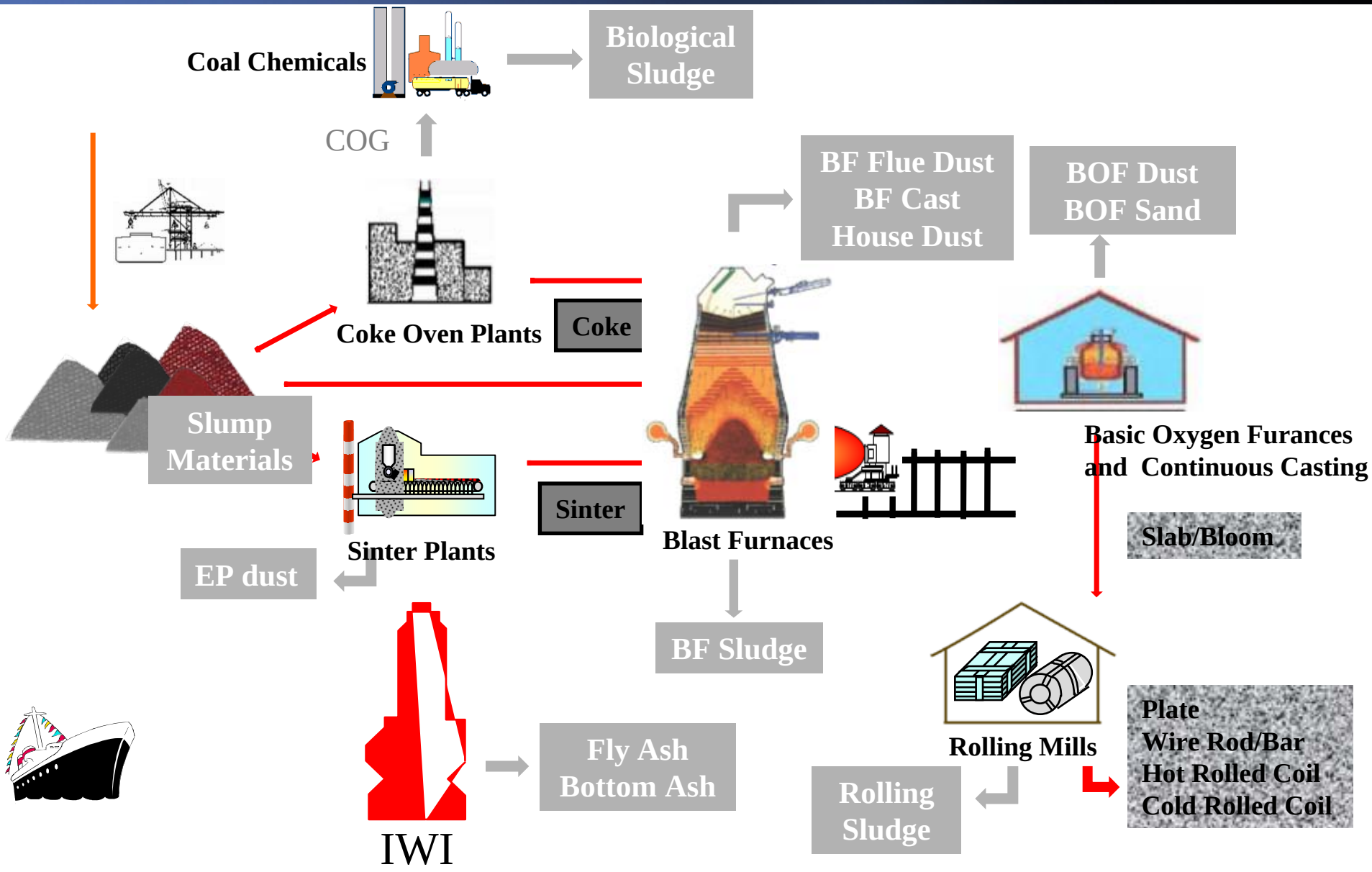
# The MFA Application at CSC

## —The integrated Zinc Control and residual material recycling at CSC

# Outline

- The production and residual materials at CSC
- The improvement of integrated recycling system at CSC
- The rationalization of the existing integrated system by Zn MFA of BF
- The establishment of Rotary Hearth  Furnace

# The production and residual materials at CSC



# The production and residual materials at CSC

## The residual materials at CSC

- **Similar components to the raw material**
  - ✓Reusable property
- **High Zn content of some residual materials**（the dusts and sludges of 0.005～1.30% wt Zn will lead to Zn accumulation in BF during recycle process.）
  - ✓The re-oxidized Zn vapor is easy to cling to falling raw materials deteriorating gas permeability
  - ✓Easy to combine with fine materials to form scaffold resulting damage of hot blasting tuyeres when scaffolds fall down

Maximize the internal reuse of residual materials under Zn control

Integrated Recycling System Inside and Outside CSC

# Integrated Dust and Sludge Recycling System of CSC

BF

BOF Slurry

**Path(1)：**
BOF Slurry
Reuse System

Vacuum Filter

BOF Sludge

Fine Dust

**Path(2)：**
Mini-Pellet Plant

**#3/#4 Sinter Plant**

**Biological Sludge**
**Garbage**
**Cold-Rolling Sludge**
**Wasted Oil & Grease**

**Path(2)：**
IWI

Fly Ash

Bottom Ash

**Path(3)：**
Y-Mix Plant

Coarse Dust, Iron-Oxide Sludge

**#1/#2 Sinter Plant**

**BF flue dust**
**BF Zn-poor Sludge**

**Path(3)：**
X-Mix Plant

Fly Ash

**BF Zn-rich Sludge**

**Hot-Rolling Oily Sludge**

Open Storage Yard

Blending Plant

**Path(4)：**
Raw Material for Cement Plant

**Cold Rolling High –Zn Sludge**

Indoor Storage Yard

**Path(5)：** Sold Overseas
(Raw material for Zn smelting)

**1.Yellow Background materials are sold out-plant**

**2.Fine Dust：Small EP、cast house 、De-s、 BOF 、W11 /W22 Bag house dust etc.**

**3.Coarse Dust：Slump Material、BF Flue Dust、IWI Fly Ash、BOF sand 、Lime Stone Dust etc.**

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# The production and residual materials at CSC

The performance of the system was not satisfactory

—The internal reuse of residual materials is too low in order to reduce the Zn accumulation in BF

↓

**Overload of sludge yards**

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Integrated Zn control need to be improved

# The improvement of integrated recycling system at CSC

- The rationalization of the existing integrated system by Zn MFA of BF
- The establishment of Rotary Hearth Furnace

# The rationalization of the existing integrated system by Zn MFA of BF

**The construction of Zn input and output model**

$$\text{Zn Input} = \sum_{i=1}^{n} [\ \text{Zn (i)} \times \text{Input Rate (i)}\ ]$$

Table 3: Calculation of Zn Inputs for #4 BF and #4 Sinter Plant of CSC.

| Zn inputs for | Input Materials | Input Rate (kg/THM) | Zn Content (%) | Zn Input (gm/THM) | % Contribution |
|---|---|---|---|---|---|
| #4 BF | Coke | 375 | 0.0016 | 6 | 2.9 |
| | Pulverized Coal | 119 | 0.0010 | 1 | 0.5 |
| | Lumpy Ore + Pellets | 380 | 0.0020 | 8 | 3.9 |
| | Fluxes | 4 | 0.0012 | 1 | 0.5 |
| | Sinter | 1,178 | 0.0160 | 188 | 92.2 |
| | **Sub-Total** | 2,056 | ---- | **204** | 100.0 |
| #4 Sinter | BOF Slurry | 14 | 0.415 | 58 | 30.4 |
| | Coke Breeze | 48 | 0.003 | 1 | 0.5 |
| | Fluxes | 68 | 0.005 | 3 | 1.6 |
| | Y-Mix | 64 | 0.058 | 37 | 19.4 |
| | Raw Mix (without BF Return Fine) | 1,211 | 0.004* | 48 | 25.1 |
| | Mini-Pellet | 26 | 0.170 | 44 | 23.0 |
| | **Sub-Total** | 1,431 | ---- | **191**** | 100.0 |

Table 4: Calculation of Zn inputs for Mini-Pellet Plant and Y-Mix Plant of CSC.

| Zn inputs for | Input Materials | Input Rate (kg/THM) | Zn Content (%) | Zn Input (gm/THM) | % Contribution |
|---|---|---|---|---|---|
| Mini-Pellet | BF Flue Dust | 8 | 0.105 | 8 | 18.2 |
| | BF Cast House Dust | 2 | 0.239 | 5 | 11.4 |
| | Hot Metal Pretreatment Dust | 0.4 | 1.111 | 4 | 9.1 |
| | BOF Dust | 1 | 0.698 | 7 | 15.9 |
| | BOF Sludge | 3 | 0.418 | 13 | 29.5 |
| | Zn-Poor BF Sludge | 1.3 | 0.289 | *4* | *9.1* |
| | EP Dust | 10 | 0.033 | 3 | 6.8 |
| | Lime Dust | 1 | 0.005 | ~0 | ~0 |
| | **Subtotal** | 26.7 | --- | **44** | 100.0 |
| Y-Mix | Dried Yard Sludge | 3 | 0.900 | **27** | *73.0* |
| | Slump Materials etc | 64 | --- | 10 | 27.0 |
| | **Subtotal** | 67 | --- | **37** | 100.0 |

# The rationalization of the existing integrated system by Zn MFA of BF

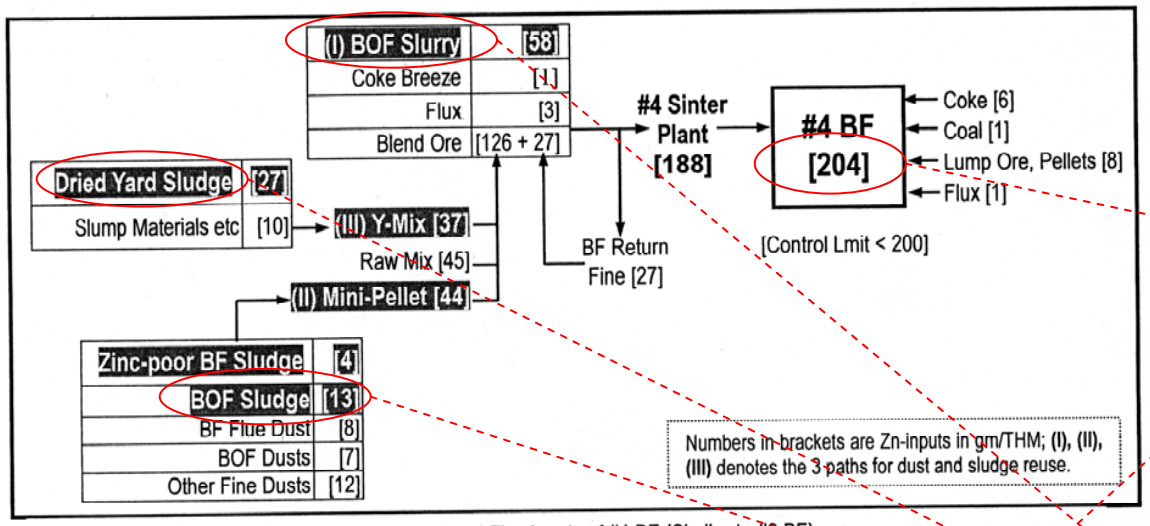



**Figure 2**: Calculated Zinc Inputs of #4 BF (Similar to #3 BF).

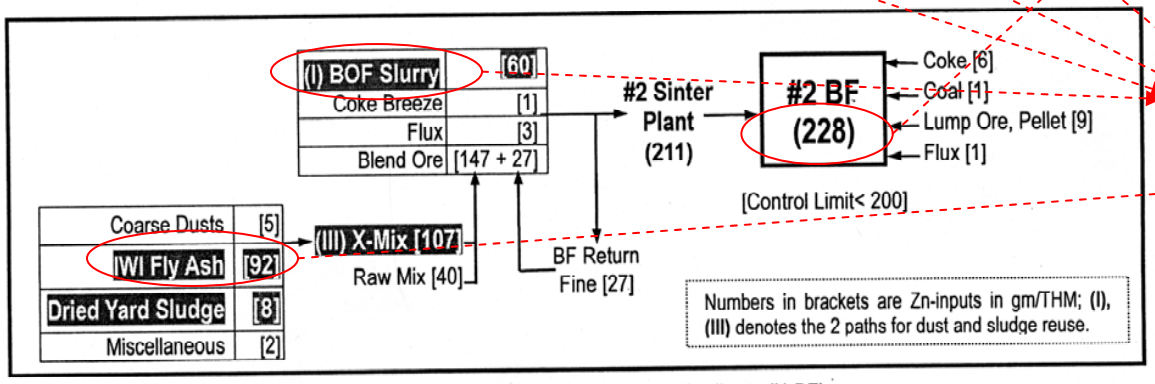



**Figure 3**: Calculated Zinc Inputs of #2 BF (Similar to #1 BF).

The Zn input of #2 and #4 BF were both over the control level, 200 gm/THM

The Zn input from BOF slurry and IWI fly ash was so high that the yard sludge was barely reused

# The rationalization of the existing integrated system by Zn MFA of BF

## Major Action to increase sludge reusing rate under Zn control

- Quality control of the scraps in BOF
- Analyze Zn content frequently to control BOF slurry reusing rate
- Reduce the Zn content of cold rolling sludge by separating high Zn cold rolling water

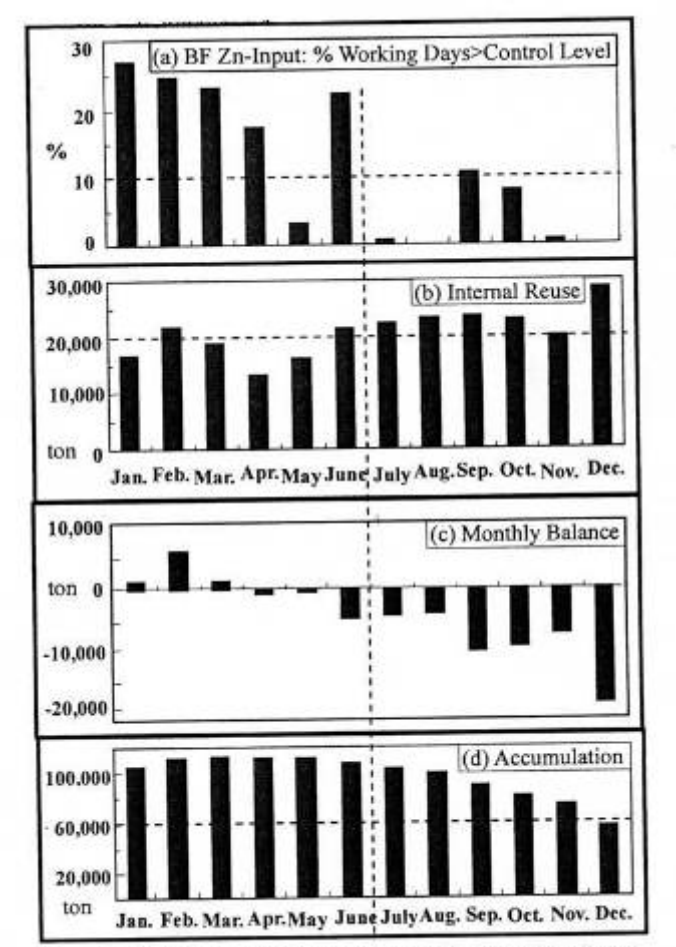
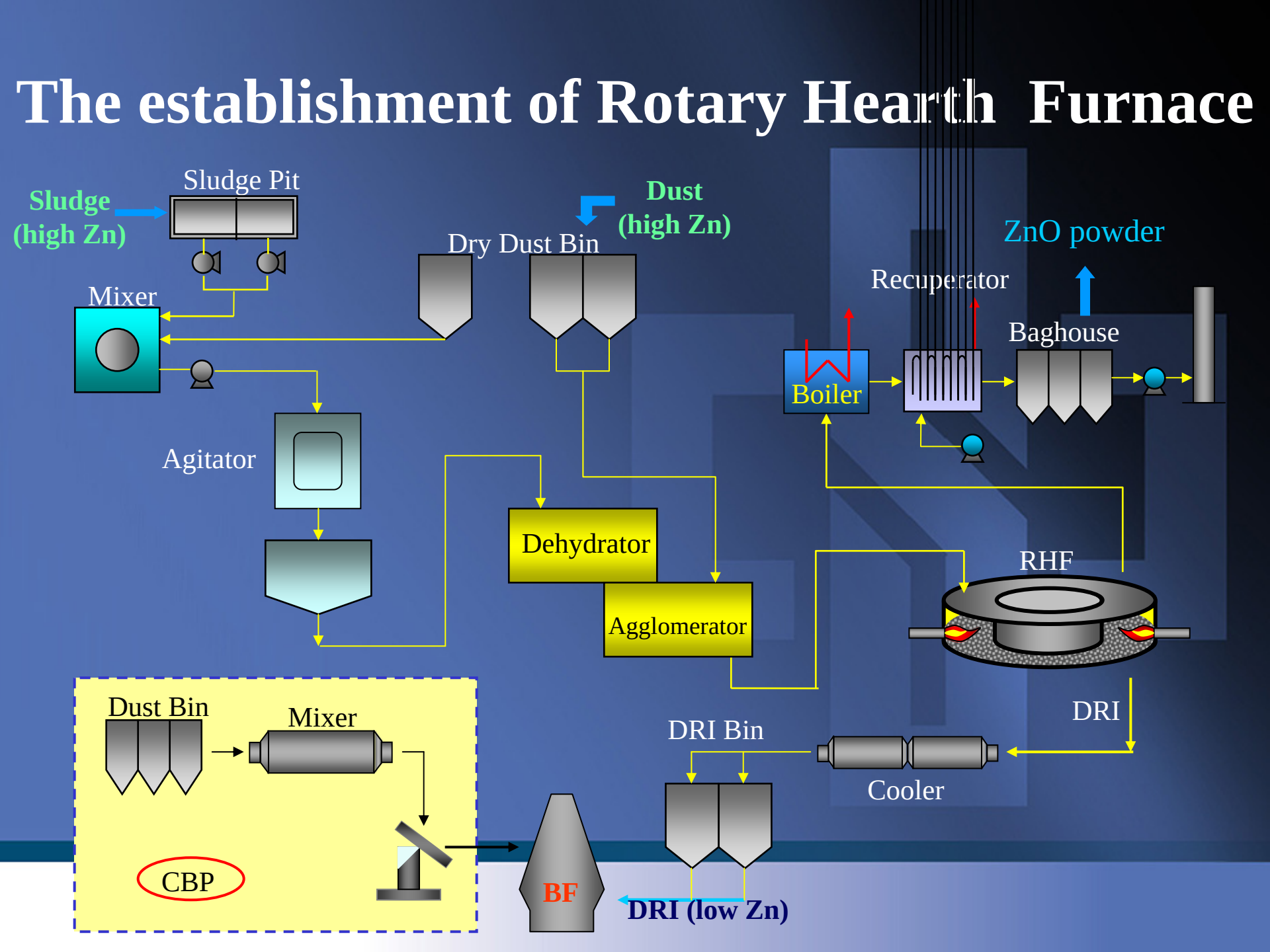



**Figure 4**: (a)% Working Days that BF Zn-Input Was Over Control Level, (b)Internal Reuse,(c)Monthly Balance, (d)Accumulation of Sludge in 2000.

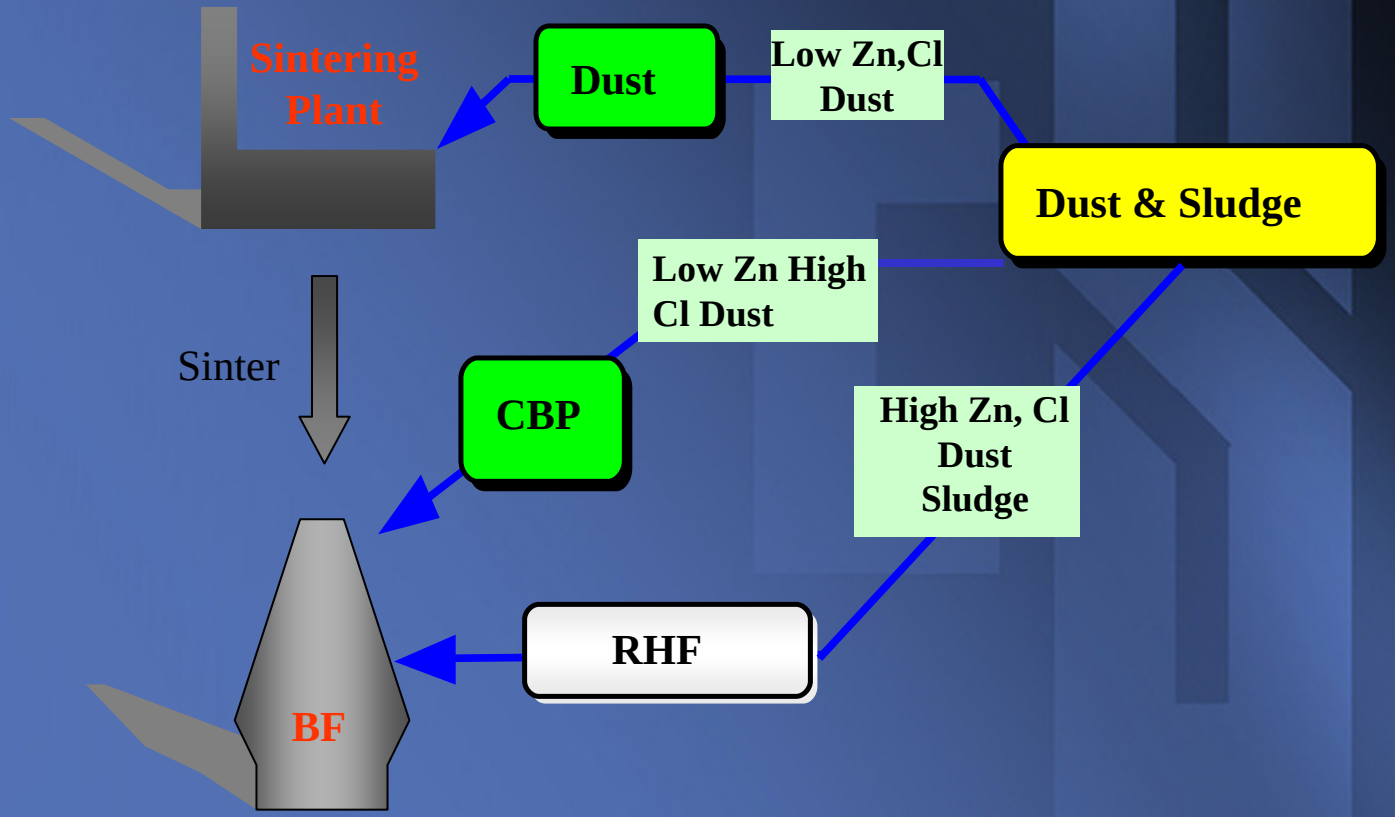
# Calculation of Zn input for #4 BF and #4 Sinter Plant of CSC 2008

| Zn inputs for | Input Materials | Input Rate（kg/THM） | Zn Content（%） | Zn Input（gm/THM） | %Contribution |
|---|---|---|---|---|---|
| **# 4 BF** | Coke | 783 | 0.0016 | 12.5 | 7.7 |
| | Pulverized Coal | 152 | 0.0010 | 1.5 | 0.9 |
| | Lumpy Ore＋Pellets | 432 | 0.0020 | 8.6 | 5.3 |
| | Fluxes | 11 | 0.0012 | 0.1 | 0.1 |
| | Sinter | 1173 | 0.012 | **141** | **86** |
| | Sub-Total | 2551 | —— | 164 | 100.0 |

# The establishment of Rotary Hearth Furnace



# The establishment of Rotary Hearth Furnace



# Integrated Dust and Sludge Recycling System of CSC after RMTP

BOF Slurry

Vacuum Filter

BOF Sludge

Fine Dust

**Path(1)：** BOF Slurry Reuse System

**Path(2)：** Mini-Pellet Plant

**#3/#4 Sinter Plant**

**#1/#2 Sinter Plant**

**Biological Sludge**
**Garbage**
**Cold-Rolling Sludge**
**Wasted Oil & Grease**

IWI

Fly Ash

**Path(3)：** Y-Mix Plant

Coarse Dust

**Bottom Ash**

**BOF dust**
**Oil-Rich Mill Scale**
**Cold-Rolling Sludge**

**Path(4)：** RHF

BF

**Path(5)：** CBP

Big EP dust

BF flue dust

**BF/BOF Sludge**
**Hot-Rolling Oily Sludge**

Open Storage Yard

Blending Plant

Fly Ash

**Path(6)：** Raw Material for Cement Plant

**Cold Rolling**
**High –Zn Sludge**

Indoor Storage Yard

**Path(7)：** Sold Overseas (Raw material for Zn smelting)

1.Blue Background materials are sludges and dusts which previously treated in X、Y and mini-pellet plant.

2.Fine Dust：Small EP、cast house 、De-S 、Stock house 、 W11 / W22 Bag House dust etc.

3.Coarse Dust： Slump Material 、 BOF sand 、Lime Stone Dust etc.

# The establishment of Rotary Hearth Furnace

| Design Recipe of RHF Feedstock | | | | | | |
|---|---|---|---|---|---|---|
| Residual Materials | Annual Yield (T/Y) Dry Base | Annual Yield (T/Y) Wet Base | Yield proportion (%)Dry Base | Yield proportion (%)Wet Base | Zn Content(%) | Zn Content(T/Y) |
| BOF Dust | 4200 | 4200 | 3.3 | 2.4 | 0.93 | 39 |
| BOF Slurry | 21970 | 33800 | 17.1 | 19.6 | 0.316 | 106.8 |
| BF Flue Dust | 3426.06 | 3938 | 2.7 | 2.3 | 0.15 | 5.9 |
| IWI Fly- Ash | 5500 | 5500 | 4.3 | 3.2 | 0.54 | 29.7 |
| BF Hi-Zn Sludge | 11832.6 | 18204 | 9.2 | 10.5 | 1.07 | 194.8 |
| BF Sludge | 24669 | 32892 | 19.1 | 19.1 | 1.26 | 414.4 |
| Oily Mill Scale | 17460 | 18000 | 13.6 | 10.4 | 0.008 | 1.4 |
| Oily DW Sludge | 37125 | 49500 | 28.8 | 28.7 | 0.06 | 29.7 |
| Cold-Rolling Sludge | 2640 | 6600 | 2 | 3.8 | 0.641 | 42.3 |
| Total | 128822.66 | 172634 | 100 | 100 | —— | 864.1 |

- Separate Zn from residual materials
- Enhance internal reuse of residual materials
- Reduce the cost of external sludge treatment

# Conclusion

- The improvement of integrated recycling system of CSC can be achieved by the rationalization of the integrated system via Zn MFA and RHF establishment.
- The rationalization process showed significant improvements of Zn level control and internal residual materials reuse.
- The RHF provided a vision of enhancement of internal residual materials reuse and cost reduction of external sludge treatment.

Thanks for your attention !