

Contract project-2004
With Ministry of the Environment, Japan



環境省

Ministry of the Environment

Air Pollution Control Technology In Glass Manufacturing Industry

March 2005

Overseas Environmental Cooperation Center, Japan

Air Pollution Control Technology in Glass Manufacturing Industry

Committee Members

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Environmental Engineering, Kyoto University
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Member:

**Mr. S. Iwasaki, Director, Metocean Environment Inc.
Dr. S. Fujii (P.E.), Takuma Co., Ltd.
Mr. Y. Ogino (P.E.), Environment Technology L.R.C.**

Prepared by

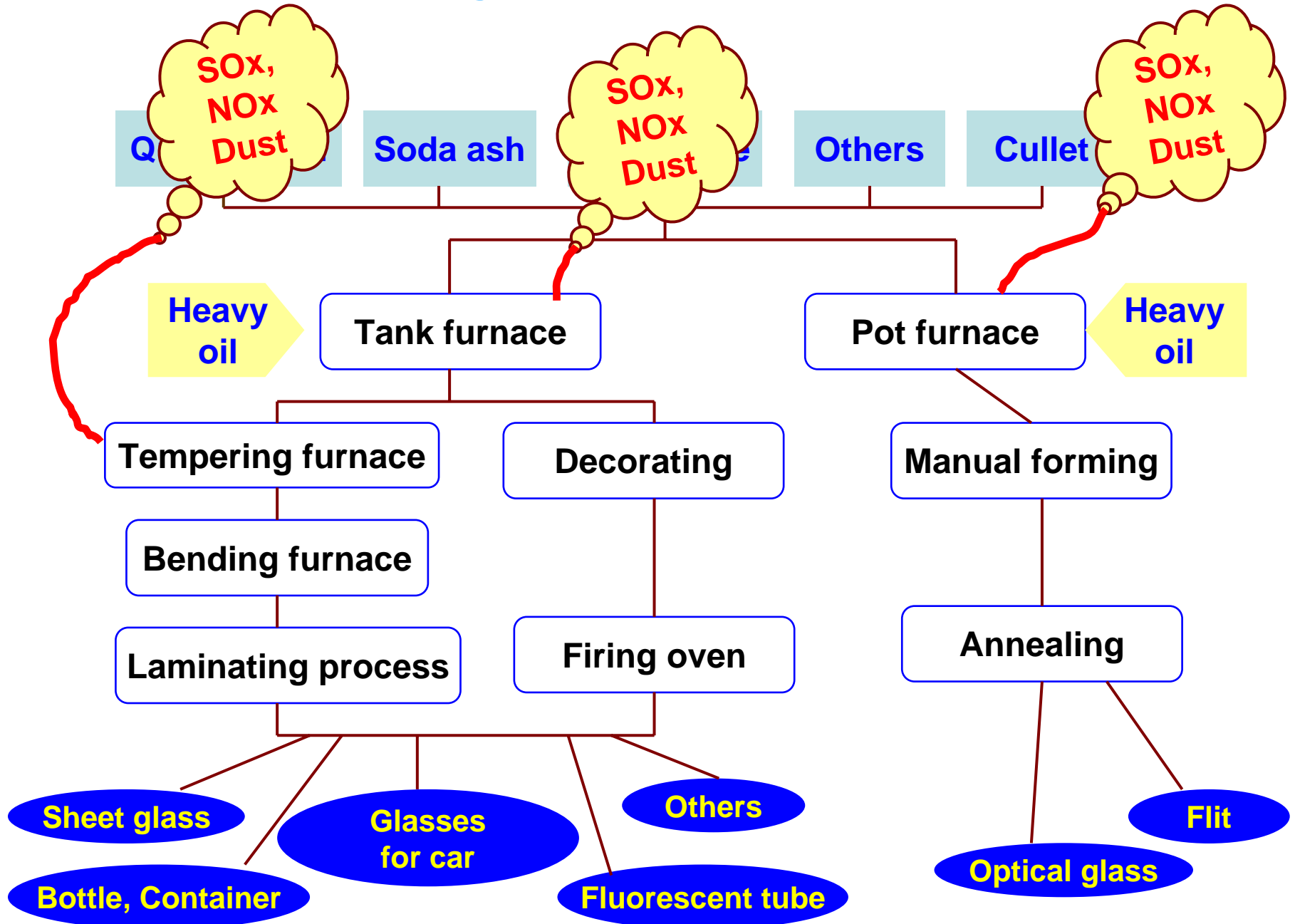
Dr. A. Hogetsu (P.E.), Research Commissioner, OECC

Asahi Glass Co., Ltd. Kashima Plant

Product: Flat glass, Automotive glass, others



1. Glass Manufacturing Process and Air Pollutants



2. Soot & Dust Reduction

2-1 Reduction by means of Fuel and Furnace Operation

Causes of Dust

- Fuel Dust (soot, ash, heavy metal)
- Raw Material Scattered substances (ash, heavy metal)
- Non-uniform mixing fuel and air

Dust Reduction Method in Soda-Lime Glass Melting

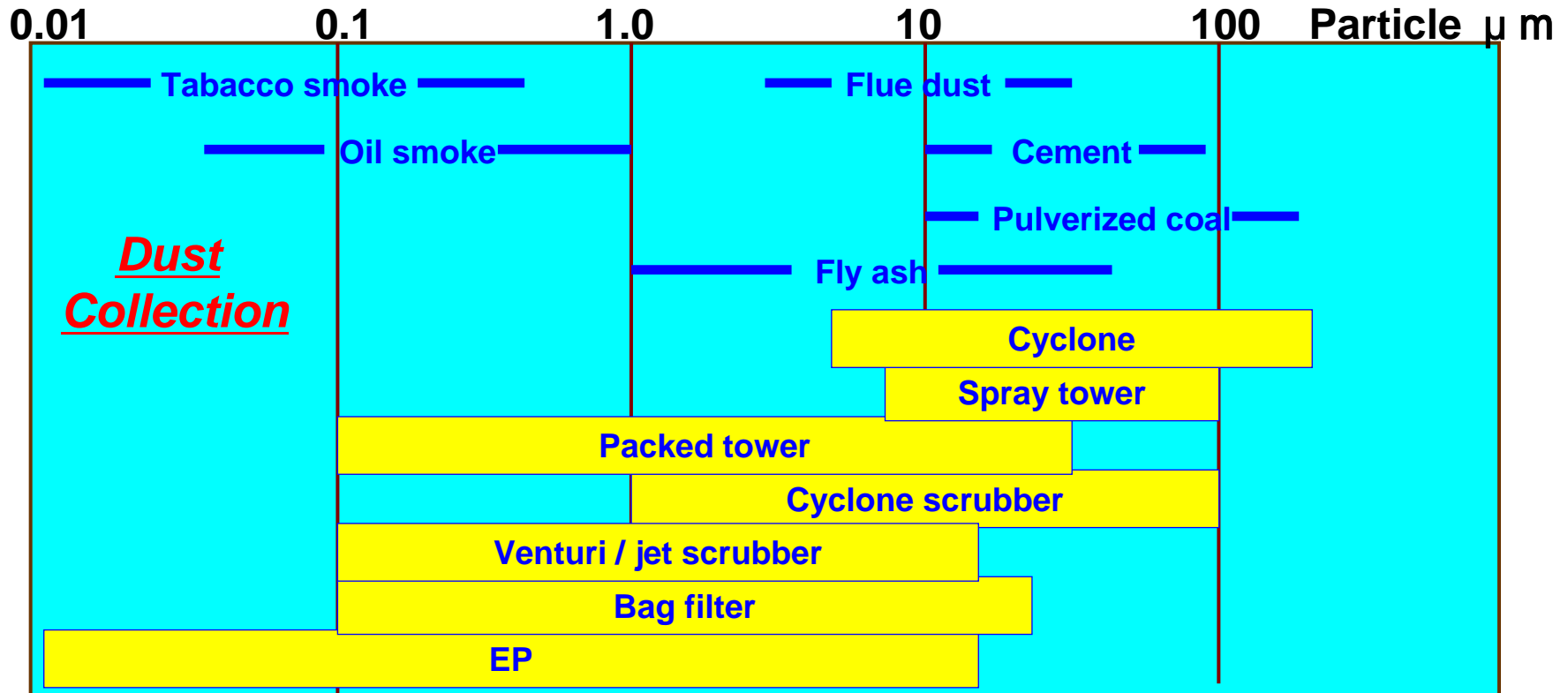
- Switching fuel; Solid Liquid Gas
Heavy oil Kerosene
- Effective atomization of fuel
- Careful manipulation of air supplying
- Adequate proportion of furnace configuration to flame shape
- Reviewing particle size of batch (glass raw material)
- Adjustment of batch moisture content in batch wise charge
- No direct striking surface of batch with flame

2. Soot & Dust Reduction

2-2 Properties of Dust and Applicable Scope of Dust Collection

Soda-Lime Glass
Melting Furnace
Flue Gas

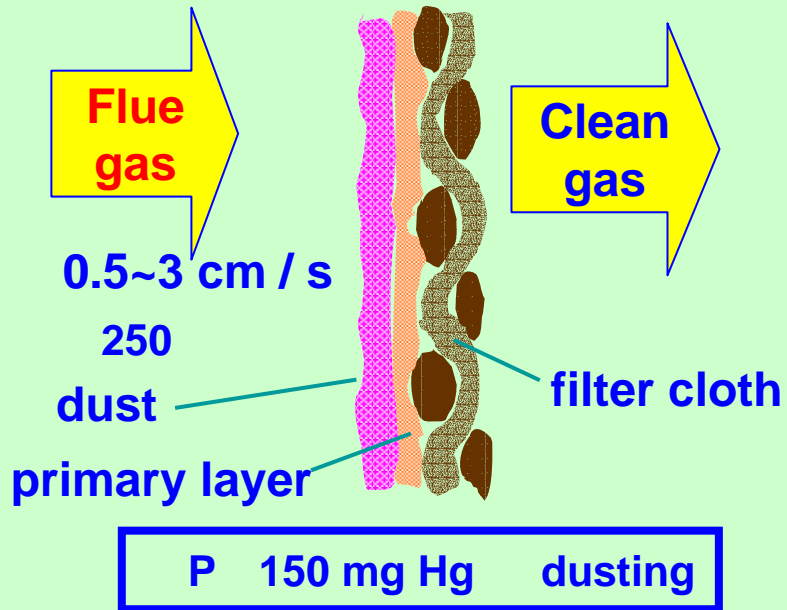
Flue gas (400~600)		Dust	
O ₂	8~9%	Dust conc.	0.2~0.4 g/Nm ³
CO ₂	10%	Particle size	~ 0.5 μm 25%
H ₂ O	10%		0.5~ 0.3 μm 50%
SOx	500~1,500ppm		0.3~0.1 μm 20%
NOx	400~600ppm		0.1 μm ~ 5%



2. Soot & Dust Reduction

2-3 Filter Dust Collector

Filtration Action in Filter Cloth

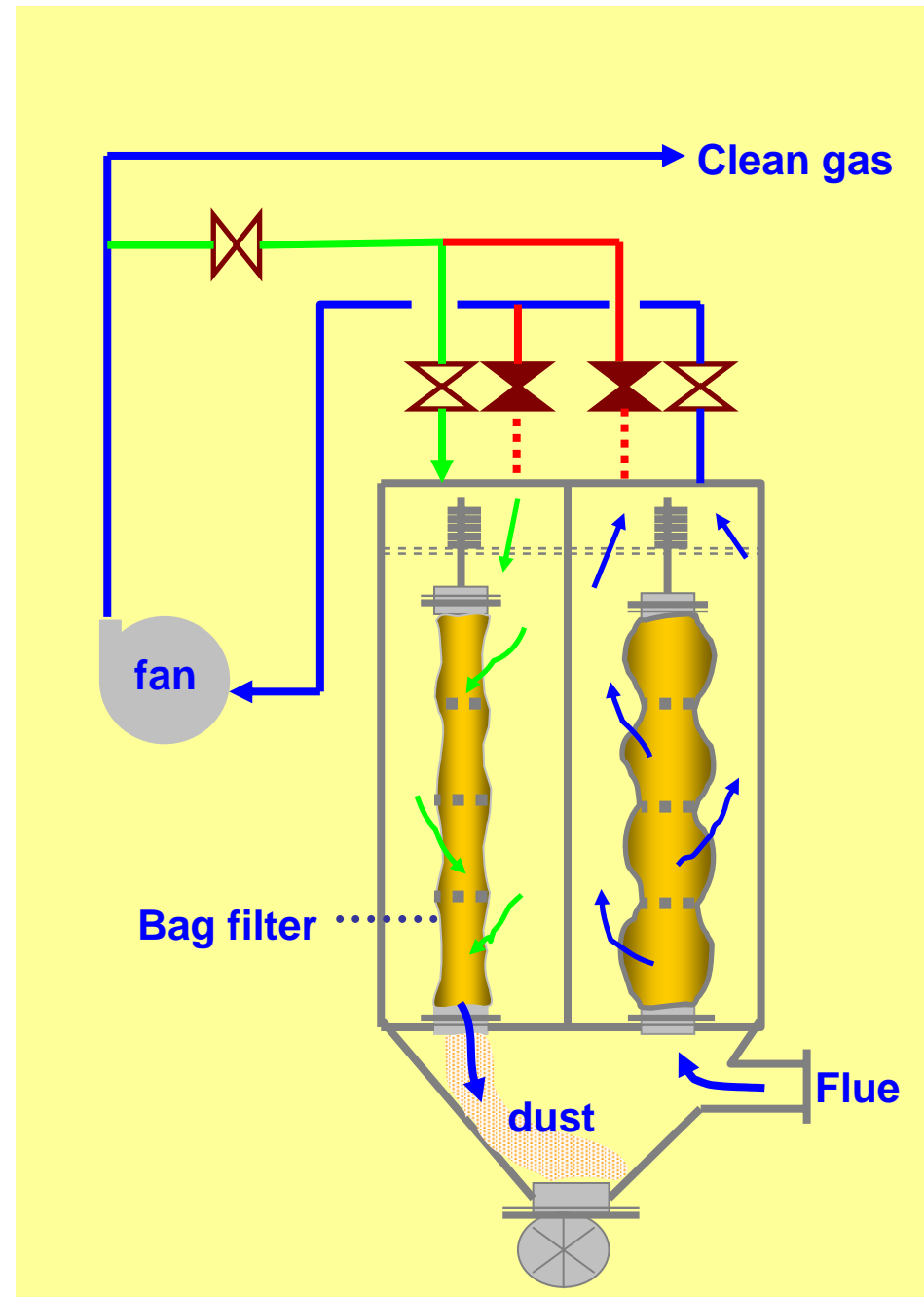


Dusting frequency

- intermittent
- continuous

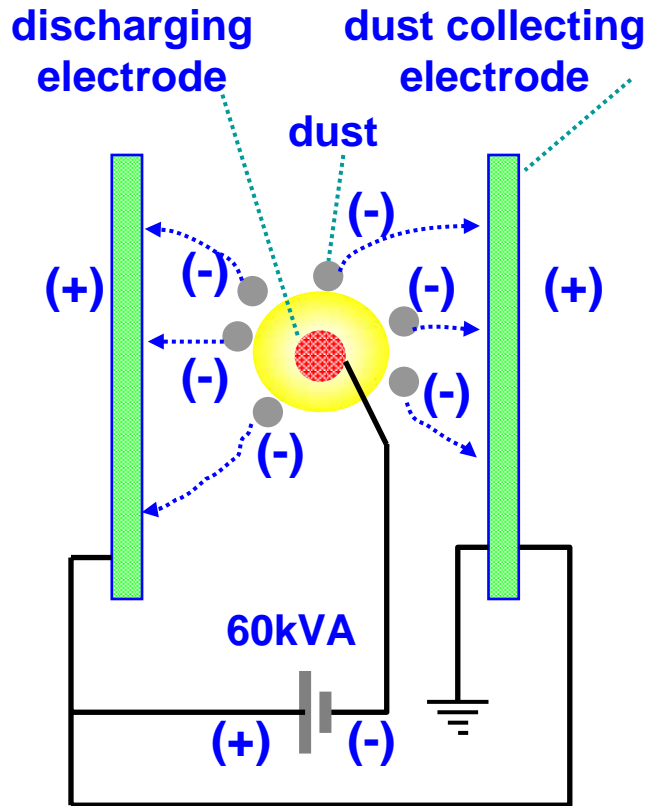
Dusting drive

- vibration
- reverse air



2. Soot & Dust Reduction

2-4 Electrostatic Precipitator



- A: re-scattering
- B: normal
- C: frequent occurring of sparks
- D: counter electric dissociation

Feature

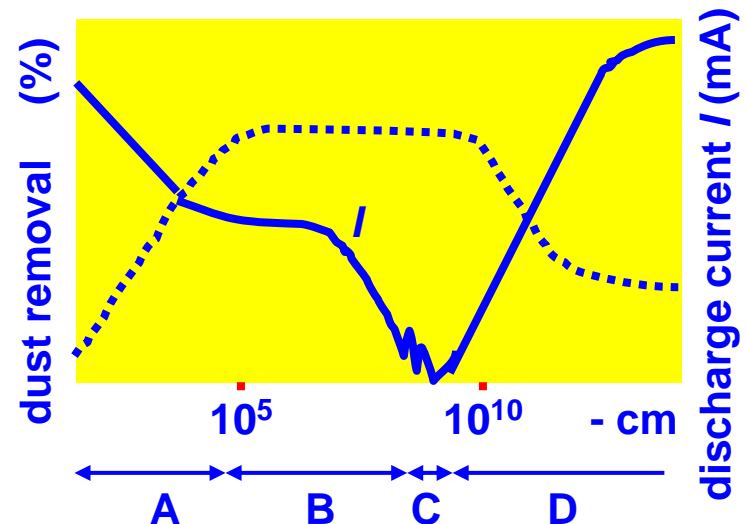
- Less influence of flue gas & dust
- Low pressure loss

Peeling dust from electrode

- Dry EP : hammering impact
- Wet EP: flow down with water film

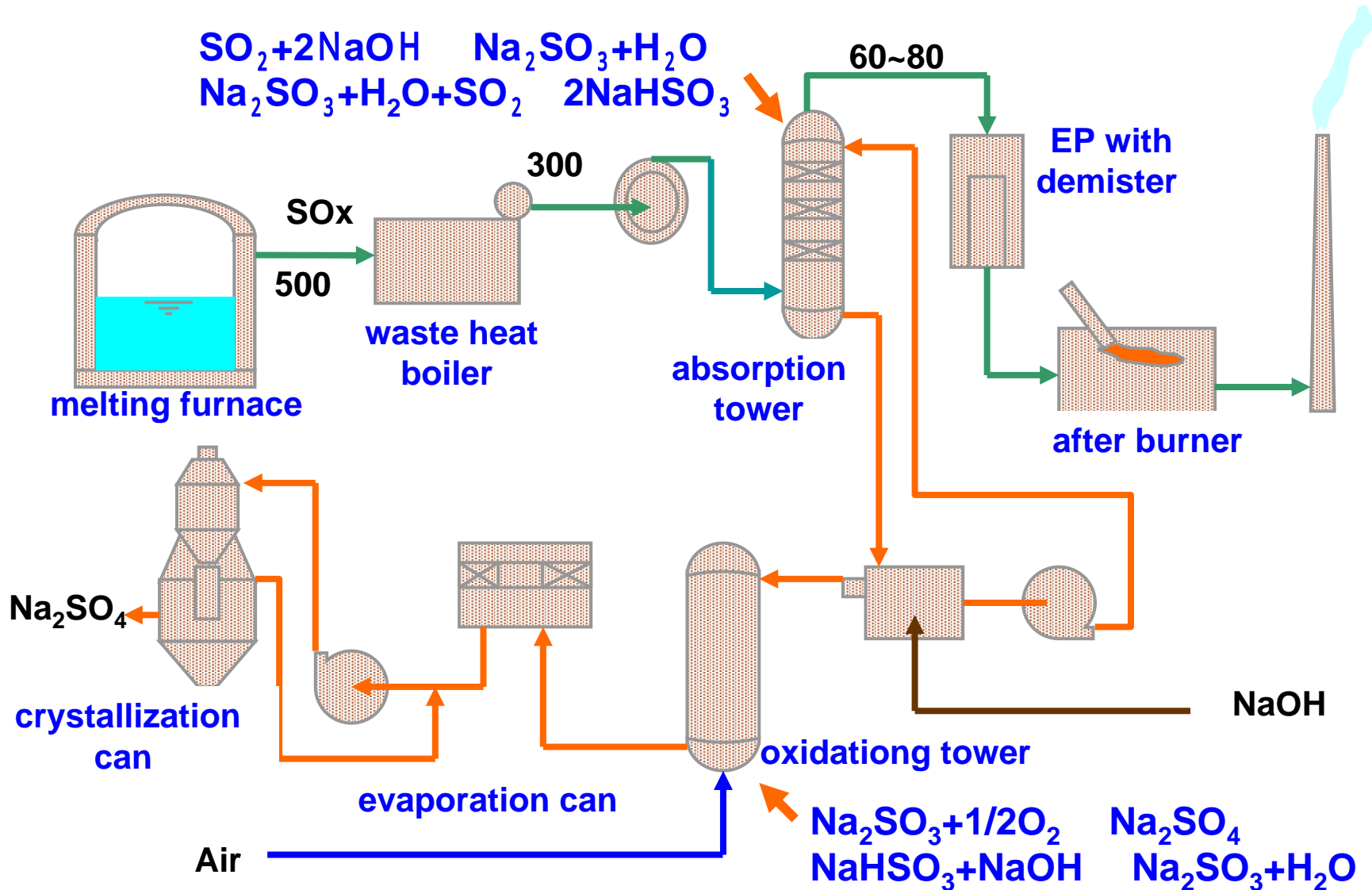
Factors affecting dust collection

- particle size
- temperature, moisture, SO_3 - cm



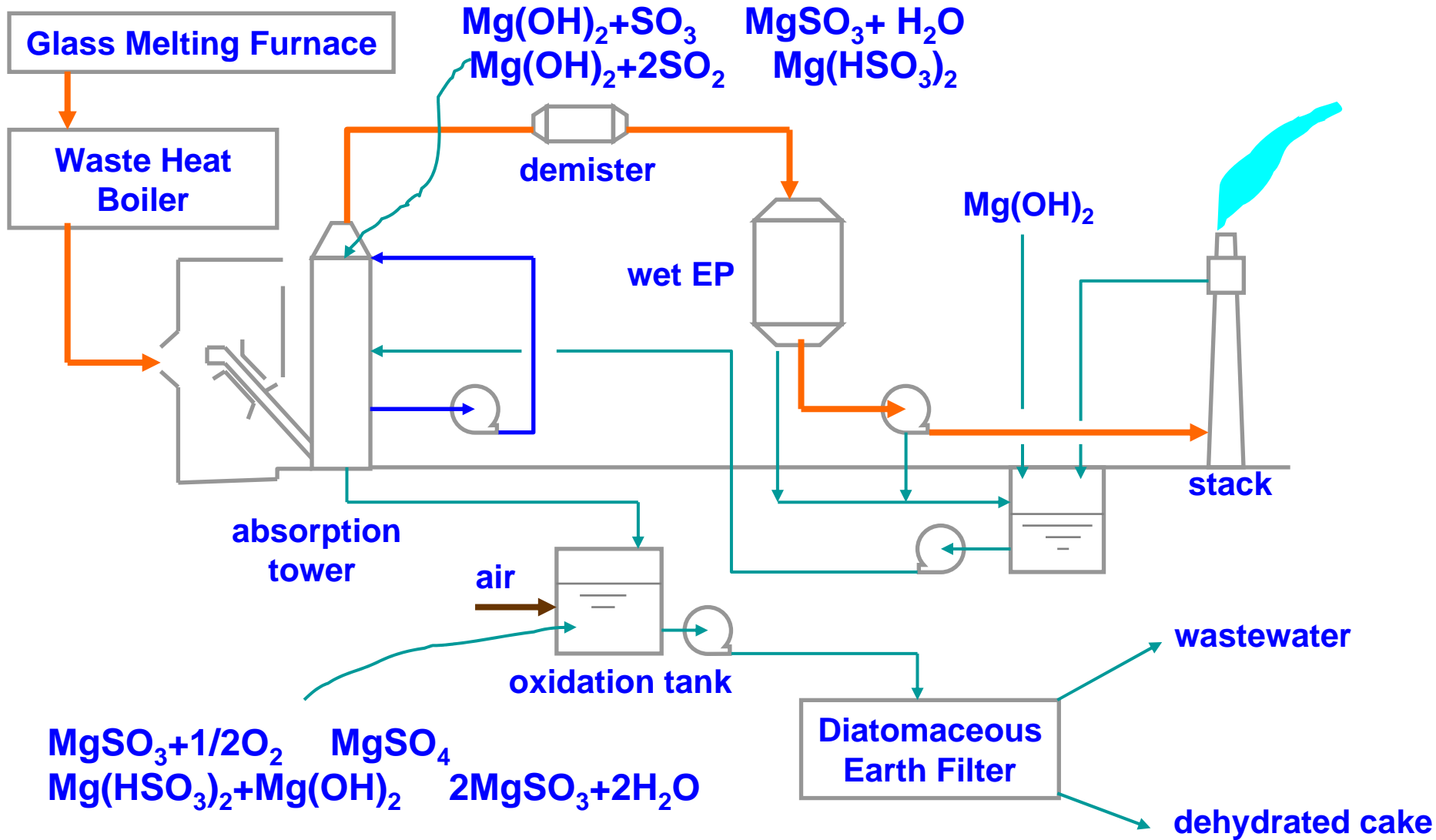
3. SOx Reduction Method

3-1 Desulphurization using Caustic Soda



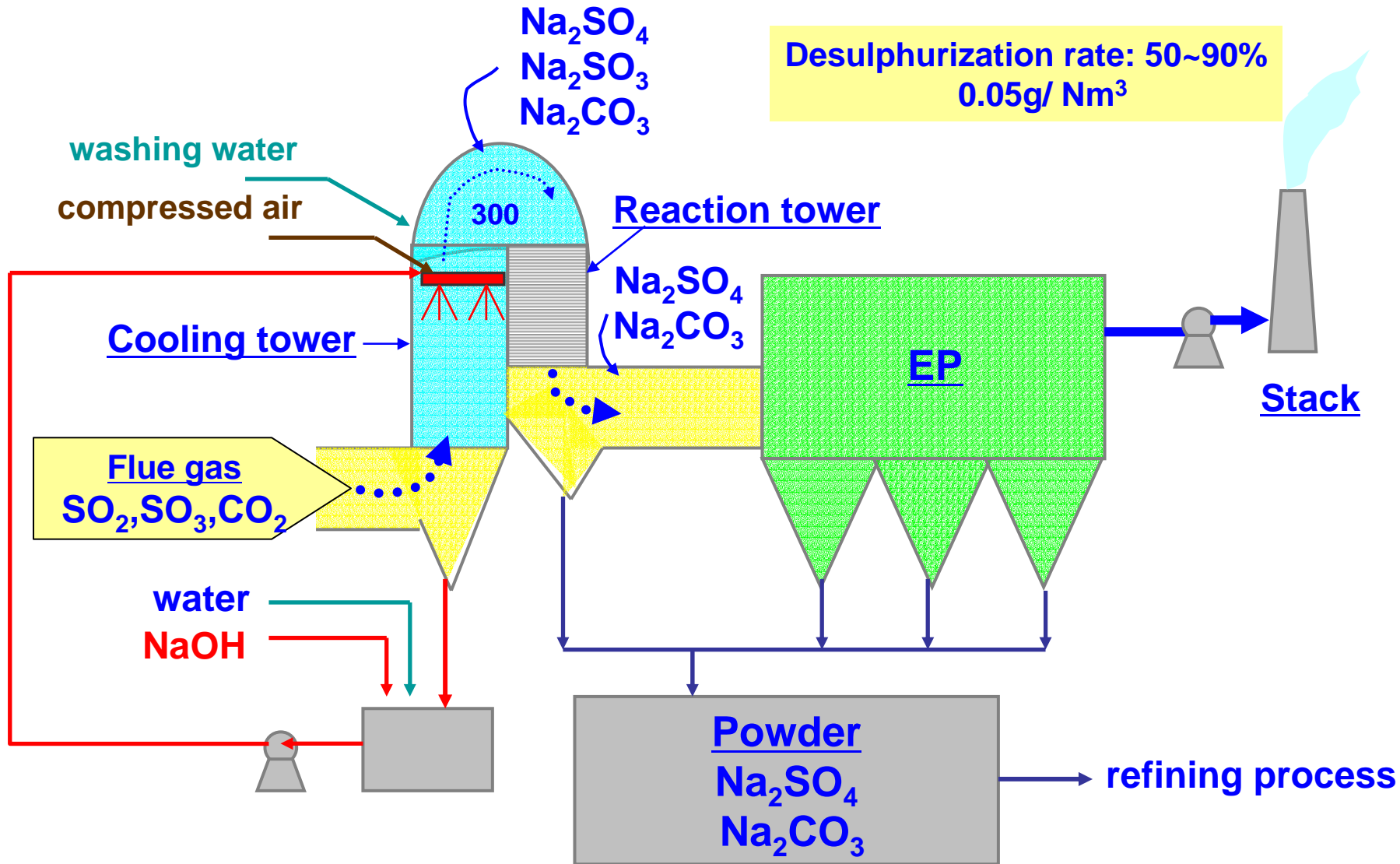
3. SOx Reduction Method

3-2 Desulphurization using Magnesium Hydroxide



3. SOx Reduction Method

3-3 Dry- type Flue Gas Desulphurization



4. NOx Reduction Method

4-2 NOx Reduction Related to Fuel

Furnace temp. 1,500 ~ 1,600

Thermal NOx

Fuel NOx

N in Fuels

Fuel	Nitrogen (wt %)
Coal	0.7 ~ 2.2
C- heavy oil	0.2 ~ 0.4
A- heavy oil	0.005 ~ 0.08
Light oil	0.004 ~ 0.006
Kerosene	0.0005 ~ 0.01
LNG	Tr.
LPG	Tr.

Heating value
Bright flame

Heavy oil > Light gravity oil
Gaseous fuel

Fuel increasing

NOx increasing



Electric energy

resistance heating

JIS K2205 kinematic viscosity (cSt, mm²/s)
C-heavy oil: 50 ~1,000, A-heavy oil: 20

4. NOx Reduction Method

4-3 NOx Reduction by Furnace Operation Method

1. Declining Glass Melting Temp.

- chemical composition ----- melting at lower temp.
- using the largest possible quantity of cullet

2. Lowering Primary Air Pressure

- lowering air pressure for fuel injection

ex. 4 kg /cm² 3 kg /cm² NOx 24 %

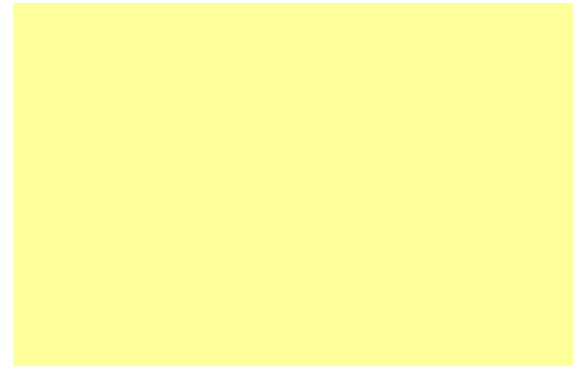
3. Lowering Secondary Air Volume

- decreasing air ratio ex. 1.2 1.1 NOx 25%

4. Lowering Furnace Temp. (Max. Temp.)

- allotting fuel distribution to maintain uniform temp. in furnace
- electric boosting

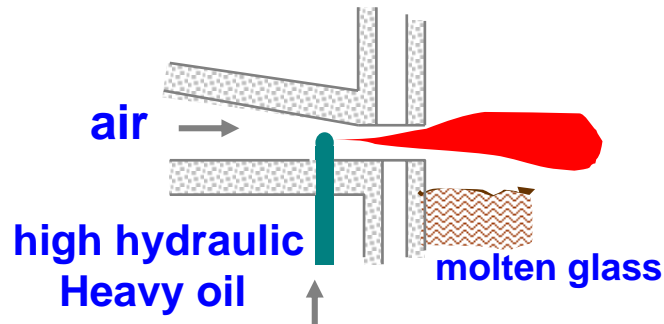
5. Combustion Control Work Standards



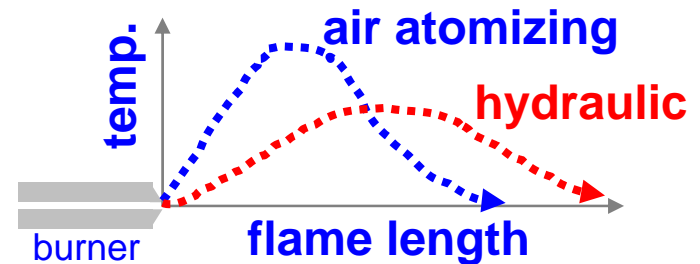
4. NOx Reduction Method

4-4 Using Low NOx Burner

1. Hydraulic burner



Burner	Heavy oil use ratio	NOx conc. ratio
Air atomizing	1.00	1.00
Hydraulic	0.88	0.62



2. Supersonic burner

- Low O₂ combustion ex. Air 170 120 m³/h NOx 25~30%

3. Laidlaw burner

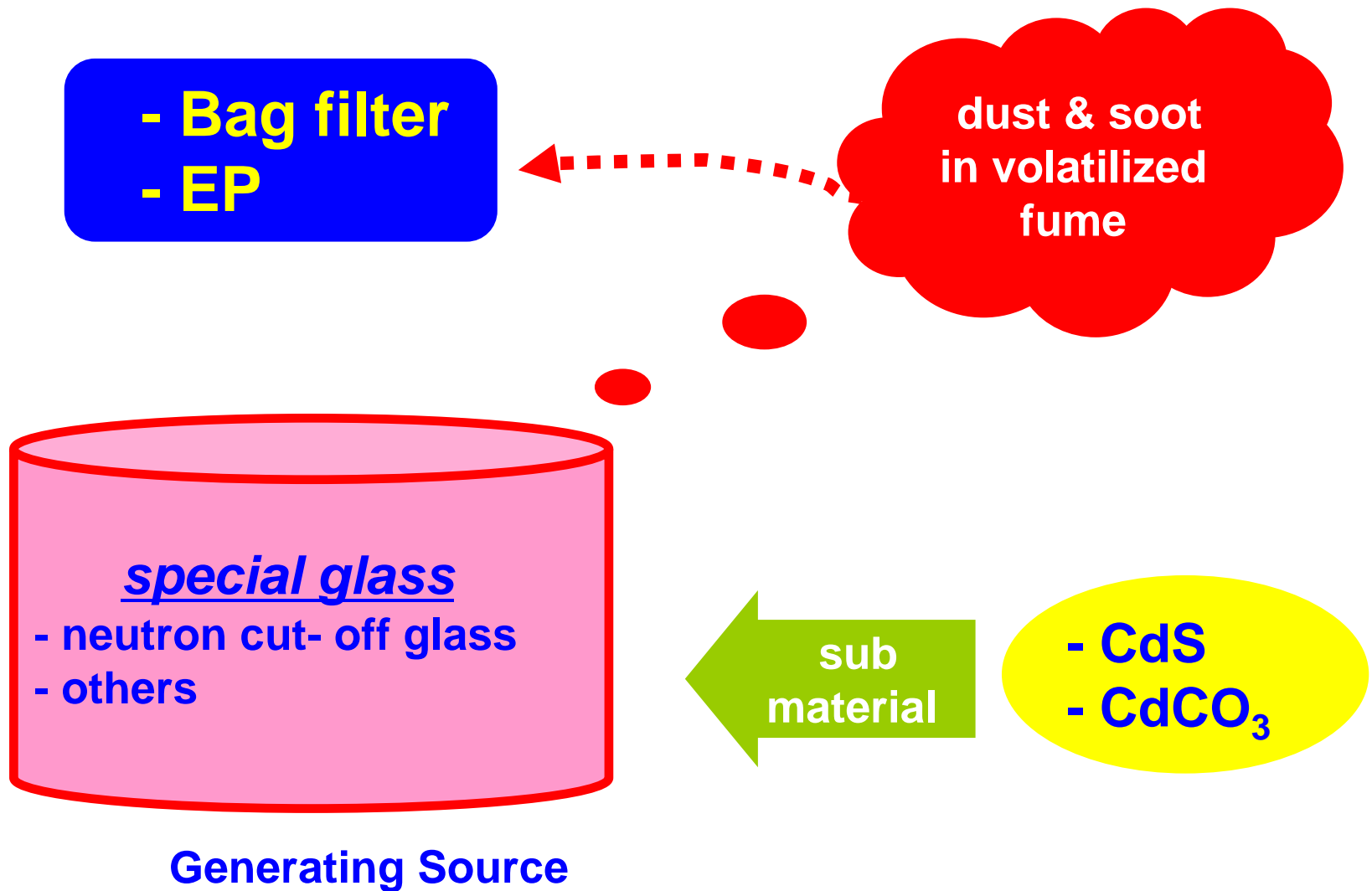
- Primary air: 30~40% less than conventional burner lower NOx

4. Gas atomizing heavy oil burner

- Town gas is used instead of primary air NOx 20~25%

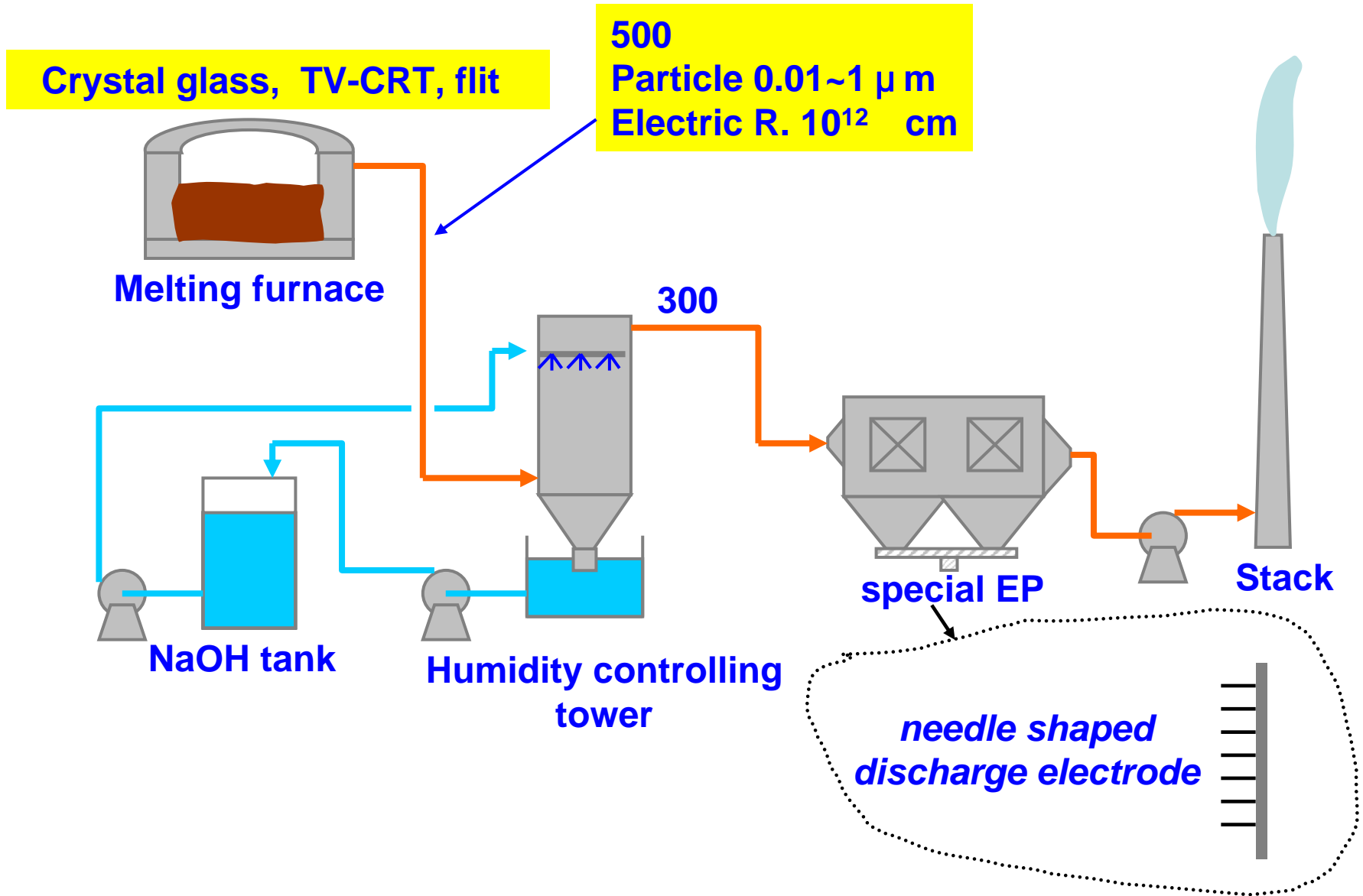
5. Removing Toxic Substances

5-1 Cd & its Compounds



5. Removing Toxic Substances

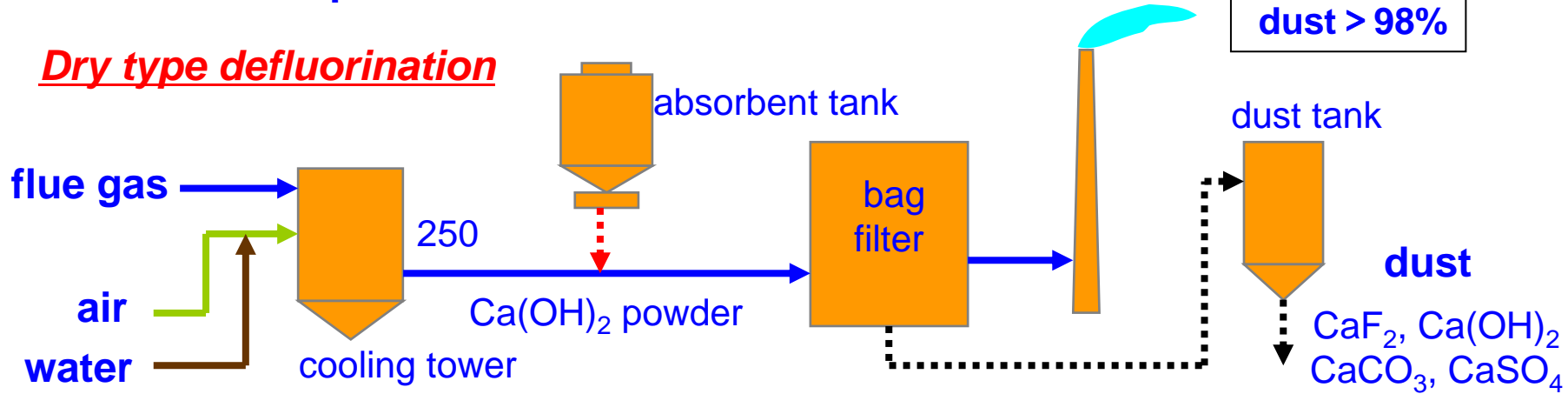
5-2 Pb & its Compounds



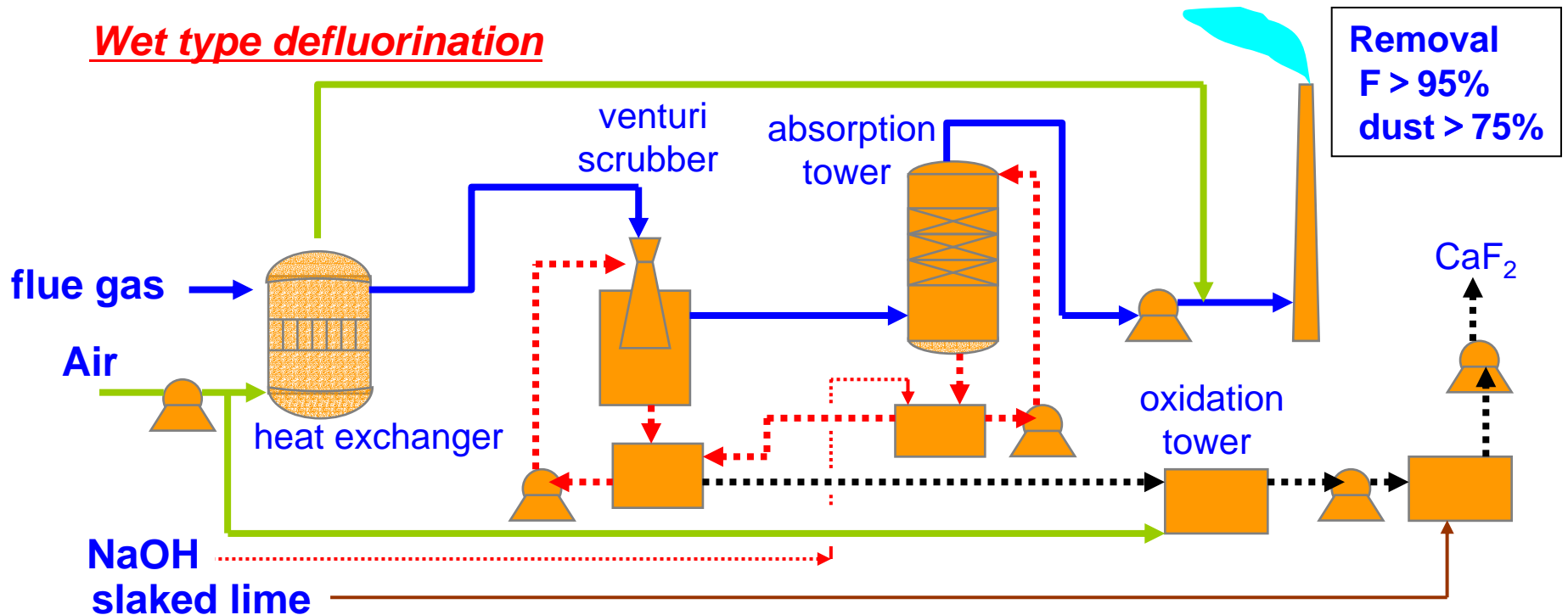
5. Removing Toxic Substances

5-3 F & its Compounds

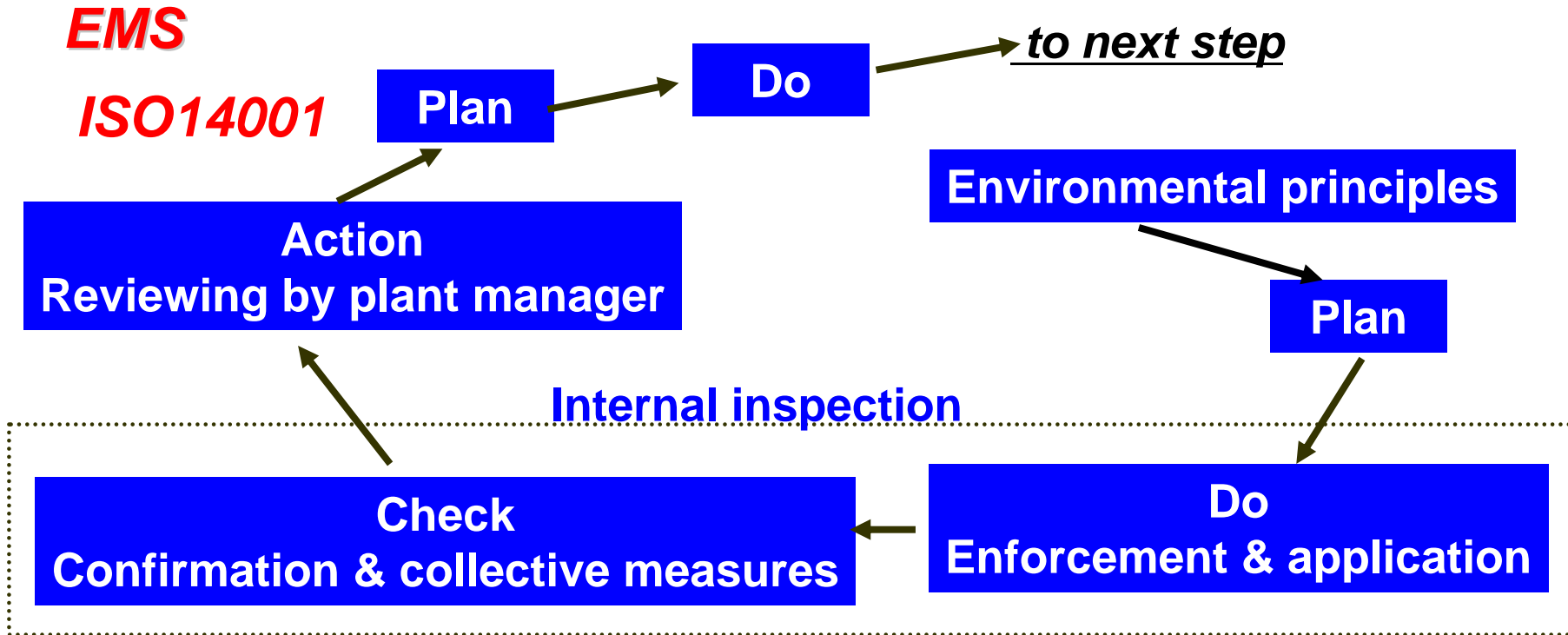
Dry type defluorination



Wet type defluorination



6. Environmental Management System



Items to be considered at factory construction & operation

1. **Environmental impact assessment**
2. **Environmental standards & emission standards**
3. **Planning of plant & air pollution control equipment**
4. **Operation control & worker training**
5. **Environmental monitoring**
6. **Environmental management system**

7. Energy Saving Technology

1. How to promote energy saving

Basic policy Understanding current state Goal Measures

2. Energy saving methods

- *Acceleration of glass melting*
 - *increasing cullet use ratio*
 - *refining of grain of raw material*
 - *moisture control of batch*
 - *improvement of fusibility by glass composition*
- *Combustion*
 - *combustion control*
 - *work standards*
 - *preventing of air intrusion*
 - *improvement & change of burner*
- *Heat insulation & reduction of cooling air*
- *Waste heat recovery*
- *Others*
 - *introduction of cogeneration system & inverter control*
 - *development thinner & lighter glass bottle*
 - *stabilization of production process*