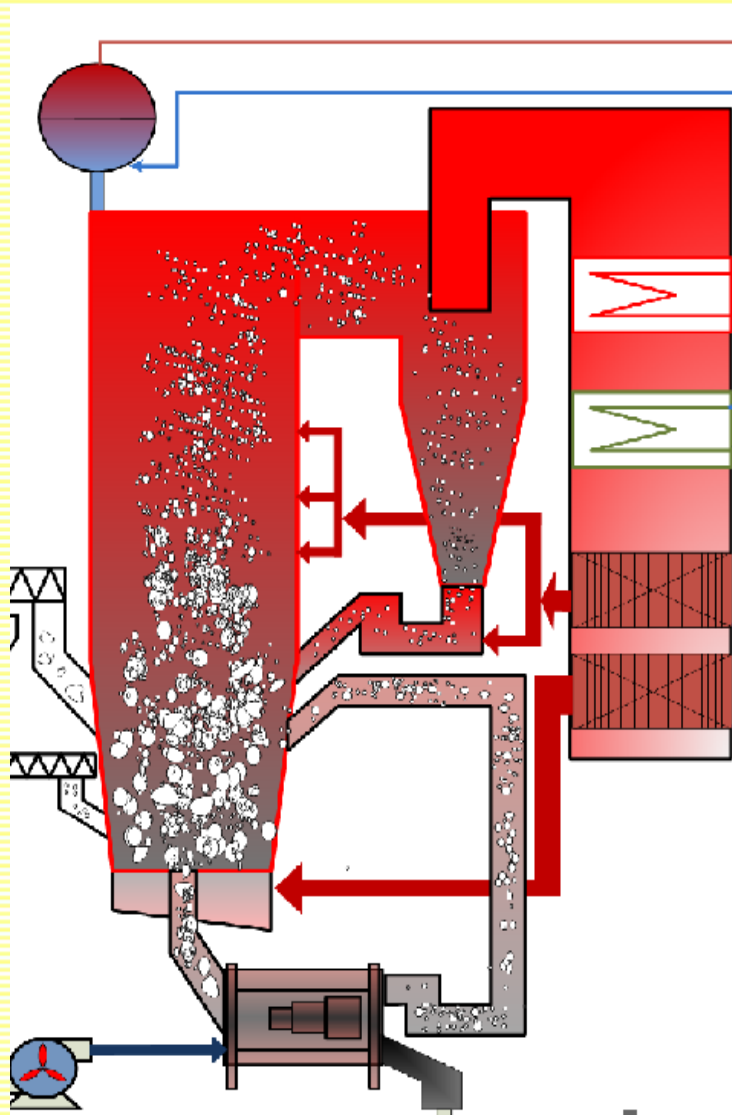
- ❖ The imported incineration equipments or technologies are sometimes difficult to treat MSW in China.
 - ⇒ Differences between developed countries and China
- ❖ The investment and operating cost of imported equipments are relatively high.

The Challenge to us is:

Develop a MSW incineration system with own intellectual property rights, which is able to dispose China's MSW efficiently, cleanly and cheaply.

Research on CFB incineration technology and power Boiler

CFB incineration technology



Why Fluidized Bed Incineration Technology

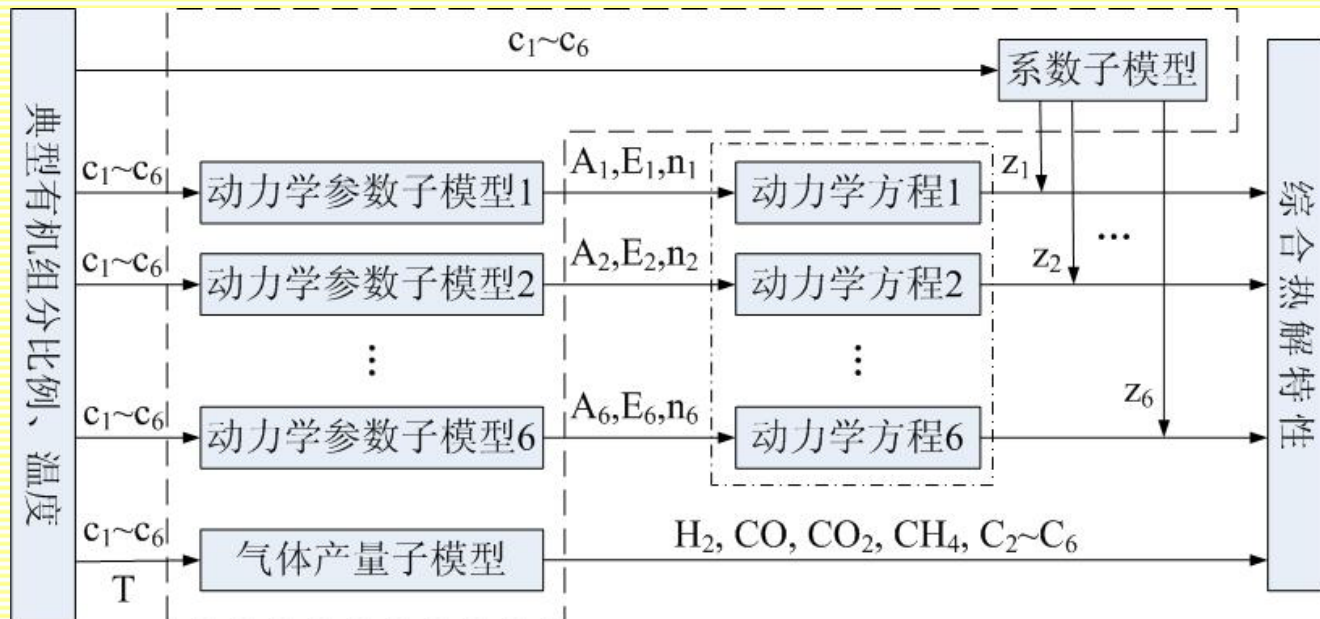
- ❖ High adaptability to the low-grade fuel
 - ⇒ Big heat capacity and strong mixing
 - ⇒ Stable and uniform temperature in furnace
 - ❖ Easy emission control because of the stable, uniform and moderate temperature
 - ⇒ Less organic pollutant emission
 - ⇒ Efficient in-furnace desulphurization
 - ⇒ Low NO_x and HCl emission
 - ⇒ Low ash carbon content (construction material)
-

Why Fluidized Bed Incineration Technology

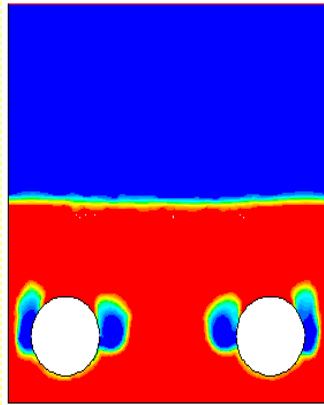
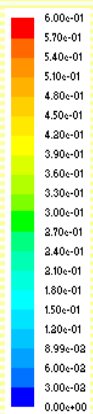
- ❖ Can use cheaper coal as auxiliary fuel
 - ⇒ More stable and uniform furnace temperature
 - ⇒ More Stable power output
 - ⇒ Adjust fuel heat value in design to adapt future improvement of heating value
 - ⇒ Reduce dioxin emission by bating de novo synthesis
 - ❖ **Difficulty:** pretreatment, feeding, ash discharge caused by quite different properties of various materials in MSW
-

Study on pyrolysis and combustion characteristics

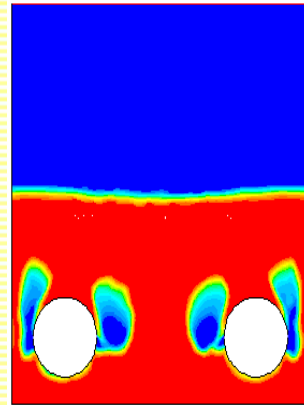
Studied the pyrolysis and combustion process of mix-collected multi-component MSW. Proposed the model for estimating its pyrolysis and combustion characteristics



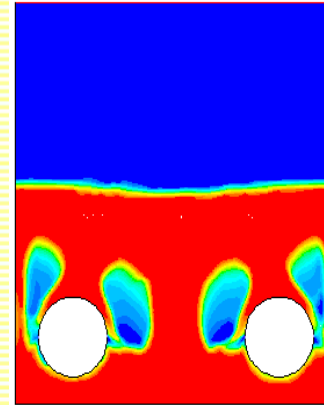
Study on fluid dynamic characteristics



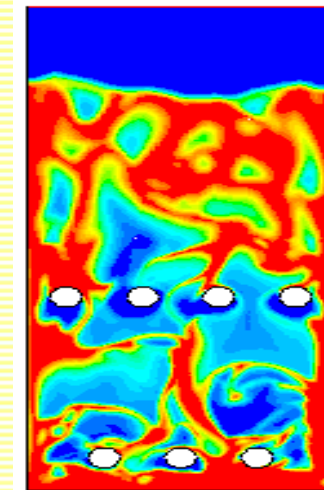
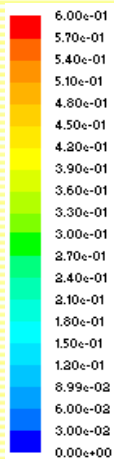
$t=0.8\text{ s}$



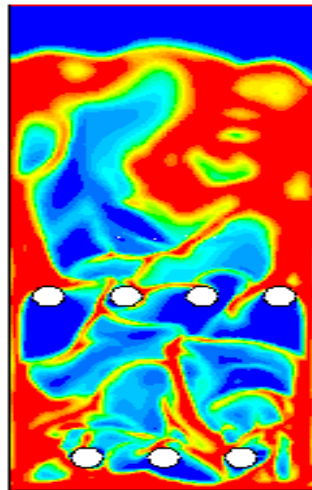
$t=1.2\text{ s}$



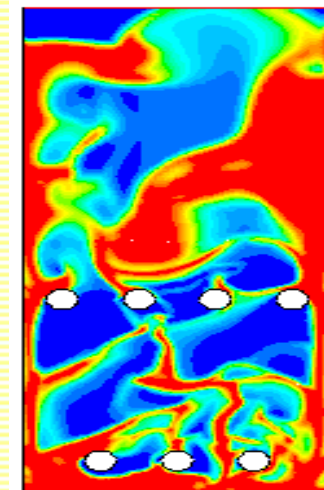
$t=1.6\text{ s}$



$t=1.8\text{ s}$



$t=2.0\text{ s}$

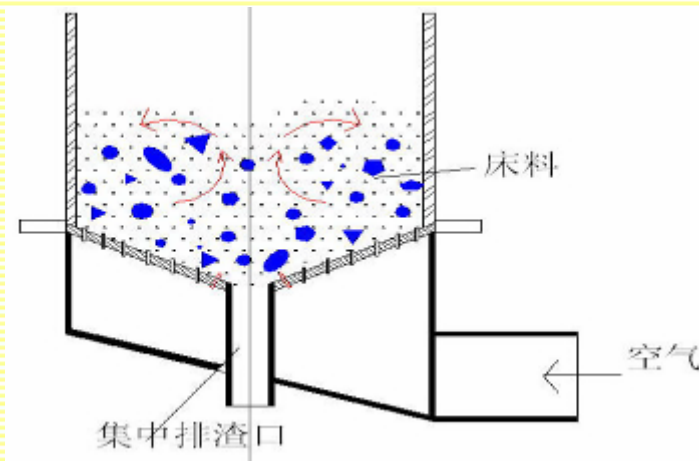


$t=2.2\text{ s}$

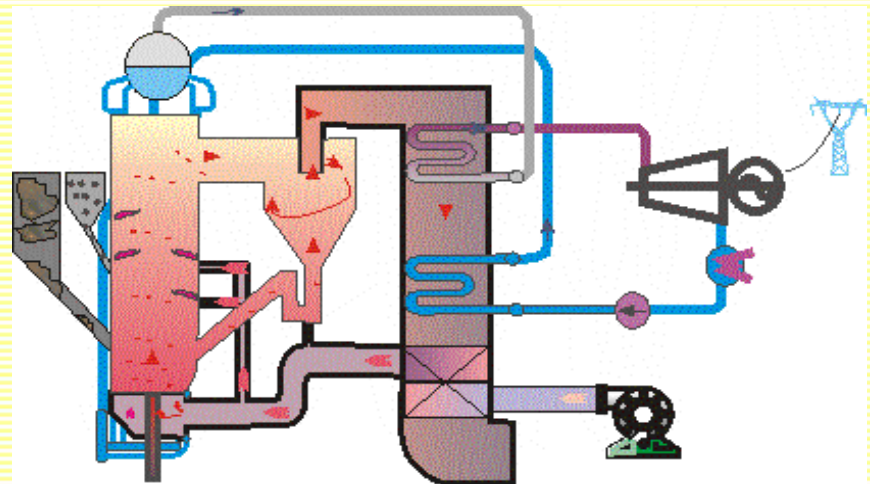


Study on CFB combustion

- ❖ Developing a new reactor which combines the inner circulation and external circulation to achieve better material mixing
- ❖ Using special bed ash continuous discharge and recycling technology.



Inner Circulation



External Circulation

Experimental facilities



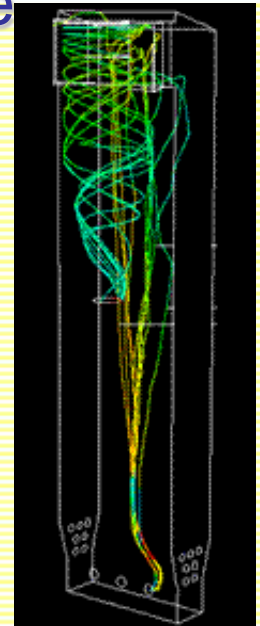
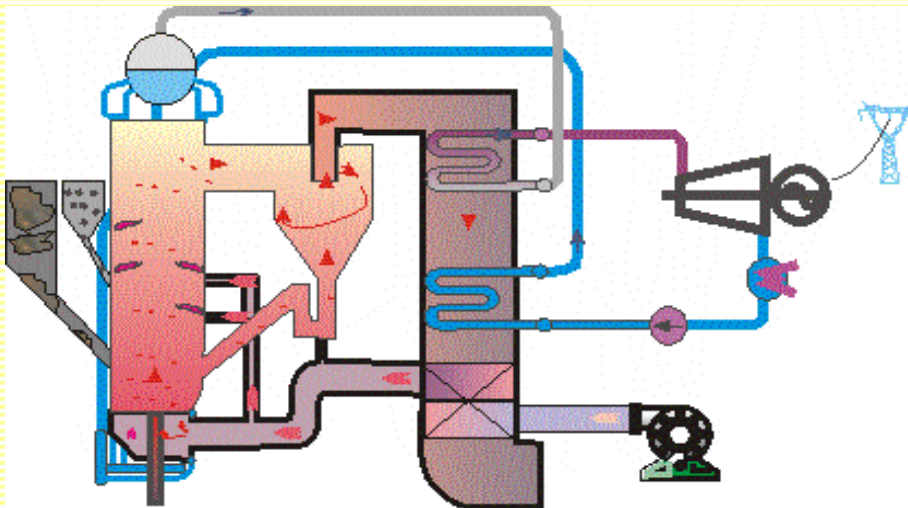
10t/d MSW test incineration system



Gasification & ash melting test rig

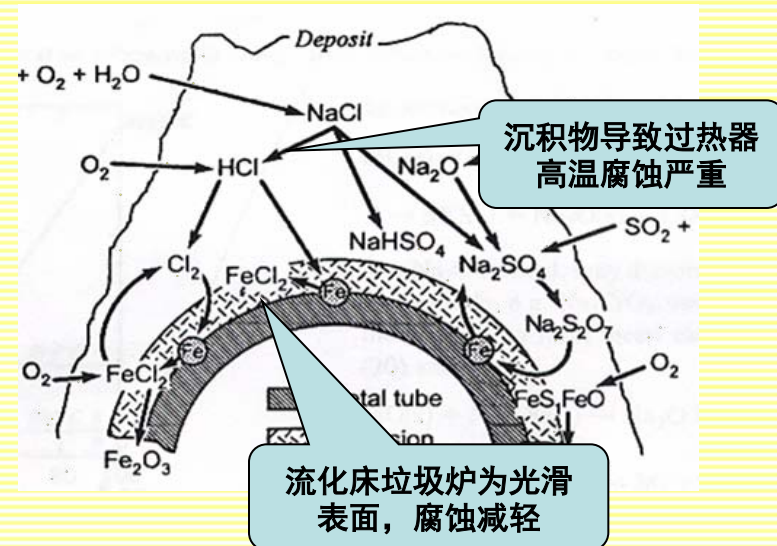
CFB technology developed by Zhejiang University

- ❖ **Bed materials of high density** ⇒ Preventing sedimentation and floatation of both “heavy” and “light” components to achieve well mixing
- ❖ **Air distributor with directional nozzles** ⇒ smooth ash discharge
- ❖ **Vortex secondary air** ⇒ Ensuring adequate mixing and longer residence time in high-temperature zone

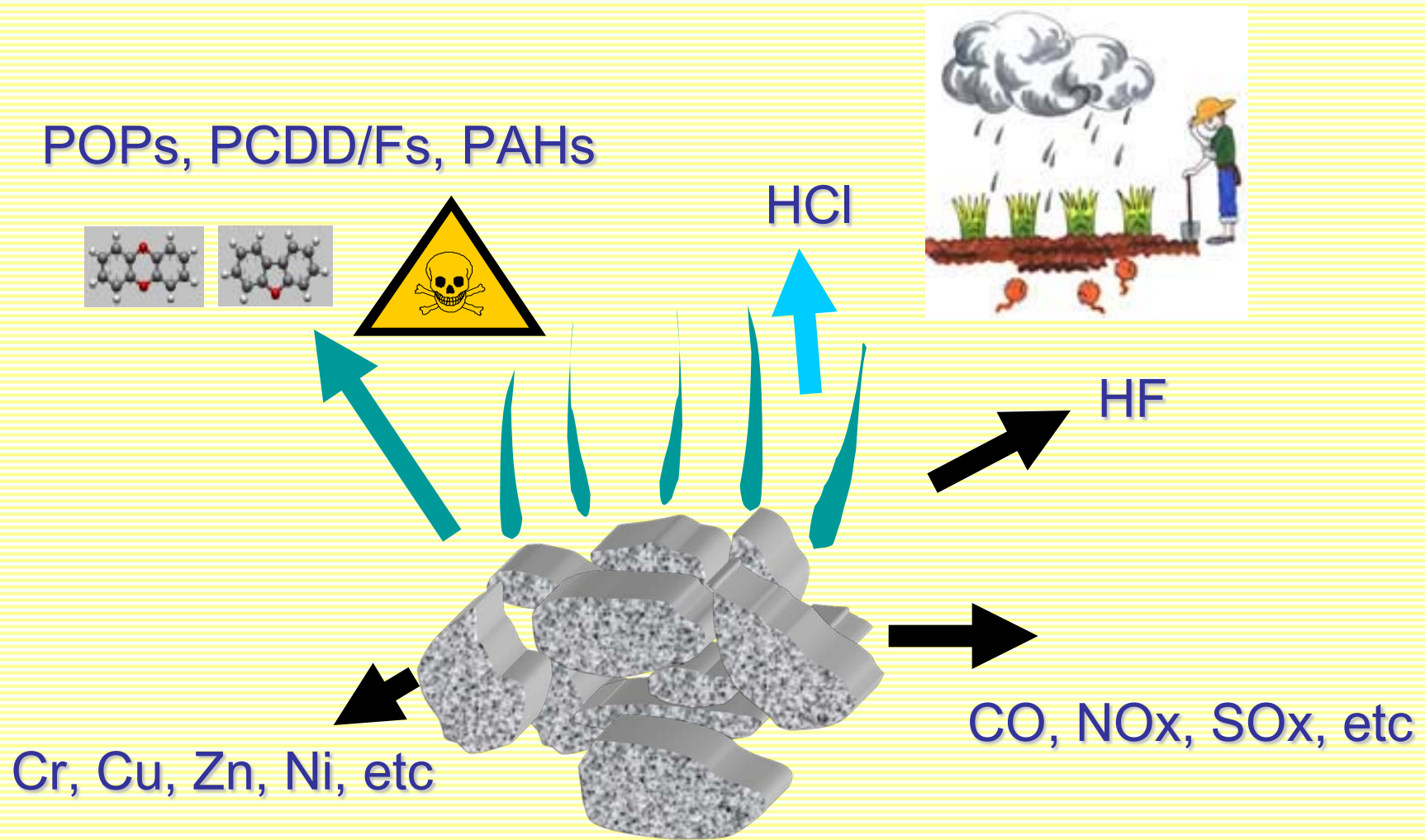


CFB Power Boiler developed by Zhejiang University

- ❖ Overcame high temperature corrosion of superheater so that steam temperature above 450°C can be used to Improve the generation efficiency
 - ⇒ Reduce $\text{Cl} \rightarrow \text{HCl}$ conversion by controlling combustion temperature, special arrangement of superheater, blowing surfaces by flue gas with high ash concentration.
- ❖ Developed boilers with capacity from 150 ton/day to 500 ton/day
- ❖ All the boilers have shown successful performance



Possible pollutants from incineration of MSW



POPs research center of Zhejiang University



dioxin source sampling
system USEPA M23



High-resolution double-
focusing magnetic mass
HRGC/HRMS

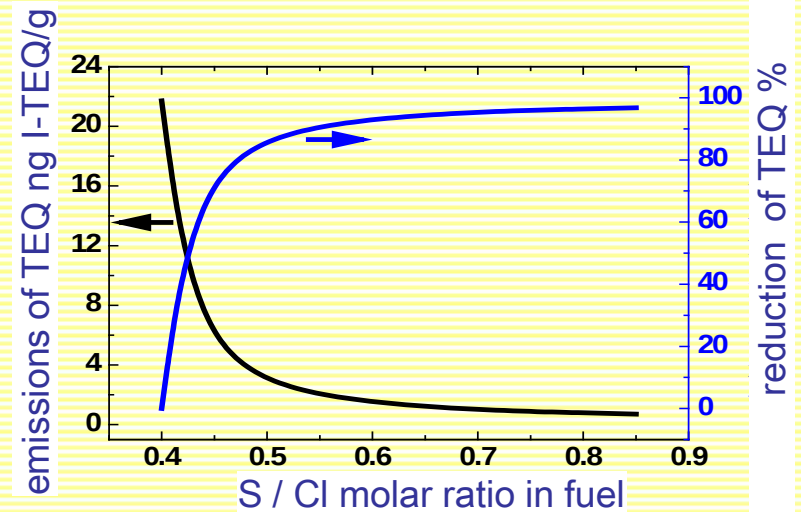


China Measurement Accreditation
(CMA)

Control of dioxin emission

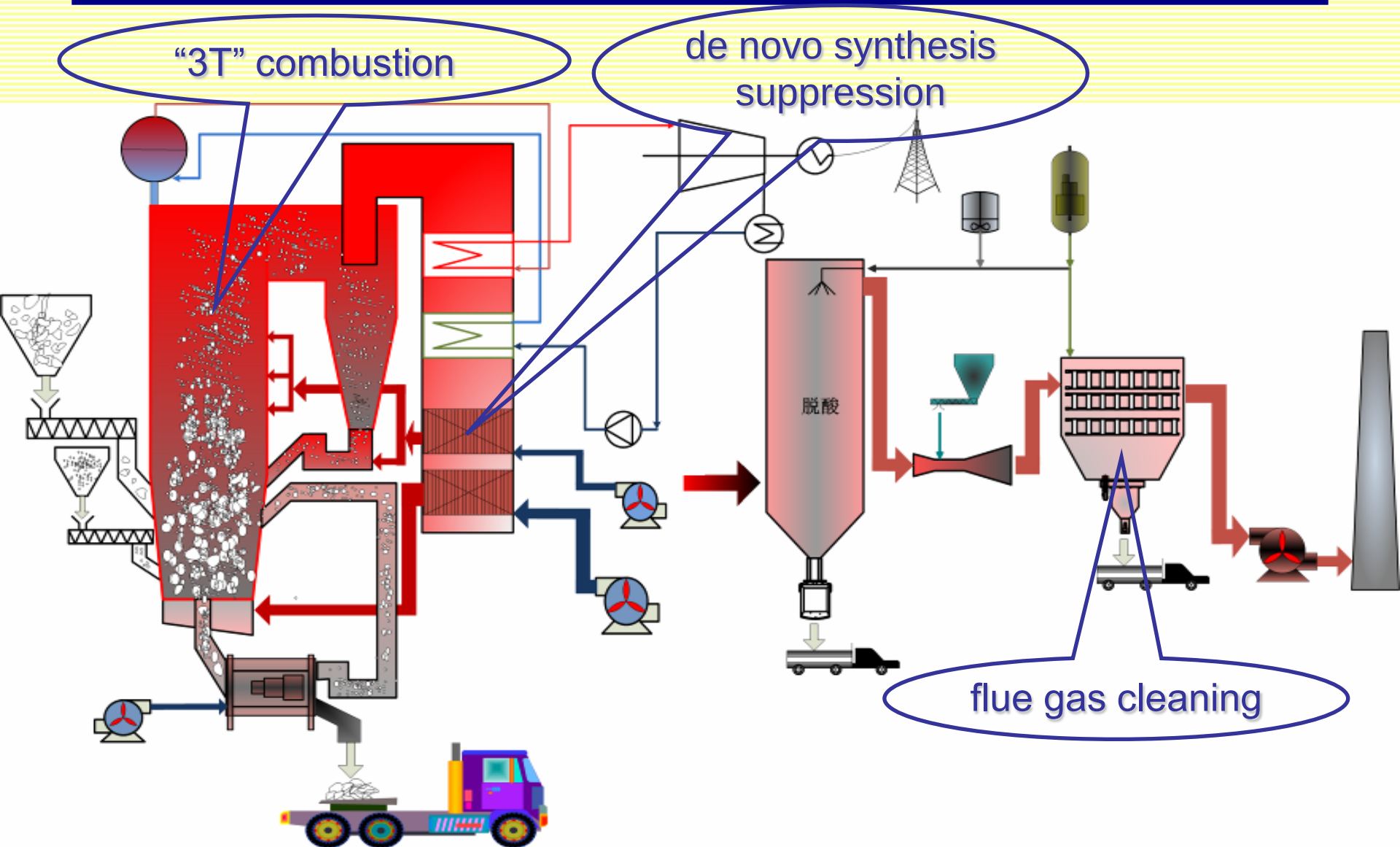
- ❖ Combustion: Temperature, Time, Turbulence
- ❖ Make use of sulfur in coal to bate de novo synthesis, reduce dioxin emission

coal sulfur content	5%	16 %
reduction of total dioxin	72.4%	95.2%
reduction of TEQ	73.0%	94.2%



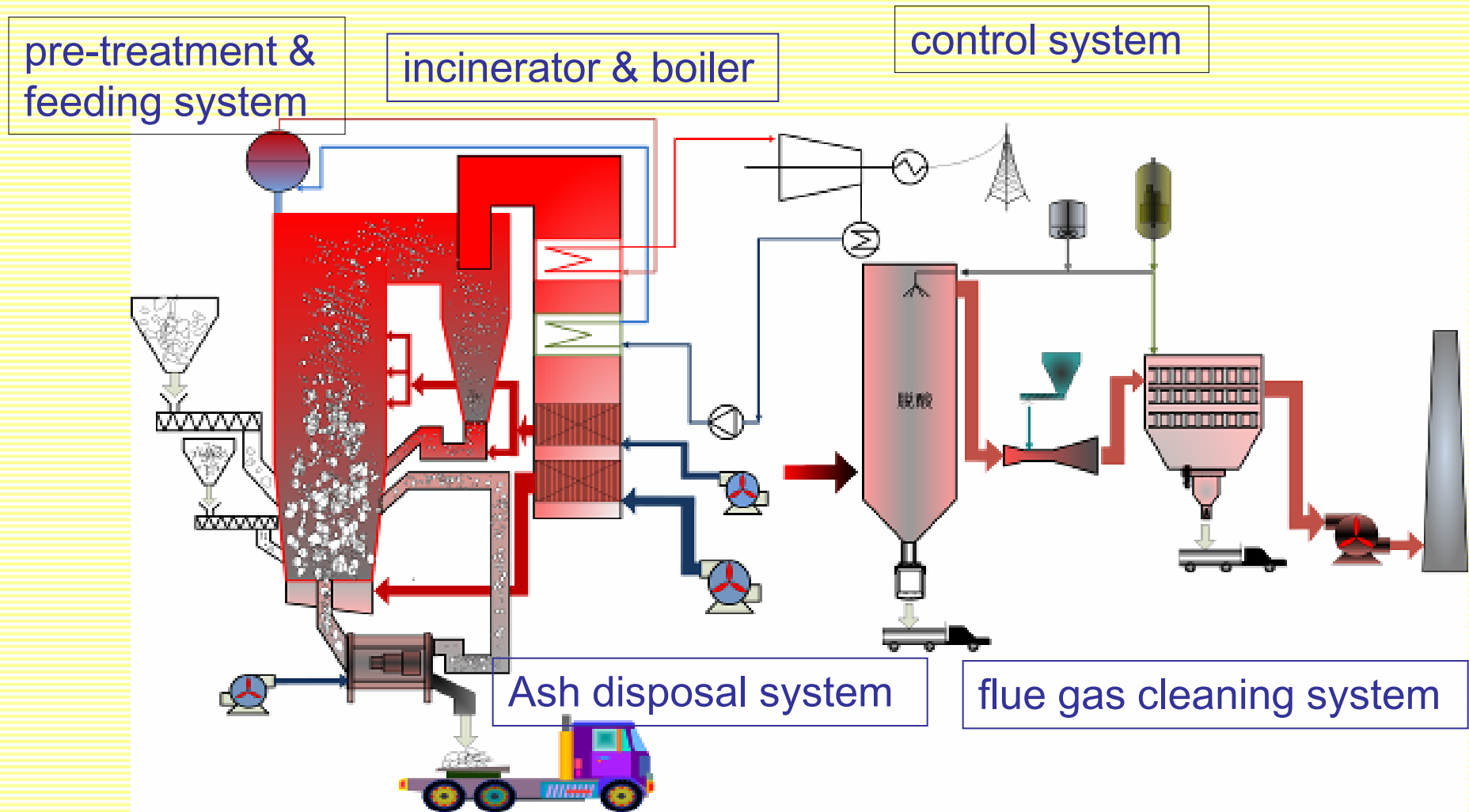
- ❖ Flue gas de-dioxin: circulating suspension gas cleaning system

Control of dioxin emission



Commercialization of developed Technology

Technology and equipment of MSW power plant



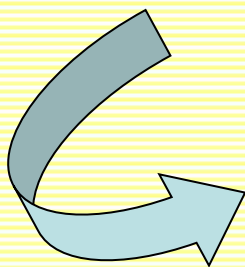
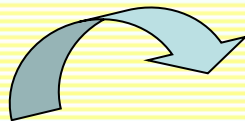
China State High-tech Demonstration Projects

- ❖ Equipped with 3 boilers, incinerating 800 t/d MSW
- ❖ Electricity generation: 18MWe (3×6 MWe)
- ❖ Put into operation in June, 2002 in Hangzhou, disposing 2.3 million tons MSW per year



Unloading platform





Feeding system



MSW CFB incineration boiler



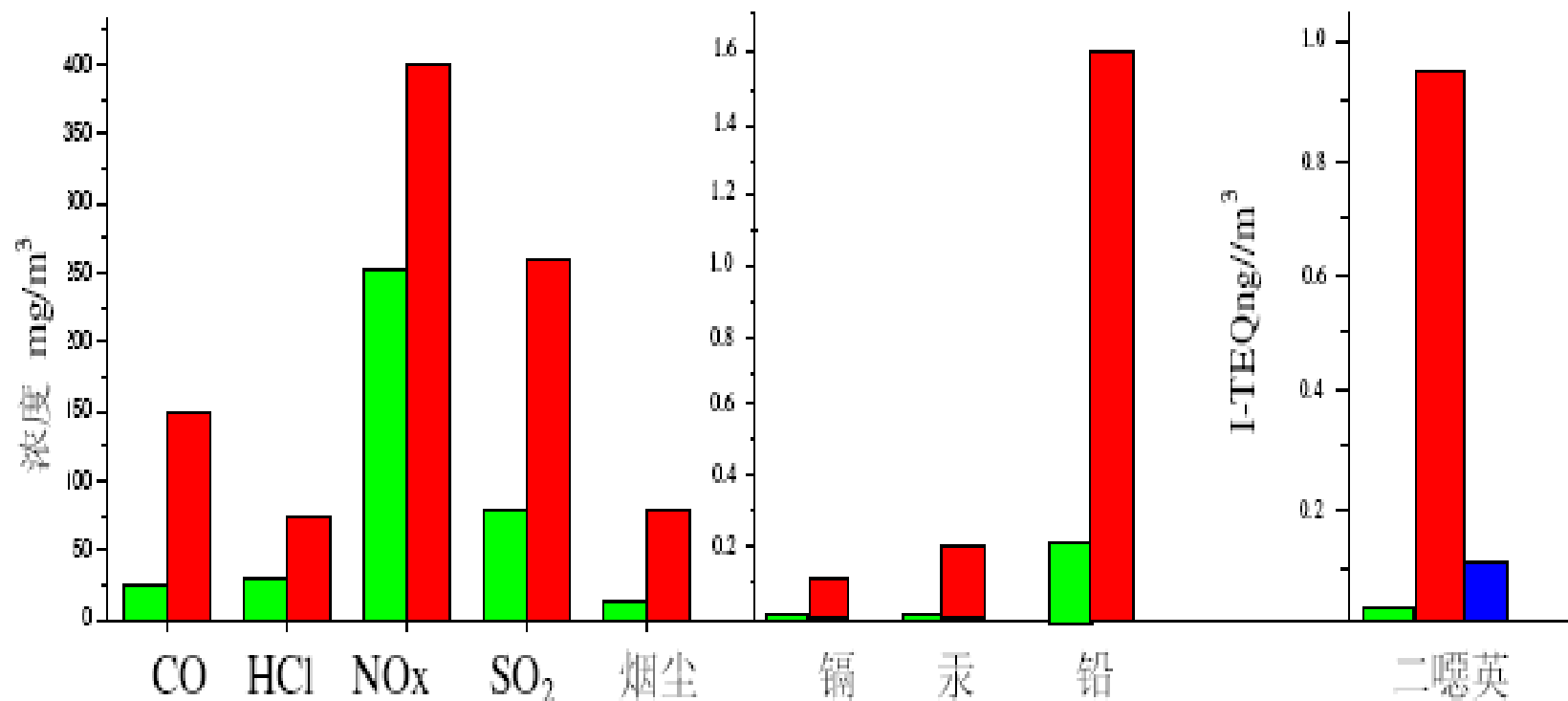
Semi-dry circulating bed flue gas cleaning system



Ash storage tank



Pollutant emission



- Testing results of this project
- National emission standard
- UN emission standard

Dioxin emission (I-TEQng/ m^3)	testing results	Chinese standard: 1.0 EU standard: 0.1
	0.0082	
	0.0025	
	0.009	
	0.077	

MSW incineration power plant in operation

By using the technology developed by Zhejiang University, we have put into operation:

- ❖ 20 MSW power plants
 - ❖ 64 incineration power boiler
 - ❖ 21750 t/d MSW disposing capacity
 - ❖ 450MW electricity output
-

Dongguan MSW Power Plant

- ❖ Equipped with 4 boilers, incinerating 1600 t/d MSW
- ❖ Electricity generation: 48MWe
- ❖ Put into operation in 2005 in Dongguan



Dongguan MSW Power Plant



Yiwu, Zhejiang

- ❖ Equipped with 5 boilers, incinerating 1600 t/d MSW, Electricity generation: 36MWe, Put into operation in 2005 in Yiwu.



Nantong MSW Power Plant

- ❖ Equipped with 3 boilers, incinerating 1500 t/d MSW, Electricity generation: 30MWe, Put into operation in 2008 in Nantong.



Pinghu MSW/Rape Stalks Power Plant

- ❖ Equipped with 3 boilers, incinerating 600 t/d MSW and 160t/d rape stalks, Electricity generation: 12MWe, Put into operation in 2008 in Pinghu.



MSW power plants in China

by the end of 2008

Source of Technology	Capacity Tons/day	Power MW
Zhejiang University, China	12250	270
Martin	6425	113.5
Zhejiang University	12250	270
Mitsubishi Heavy Industries	6425	113.5
Seghers	6350	93
Chinese Acad. of Sci.	6100	187
Chinese Weiming Group	3945	60
Alstom	2295	41
Tianxiong, Japan SN	1200	18
❖ Fluidized bed incineration plant:		41.39%
❖ Imported grate incineration plant:		48.77%
❖ Homemade grate incineration plant:		9.84%
Hangzhou Xinshiji FHW	320	6
non-electrical incineration plant	3463	0
total	52918 (49455)	967

National Awards



China National Prize for Progress
in Science and Technology



China National Award
for Excellent Patent

Thank you !
