



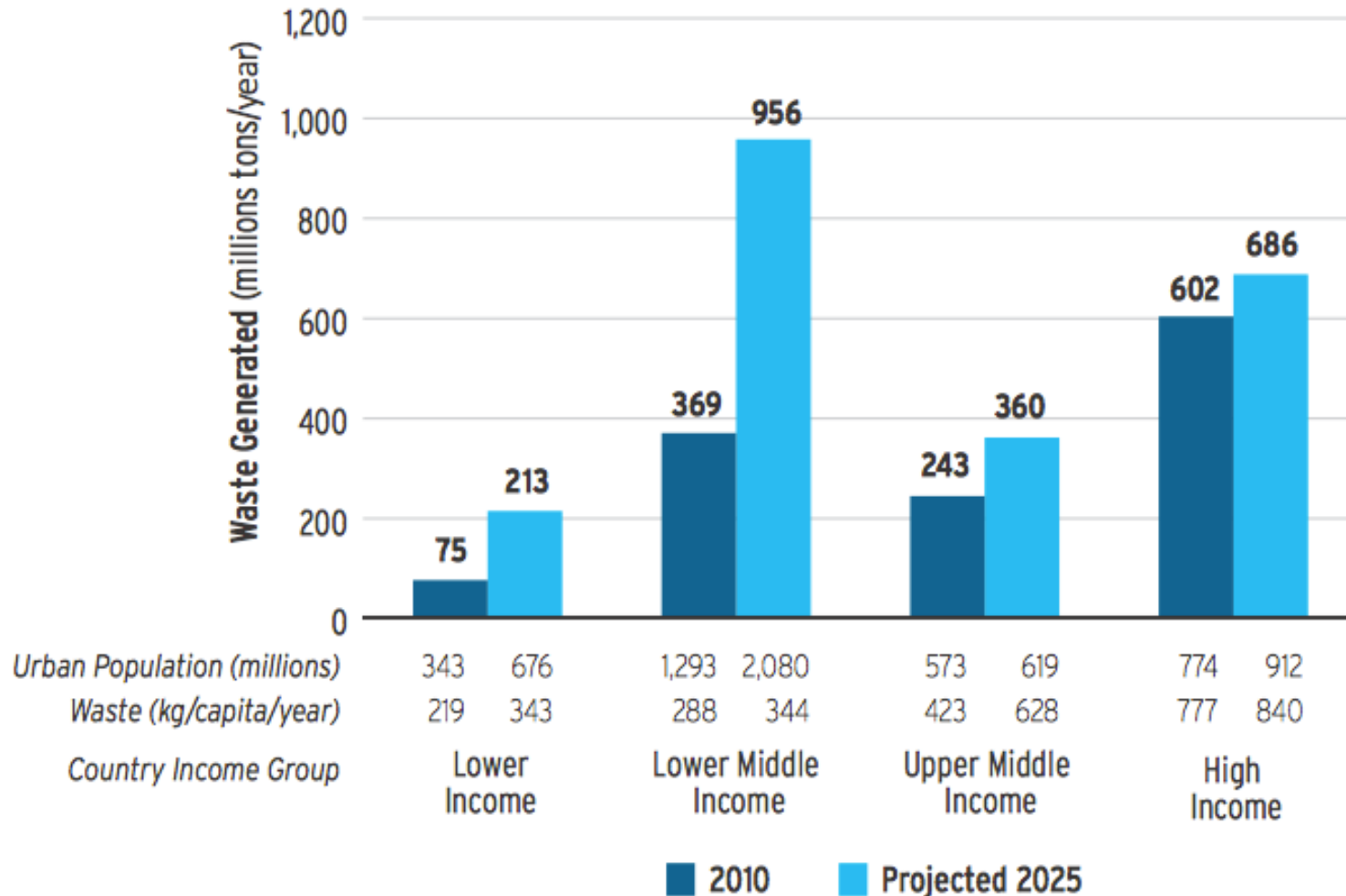
Rapid growth of CFB WTE technology in China

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Global MSW generation



MSW generation in different regions

Summary by Region								
Region	Number of Countries Included	Current Available Data			Projections for 2025			
		Total Urban Population (millions)	Urban MSW Generation		Projected Population		Projected Urban MSW Generation	
			Per Capita (kg/capita/day)	Total (tonnes/day)	Total (millions)	Urban (millions)	Per Capita (kg/capita/day)	Total (tonnes/day)
AFR	42	261	0.65	169,120	1,153	518	0.85	441,840
East Asia Pacific		777	0.95	738,959	2,124	1,230	1.52	1,865,380
ECA	19	227	1.12	254,389	339	240	1.48	354,811
LCR	33	400	1.09	437,545	682	466	1.56	728,392
MENA	16	162	1.07	173,545	379	257	1.43	369,320
OECD	27	729	2.15	1,566,286	1,032	842	2.07	1,742,417
SAR	7	426	0.45	192,411	1,939	734	0.77	567,545
Total	161	2,982	1.19	3,532,255	7,648	4,287	1.42	6,069,705

MSW Composition

		Food	Paper	Plastics	Wood	Textile	Metals	Glass	Yard	Others
Asian countries and District	Malaysia	60	12	13	3	5	3	1	-	3
	China	50	10.0	5.8	6	2.5	3.5	2	10	10.1
	HK	42.3	21.1	18.5	-	-	2.2	3.2	1.4	11.3
	Singapore	20	25	22	7	4	3.0	2.0	7	10
	Korea	16.3	21.4	8.9	-	-	8	4.7	-	30.7
	Japan	11.4	53.1	9.3	4.3	-	2.8	5.3	-	13.8
Latin America	Mexico	52.4	14	11	-	1.4	3.4	5.9	-	12
Developed Countries	Italy	31	28	14	4	4	3	8	-	8
	England	25	31	8	0	5	8	10	-	13
	USA	22	47	5	0	0	3	3	-	20
	Germany	16	31	4	0	2	5	13	-	29
	France	15	34	4	0	3	3	9	-	32

Source: Monitoring of Solid waste in Hongkong-Waste Statistics for 2011

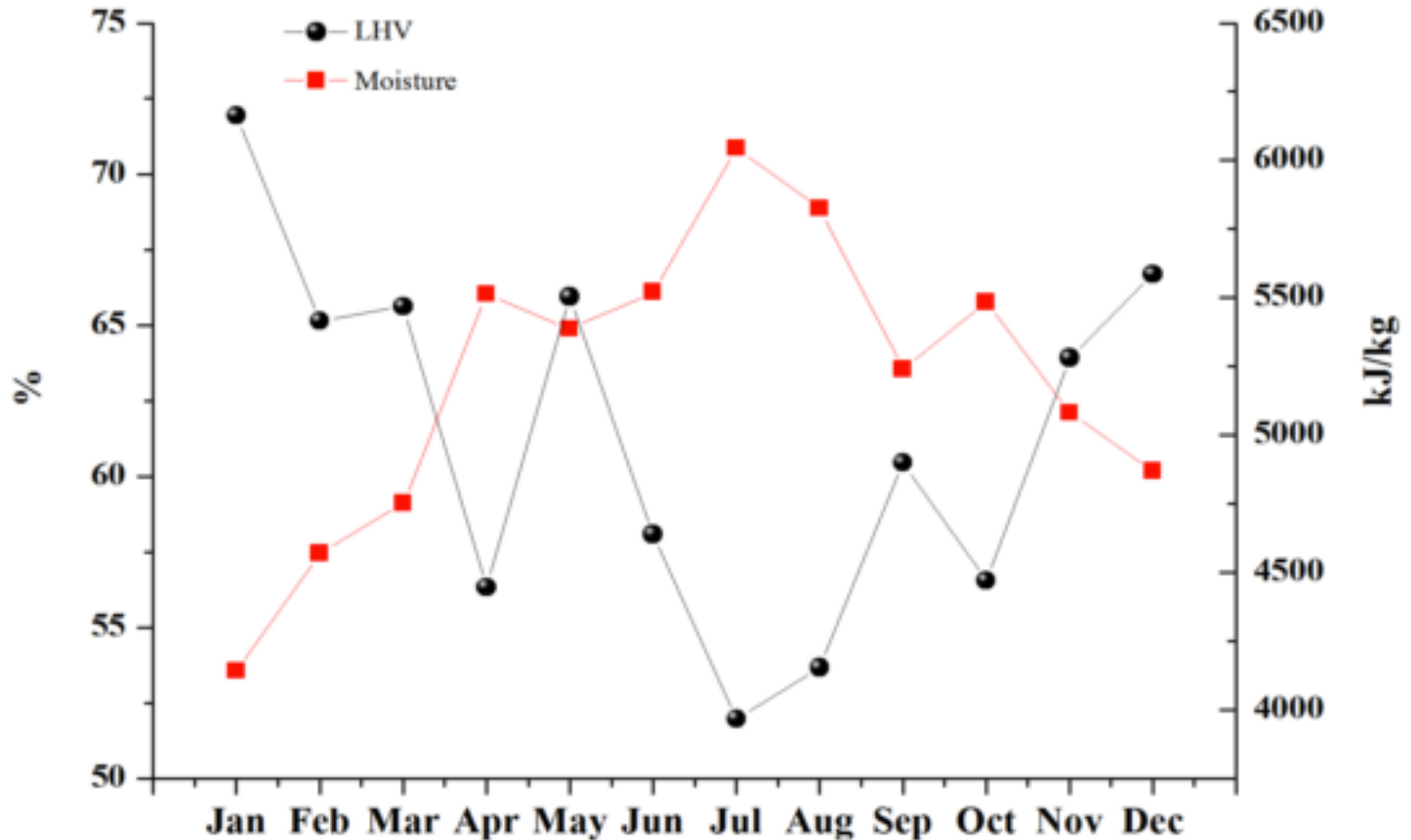
Municipal Waste Management Report: Status-quo and Issues in Southeast and East Asian Countries

Base de Datos Estadísticos, SEMARNAT, 2010. Mexico

MSW Lower Heating Value (LHV)

Country	Lower heating value (MJ/kg)
Malaysia	5.3
China	5.9
HK	7.4
Singapore	9.8
Korea	8.9
Japan	12.5
Mexico	6.7
Italy	10.2
England	12.1
USA	11.7
Germany	12.0
France	12.0

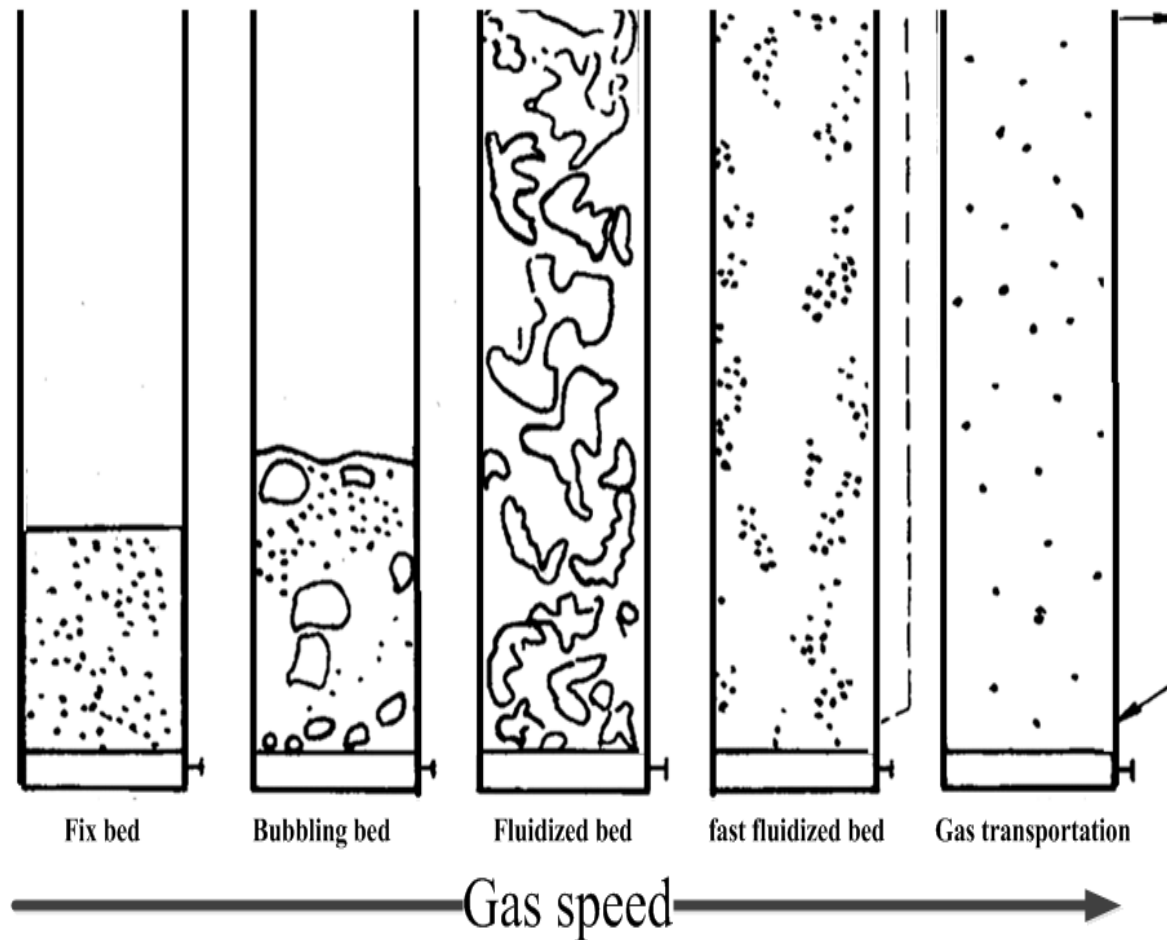
Monthly Moisture Content and Heating Value of Shenzhen city at 2011



Problems in combusting high moisture MSW

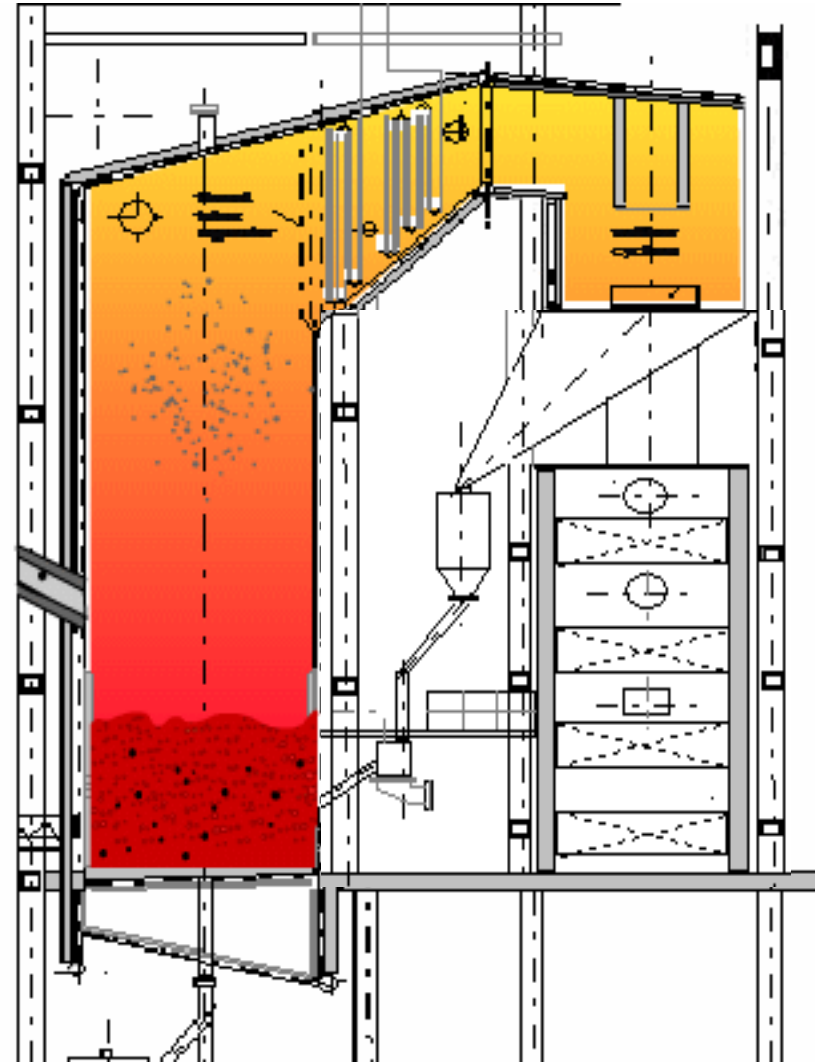
- a) Difficult to ignite
- b) Energy required for drying
- c) Long residence time required for burnout

The development of FB for high moisture LHV MSW combustion

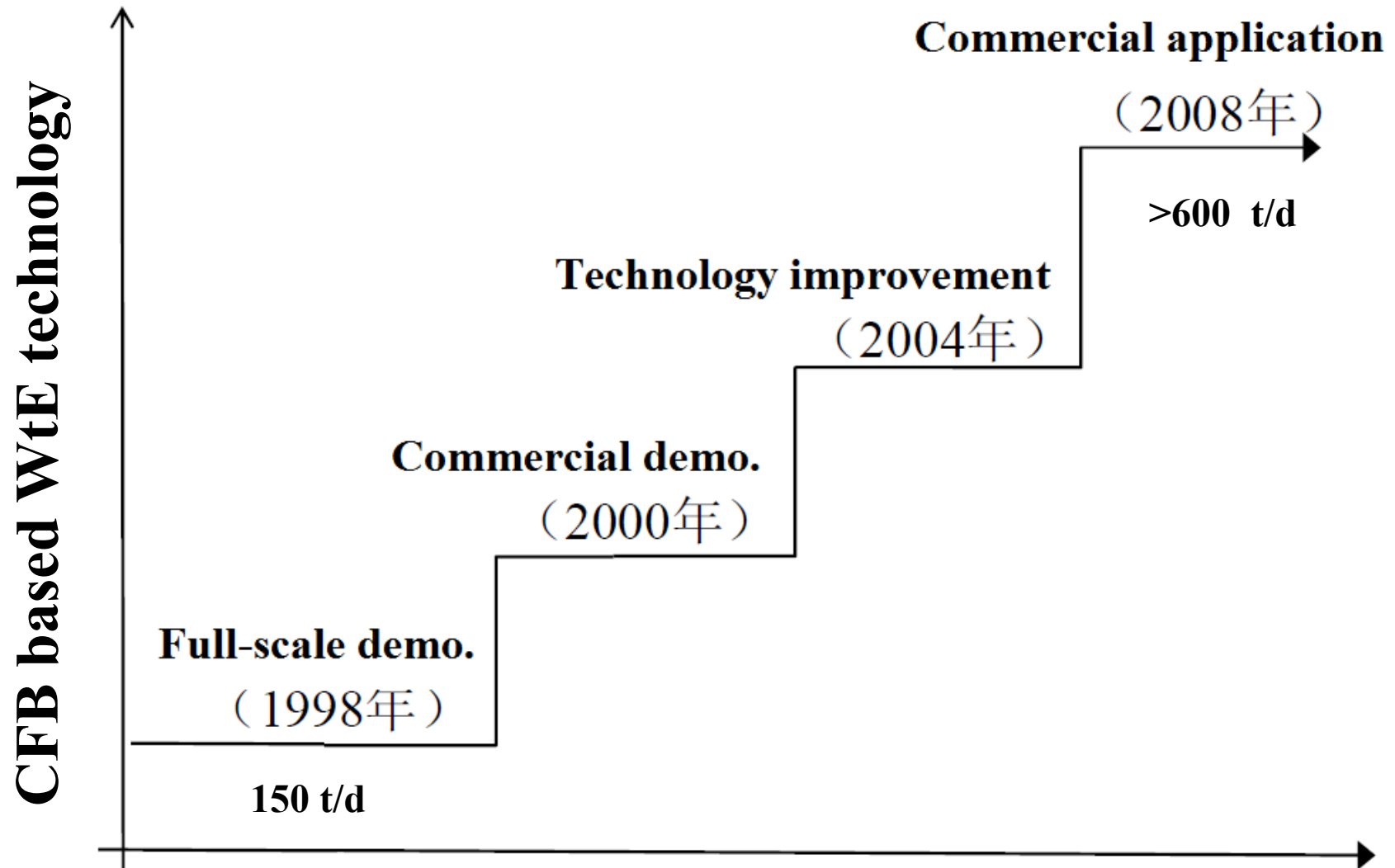


Advantages of Fluid Bed reactors

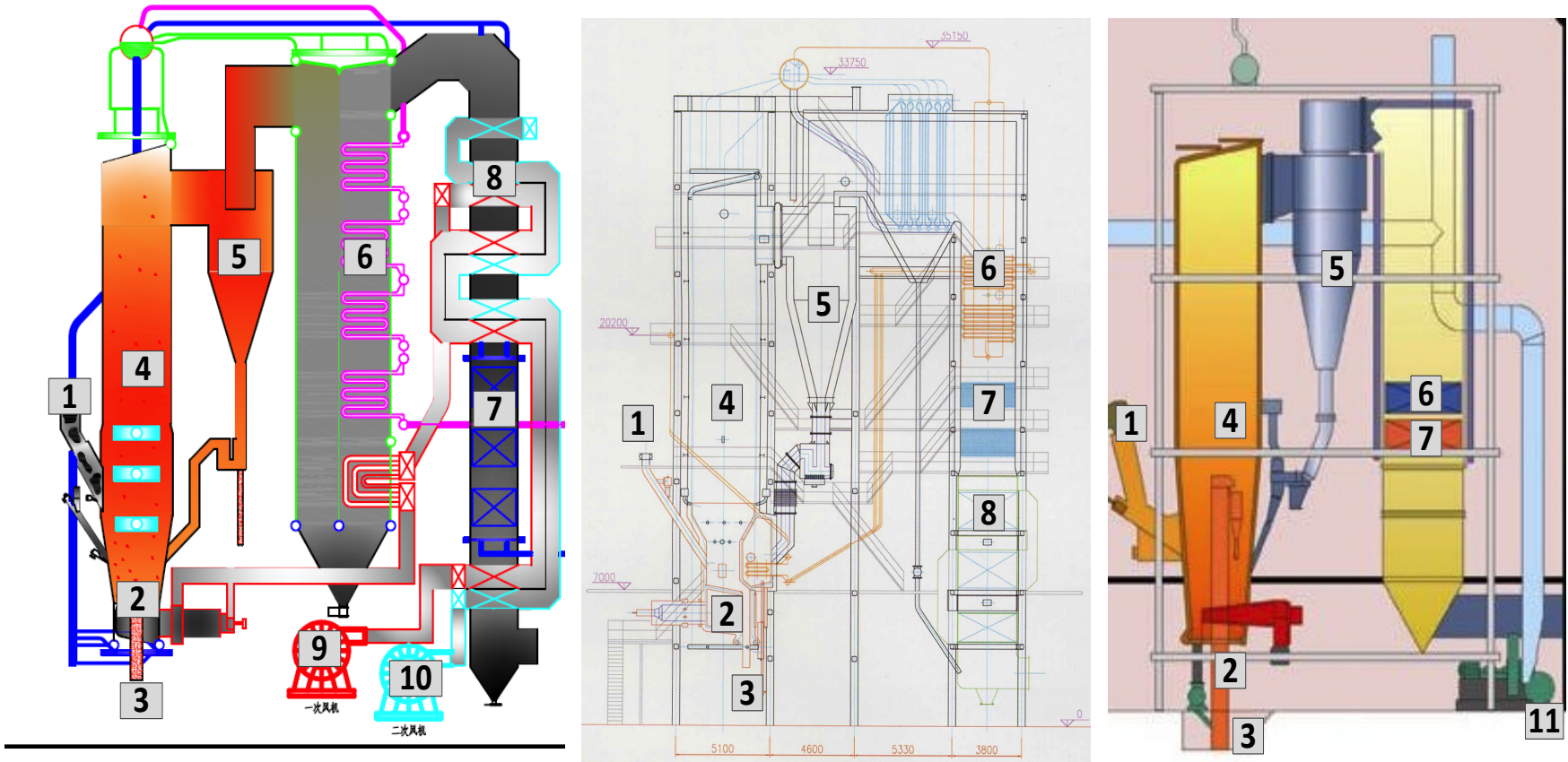
- a) High thermal inertia and temperature of bed dries and ignites MSW rapidly
- b) Long residence time of bubbling bed
- c) High turbulence results in more uniform temperature in the gas flow through combustion chamber
- d) More compact reactor and high thermal flux



Progress in developing CFB MSW reactors



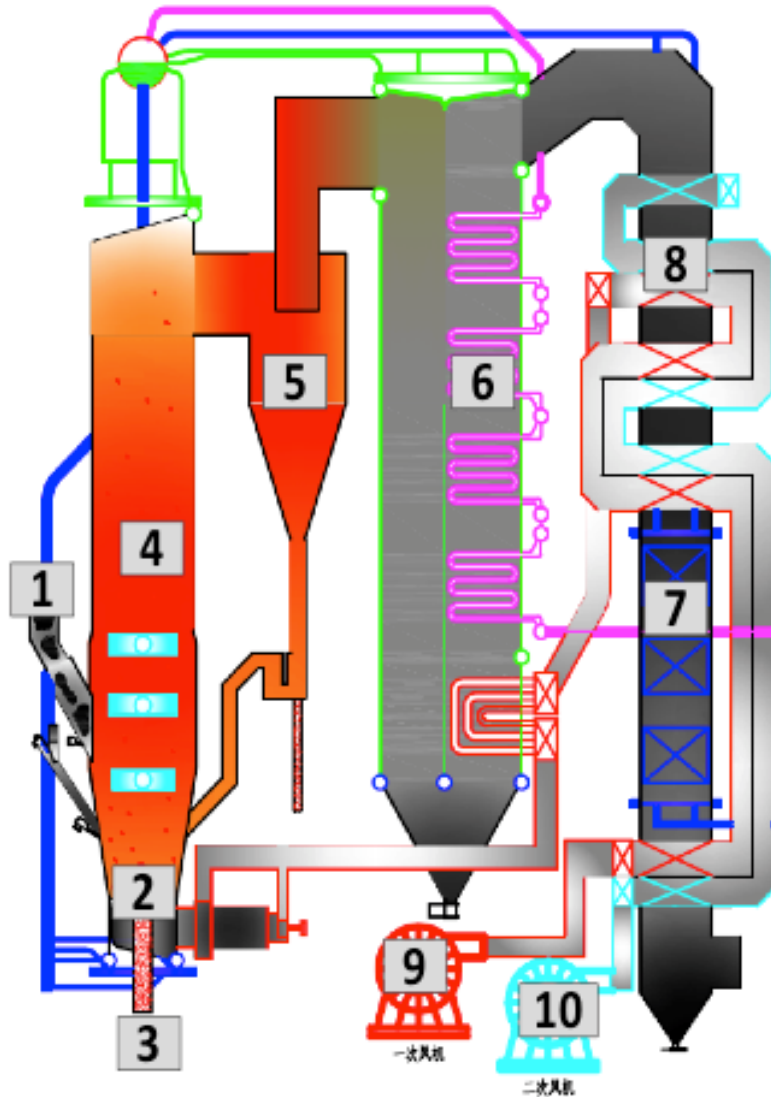
CFB technologies in China



(a) Zhejiang Univ. (b) Chinese Academy of Sciences, (c) Tsinghua Univ.

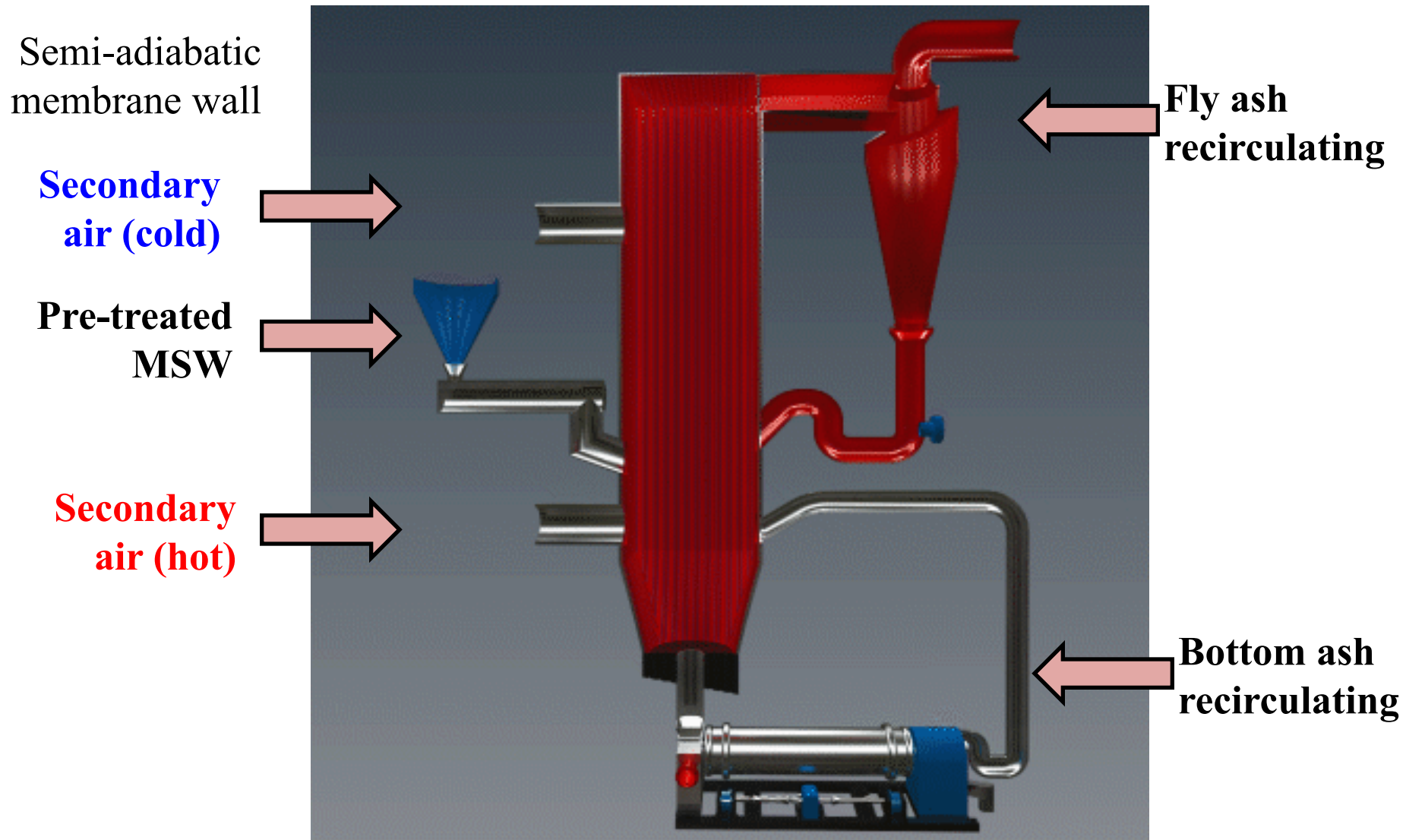
1) msw feeder; 2) air distributor; 3) bottom ash discharger; 4) CFB combustion chamber; 5) cyclone separator; 6) super heater 7) economizer; 8) air preheater; 9) primary fan 10) secondary fan 11) induce fan

Zhejiang University CFB



- 1) MSW Feeder
- 2) Air Distributor
- 3) Bottom Ash Discharger
- 4) Reactor
- 5) Cyclone
- 6) Superheater
- 7) Economizer
- 8) Air Pre-heater
- 9) Primary Fan
- 10) Secondary Fan

CFB technologies Developed by ZJU



National Demonstration Project

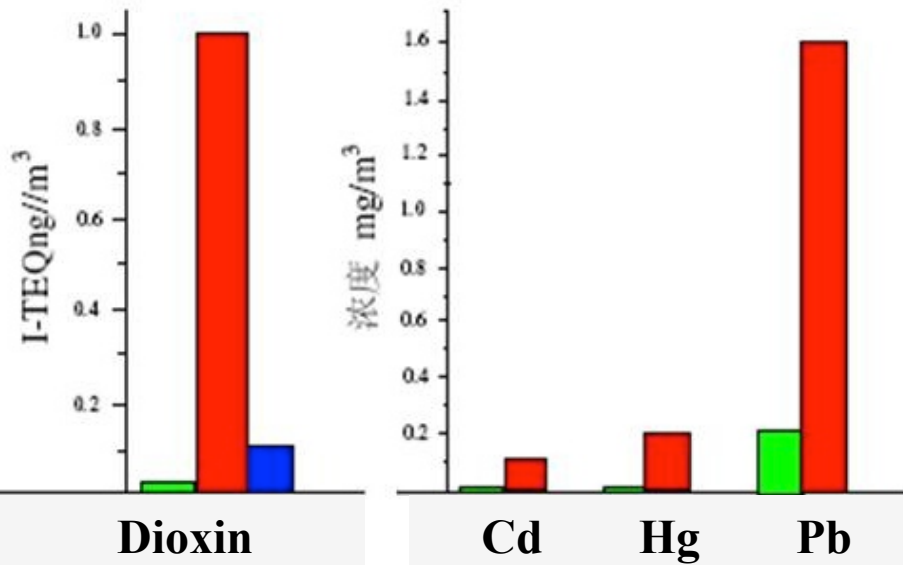
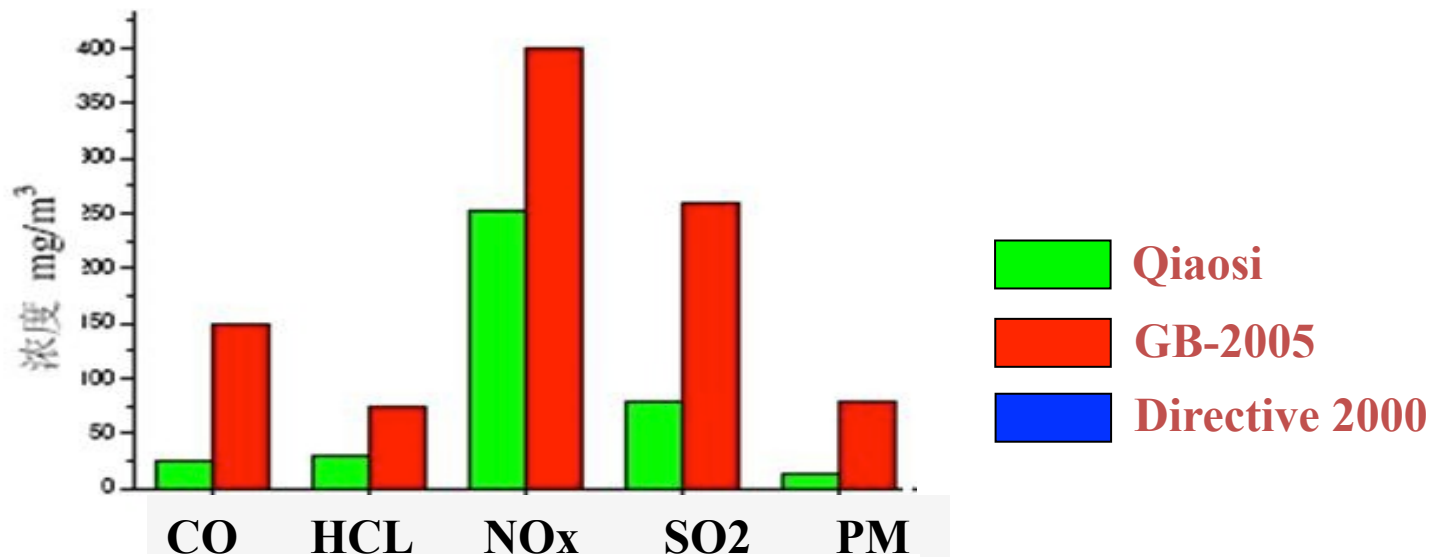
Hangzhou Qiaosi Waste-to-Energy Power Plant (2002)

- National Demonstration Project supported by the Chinese National Planning Bureau.
- Technology of Zhejiang University.



- *Capacity: 800 tons/day*
- *Three lines: 200+300+300*
- *Turbine units: 12 MW*

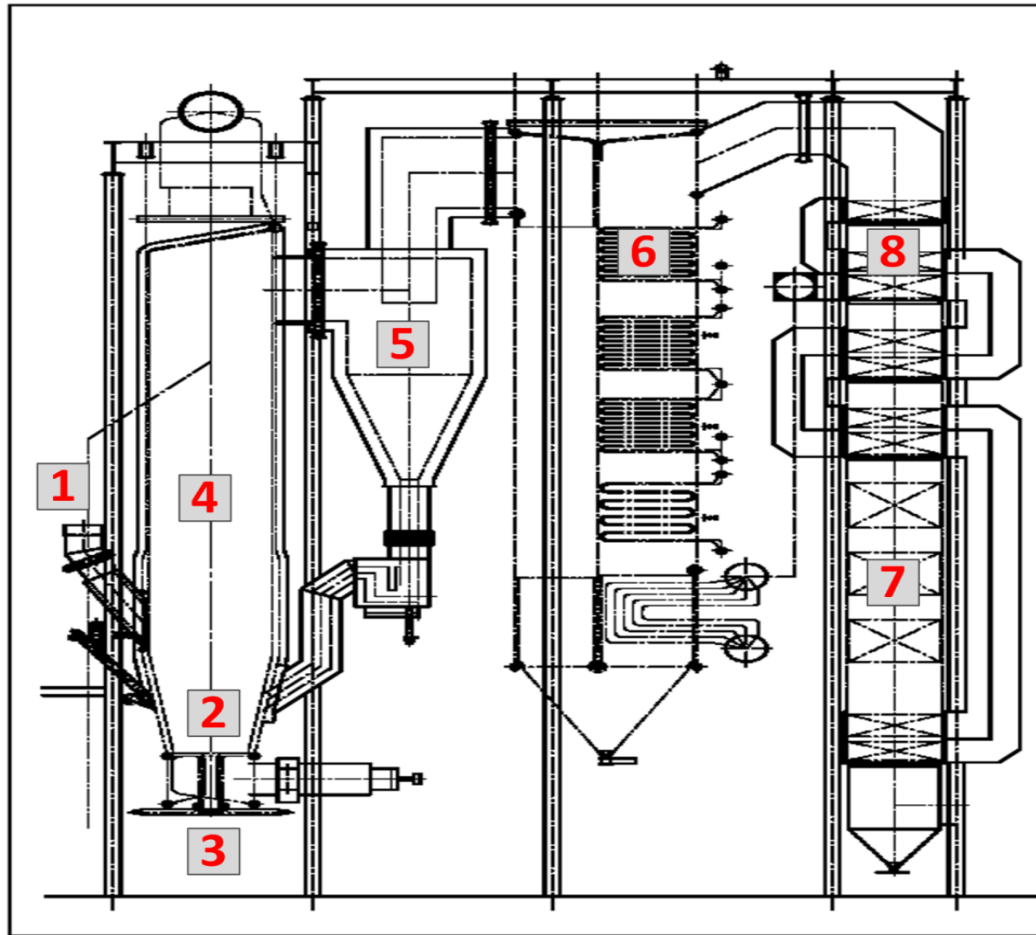
Performance on Pollutants control



Measured by Belgium SGS dioxin lab

The largest CFB MSW incinerator in China

Layout of 800 t/d CFB incinerator at Cixi city, Zhejiang province, China



1) MSW feeder; 2) Air distributor; 3) Bottom ash discharger; 4) CFB combustion chamber; 5) Cyclone separator; 6) Super heater 7) Economizer; 8) Stack

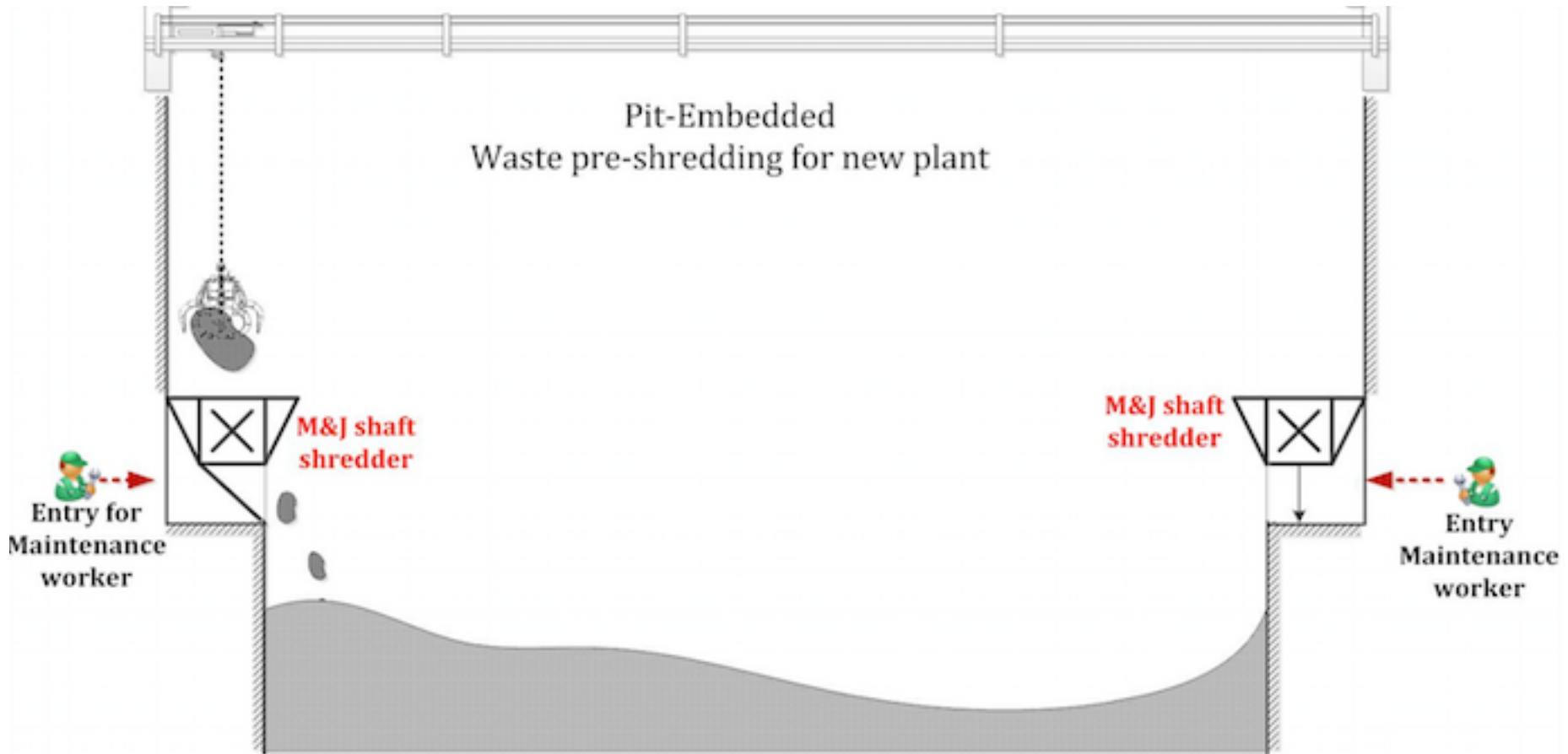
The shredder for CFB MSW incinerator

Low Speed – High Torque Shredders

- Uses **shear forces** (instead of impact) to tear materials
- Speed: 10-50 rpm
- Reverse motion to unclog shredder

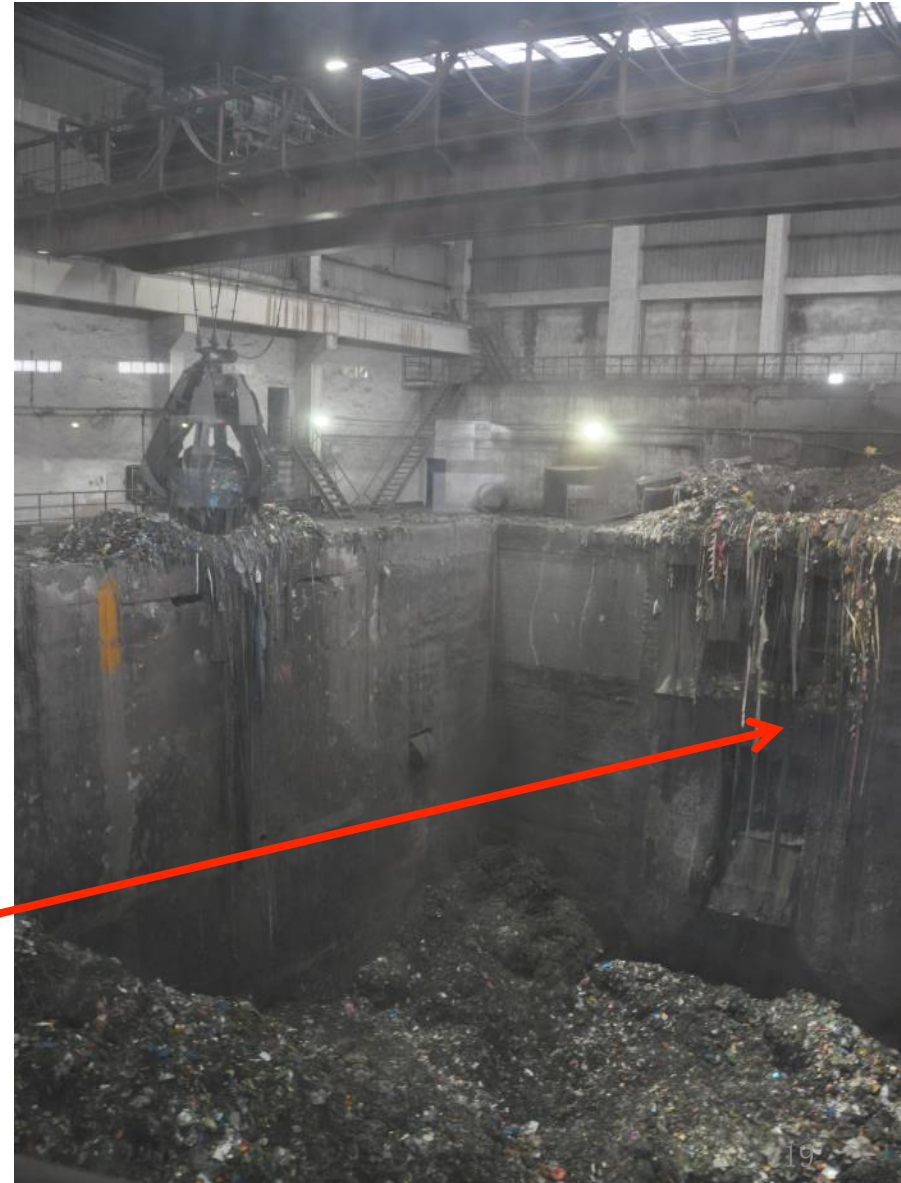
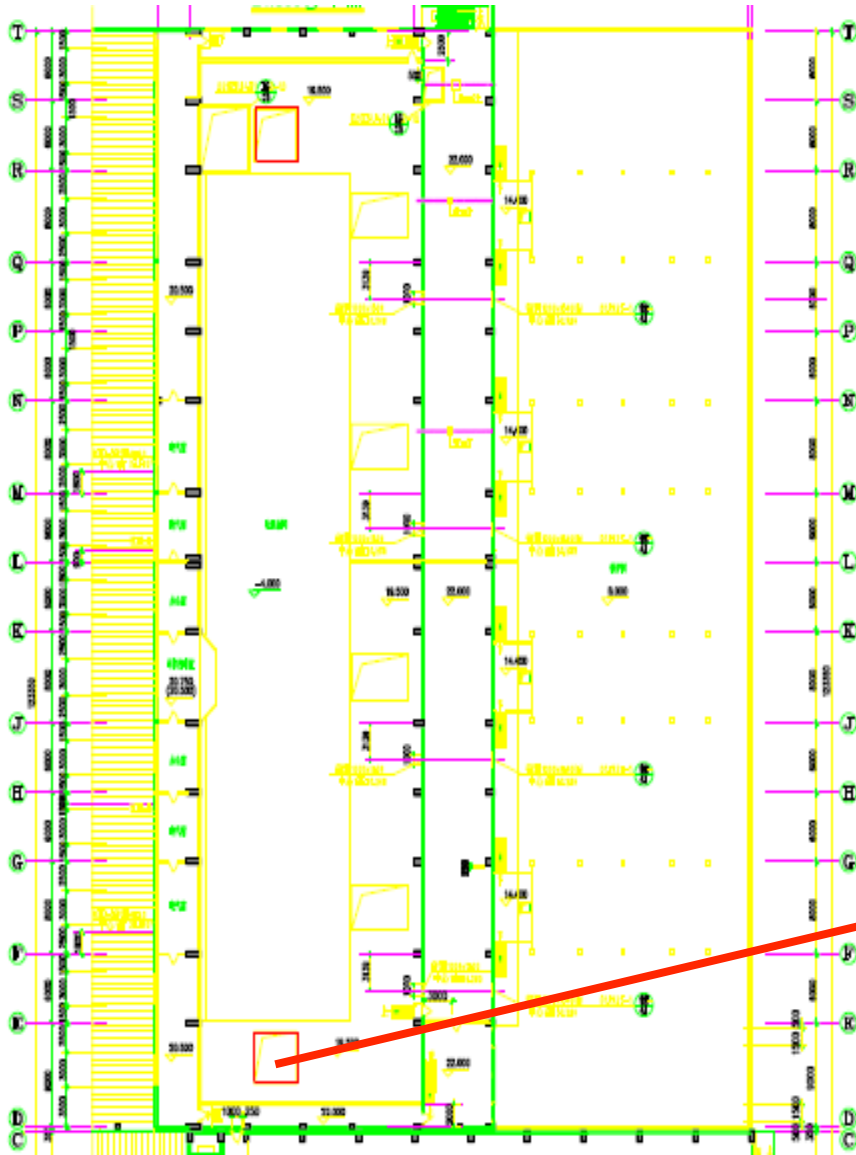


Location of shredders in WTE bunker



Two shredders serving the 2,300 ton/day Cixi plant (4 lines)

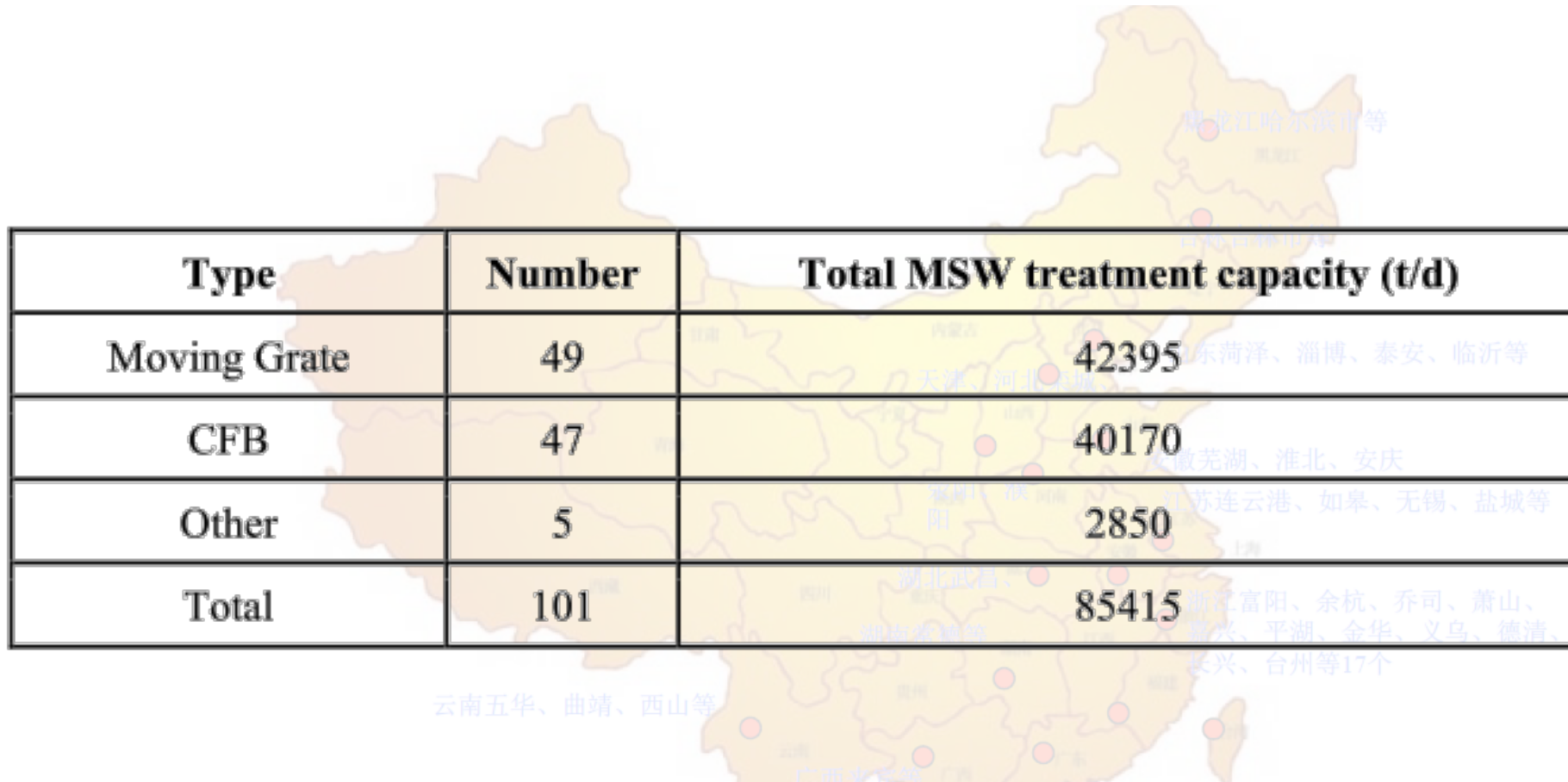
The shredder for CFB MSW incinerator



The shredder for CFB MSW incinerator



Types of MSW WTE plants in China



Type	Number	Total MSW treatment capacity (t/d)
Moving Grate	49	42395
CFB	47	40170
Other	5	2850
Total	101	85415

By 2012, there were **47 CFB WtE Plants** with a total MSW treatment capacity of **40,000 tons per day (47% of total capacity)**

Plants



2005, guandong 1600 t/d



2010, hubei, 2600 t/d



2011, cixi 800t/d



2013, henan, 2700 t/d

Conclusions

- 1) In the near future, there will be an increase of MSW generation, especially in developing countries.
- 2) CFB incineration technology is a promising solution for high moisture, low LHV MSW.
- 3) The CFB plants that have been built in recent years are less capital intensive per ton than moving grate type. If that can be done for other developing countries, CFB can be a promising solution.

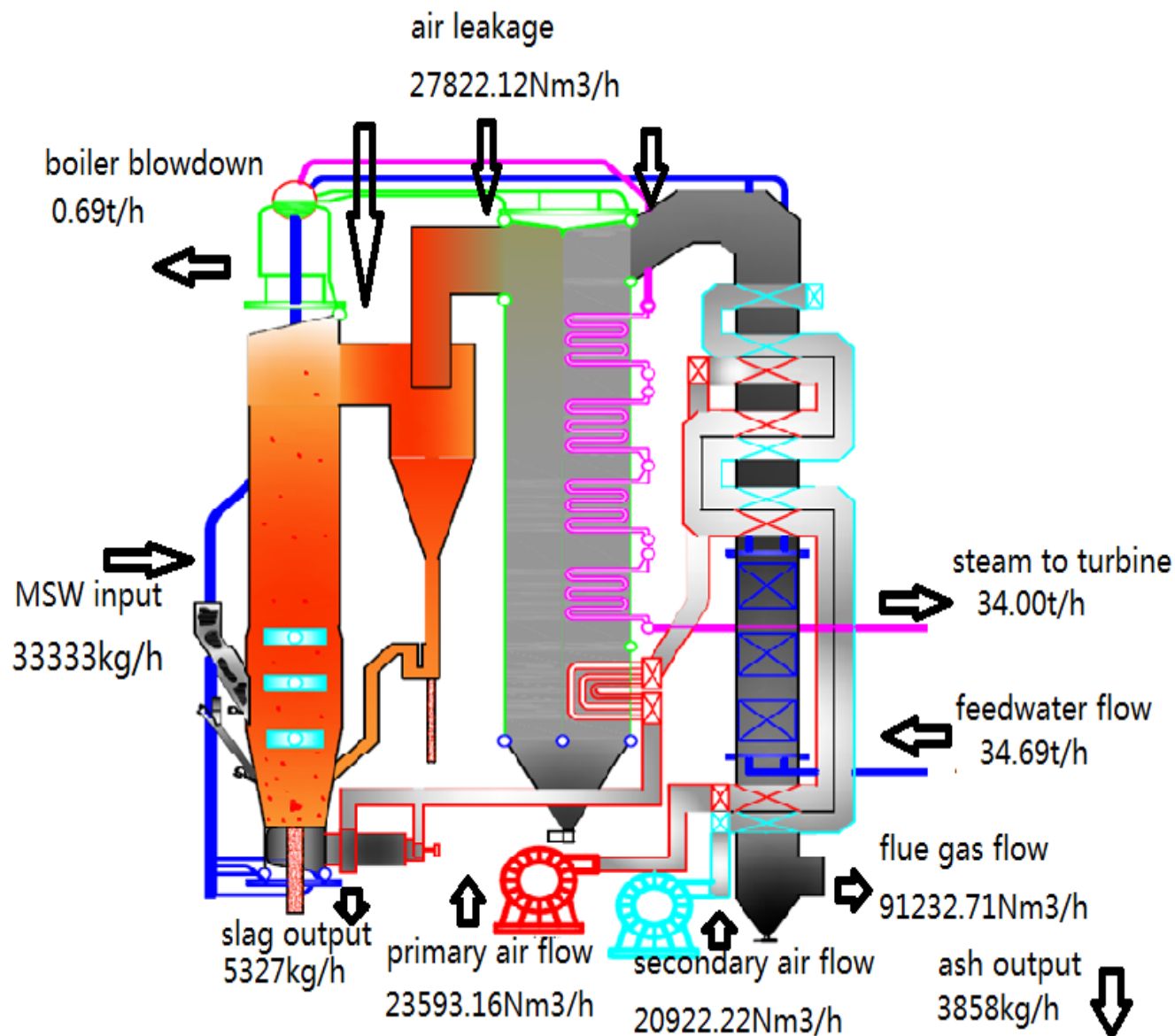
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- **Contribution of the Global WTER Council (www.wtert.org)**

Backup Slides



DESIGN AND APPLICATION OF AN 800T/D CIRCULATING FLUIDIZED BED INCINERATOR FOR FIRING PURE LOW HEATING VALUE CHINESE MSW

State Key Laboratory of Clean Energy Utilization, Institute for Thermal Power Engineering,, Zhejiang University, Zheda Road

Table1 The indicators of incinerator system

Waste incinerated	800t / d
Steam output	34t / h
Calorific value	3970 kJ / kg (948kcal/kg)
Steam pressure at superheater outlet	5.3Mpa
Steam temperature at superheater outlet	485°C
Feedwater temperature	150°C
Exhaust gas temperature	165°C
Incinerator efficiency	> 75%

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Table 2 The operation parameters and pollutants emission of the incinerator and their design value

item	Design value	Monitored value
Boiler output	33.9t / h	41.525 t / h
Waste incinerated	800t / h	834.20 t / h
Thermal efficiency	75%	77.1%
PM emissions	<80mg/Nm ³	11.56 mg/Nm ³
SO ₂ emissions	<260mg/Nm ³	52.73 mg/Nm ³
NO _x emissions	<400mg/Nm ³	144.32 mg/Nm ³
Dioxin concentration	<1.0 ng TEQ/Nm ³	0.09650 ng TEQ/Nm ³
Gehman blackness	<1	<1

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