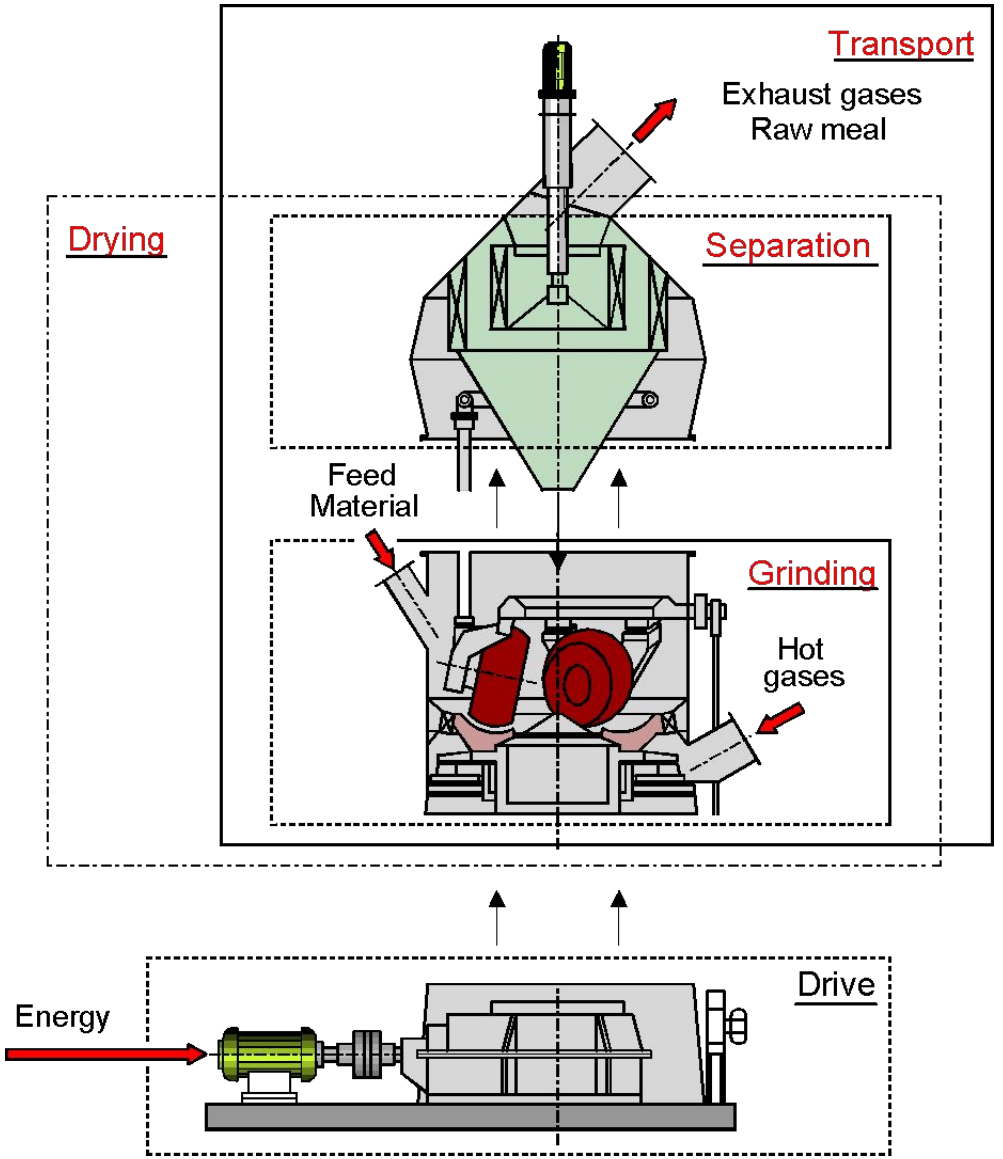
CEMENT PRODUCTION PROCESS

ROLLER MILL

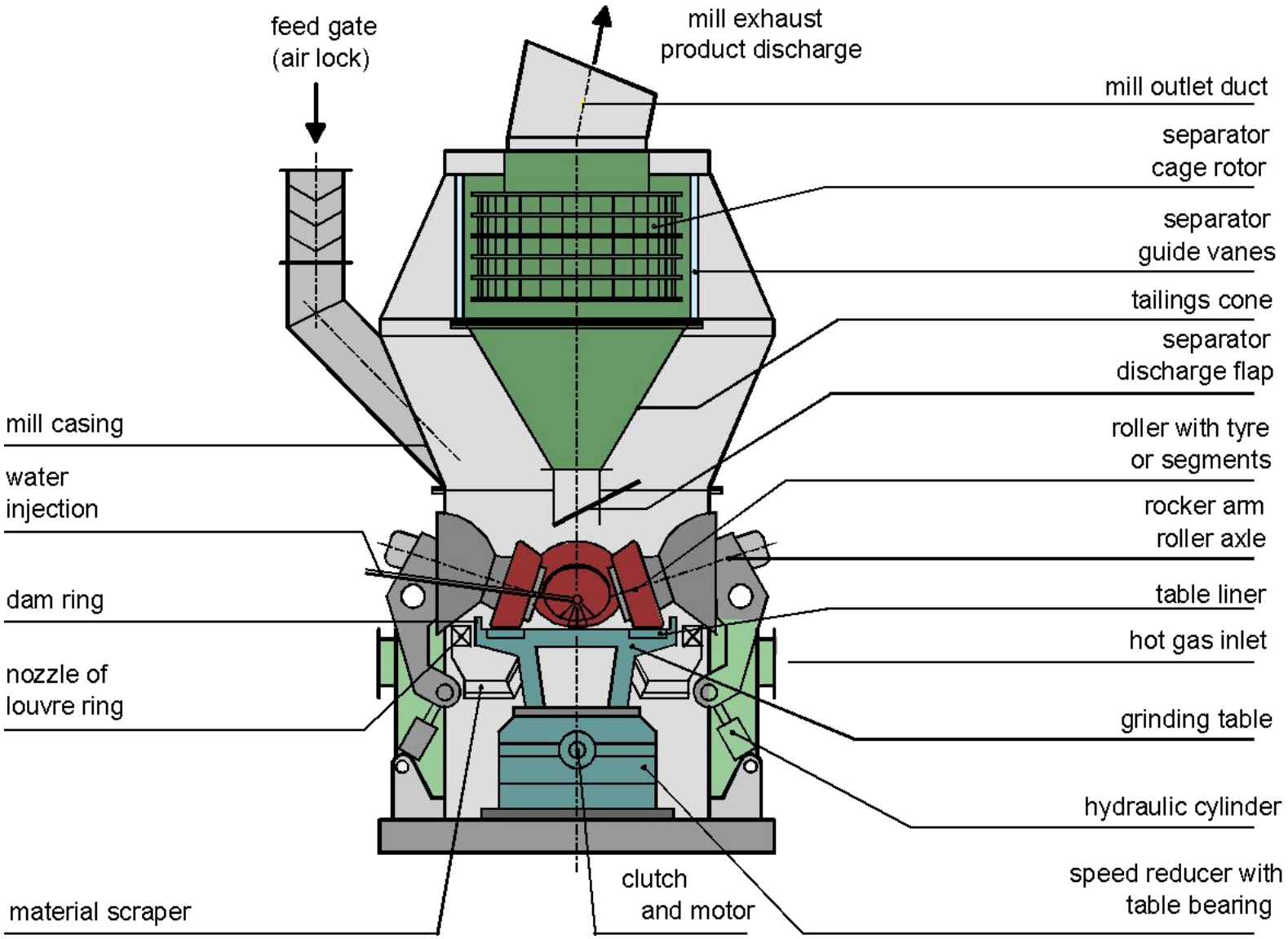
ROLLER MILL

Vertical Roller Mill (VRM) - 3 Sections

1. Separation →
2. Grinding →
3. Drive →



Vertical Roller Mill (VRM) - Details

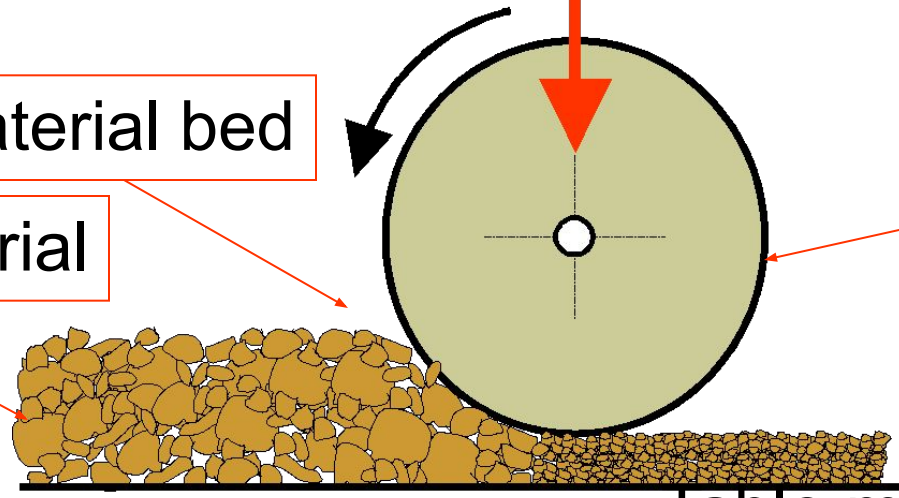


VRM - Working principle

Vertical roller mill

Grinding force =

Roller weight + (pressure) Force



Material bed

Feed material

Roller rolls freely with table

Table moves with drive

Max Particle size in feed: 5-8 % of roller diameter

Feed size:

f (Roller ø)

VRM - Material Flow inside

Separator:

removes fine material

rejects coarse material

Gas & Product Material

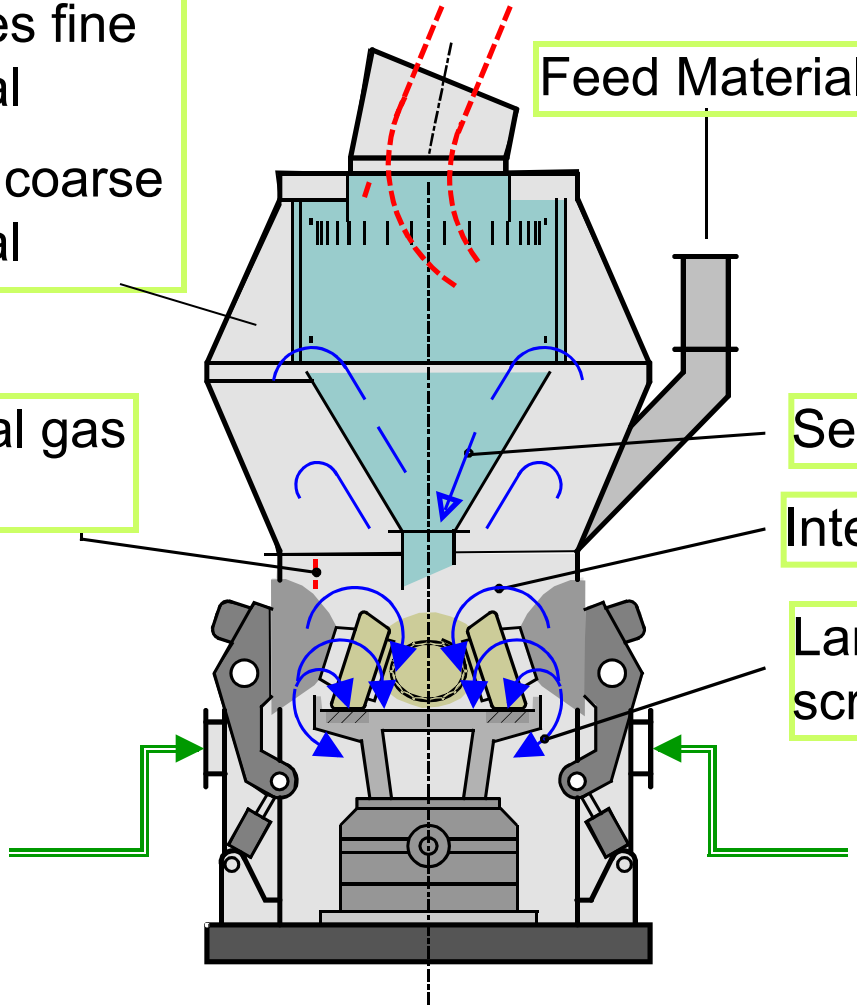
Feed Material

Internal gas flow

Separator Rejects

Internal Circulation

Large Material falls through to scraper



Materia

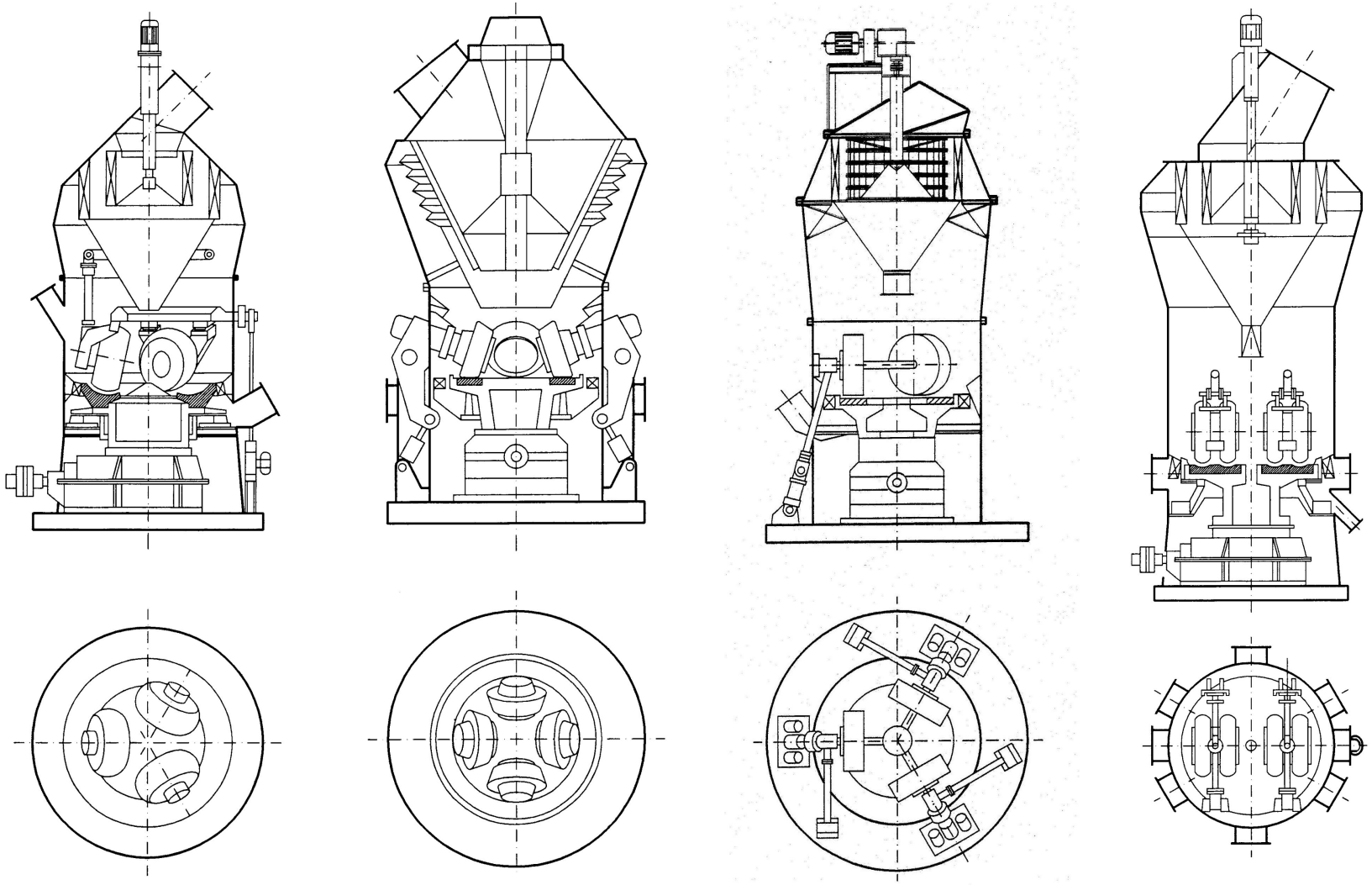
Material &

Gas

Ga

s

VRM - Some Common Mill Configurations



G.Pfeiffer

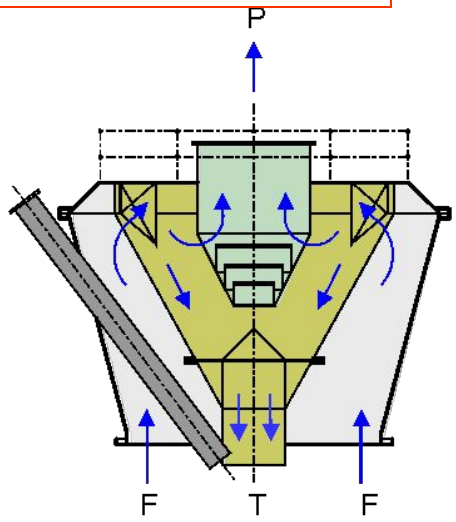
Loesche

FLS Atox

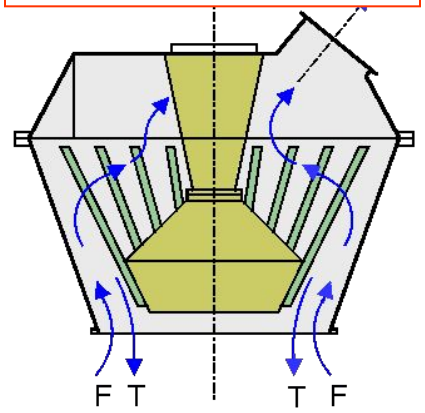
Polysius

VRM - Built-in Separator

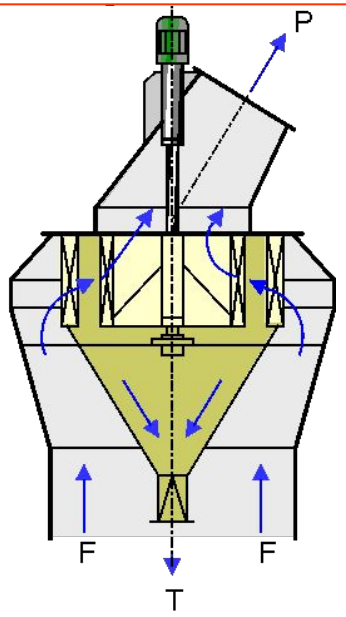
Static type



Conventional Rotor type

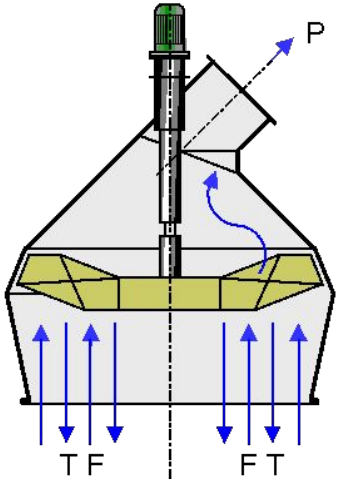


Cage Rotor type



Separation control:

1. Vane adjustment
2. Speed control



F = Feed

P = Product

T = Tailings

Separators of 3rd Generation

(Vertical roller mill)

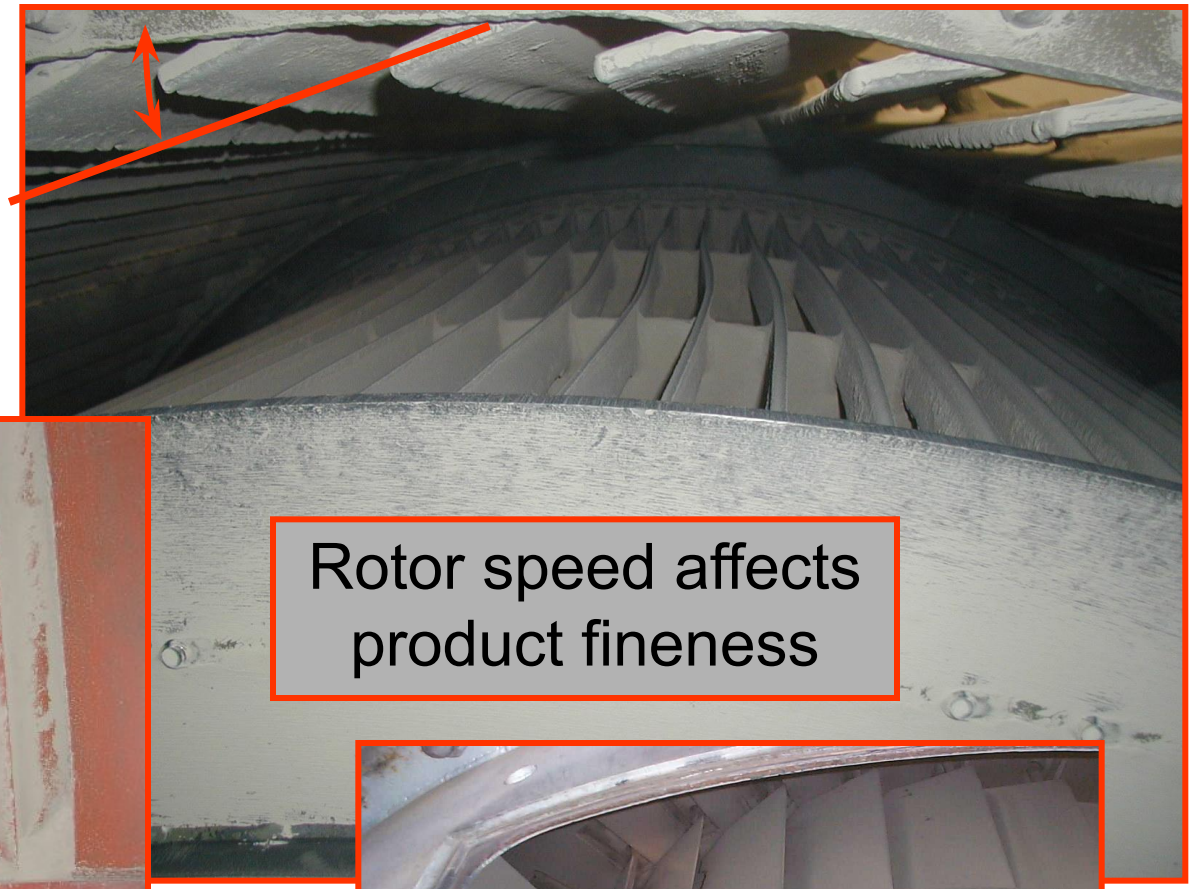
Reject cone

Cage rotor

Guide vane system

VRM - Separator Fotos

Angle affects product sizing



Rotor speed affects product fineness

Rotor seal affects separator efficiency

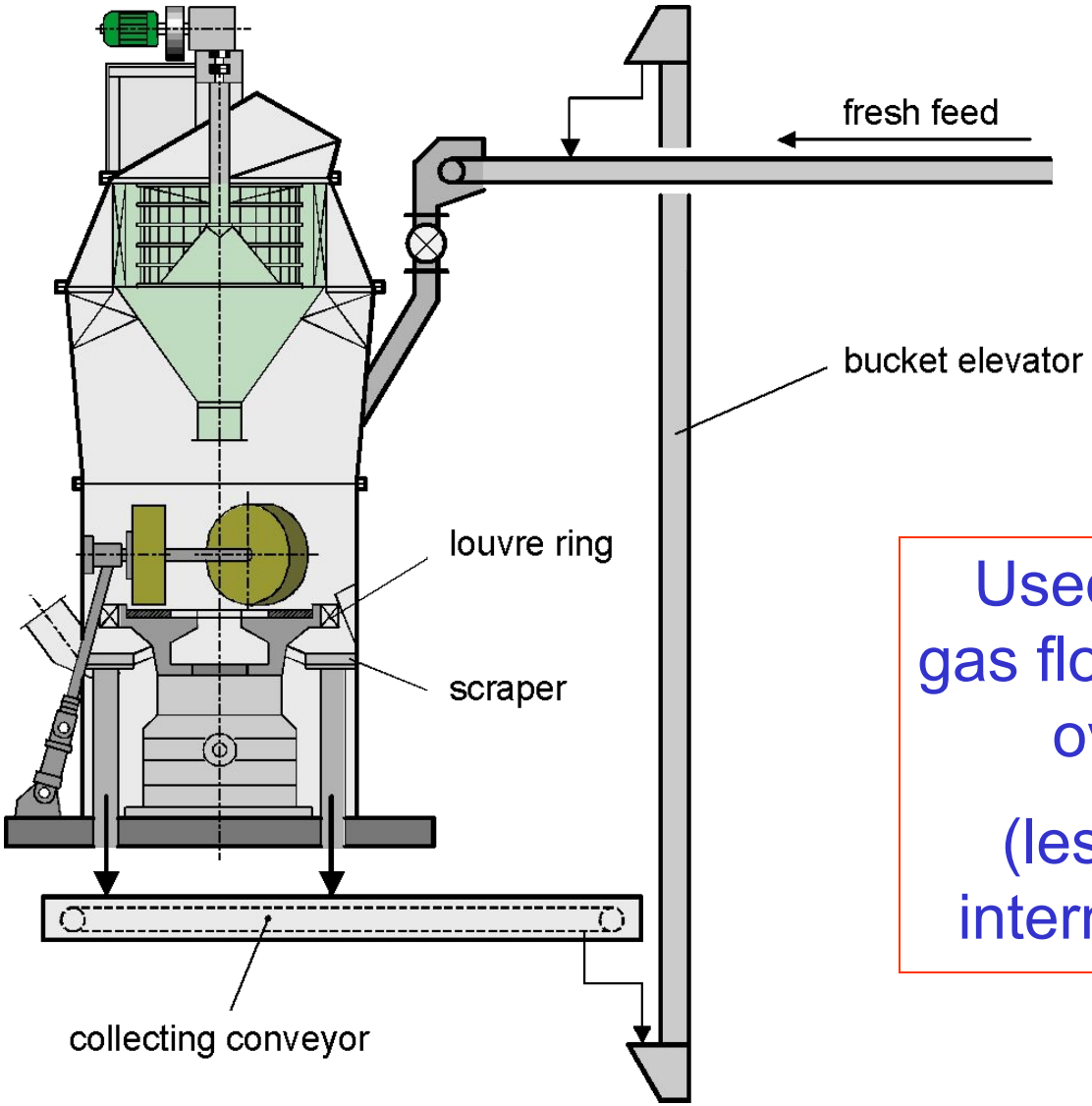
Potential Problems/clogging

Cage rotor separator casing

partly clogged guide vane system

Material deposits due to insufficient airflow or airflow distribution

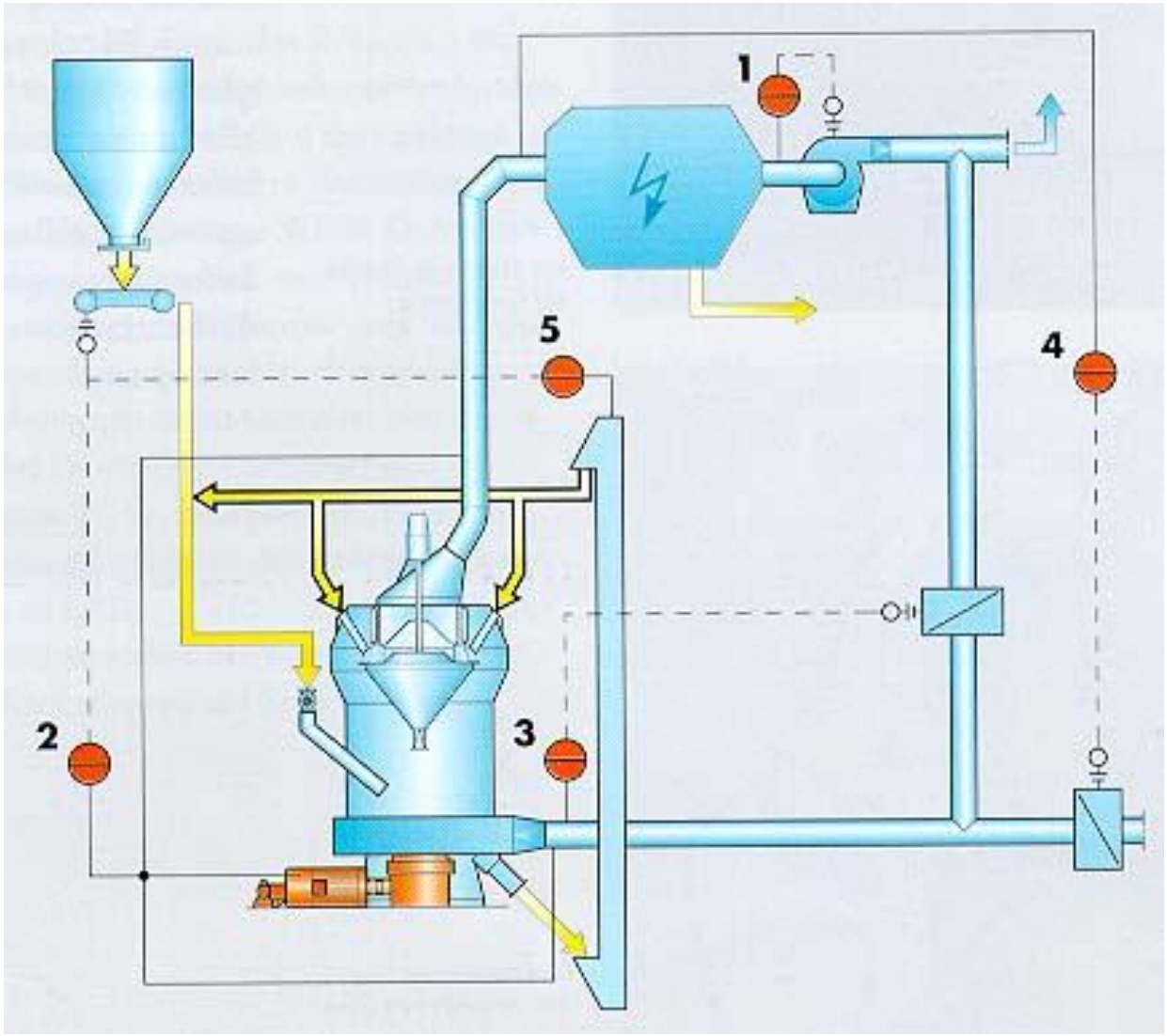
VRM - External Circulation



Used for reducing gas flow pressure lost over the mill

(less pneumatic internal circulation)

VRM - Example flow-sheet



Control points

1 gas flow

2 pressure difference

3 return gas flow pressure

4 outlet temperature

5 external recirculation

VRM - Control & Maintenance

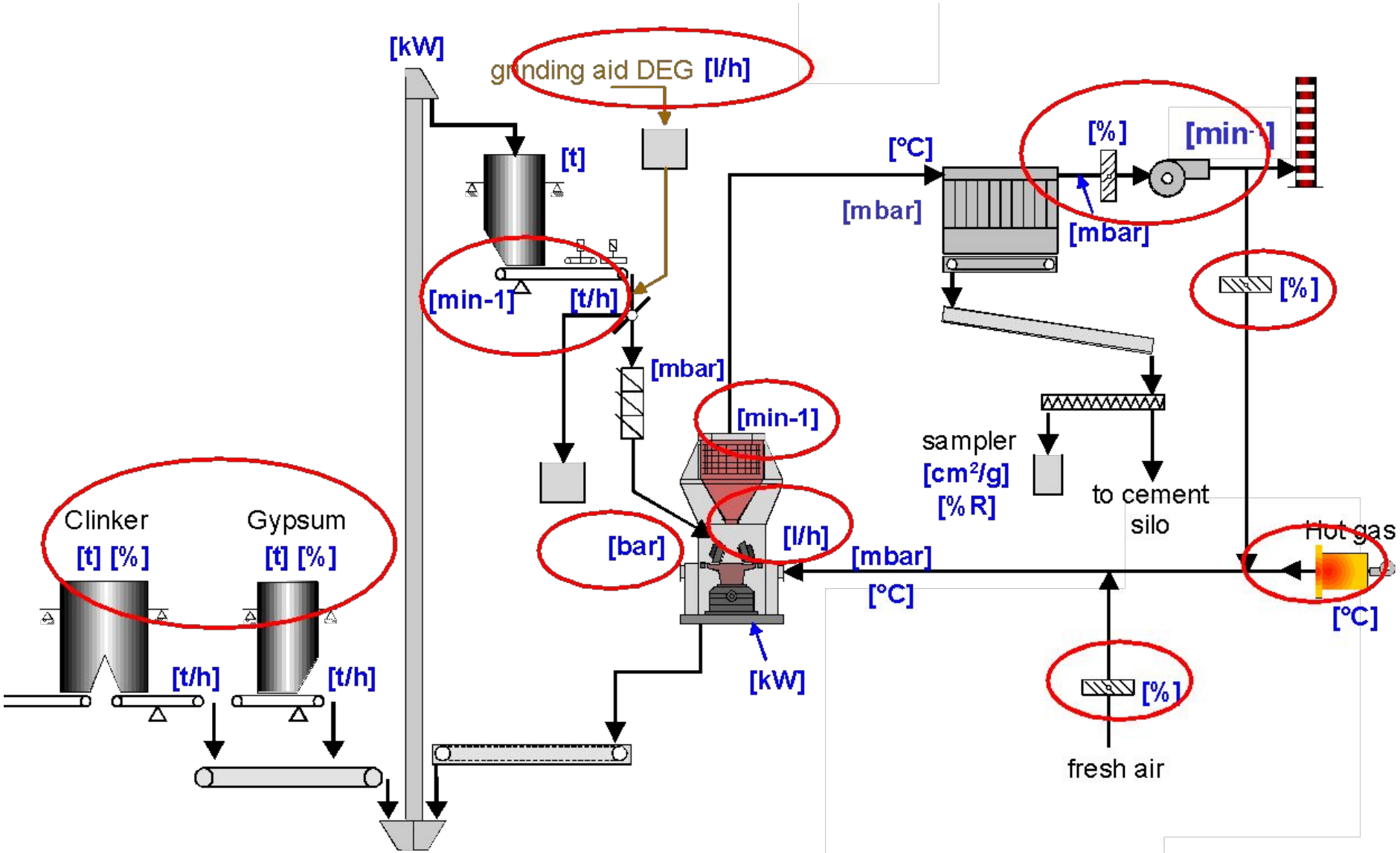
Control

- Gearbox - Vibration monitor
  - Temperature monitor
- Gas flow - Temperatures & pressures
- Hydraulics - Pressures

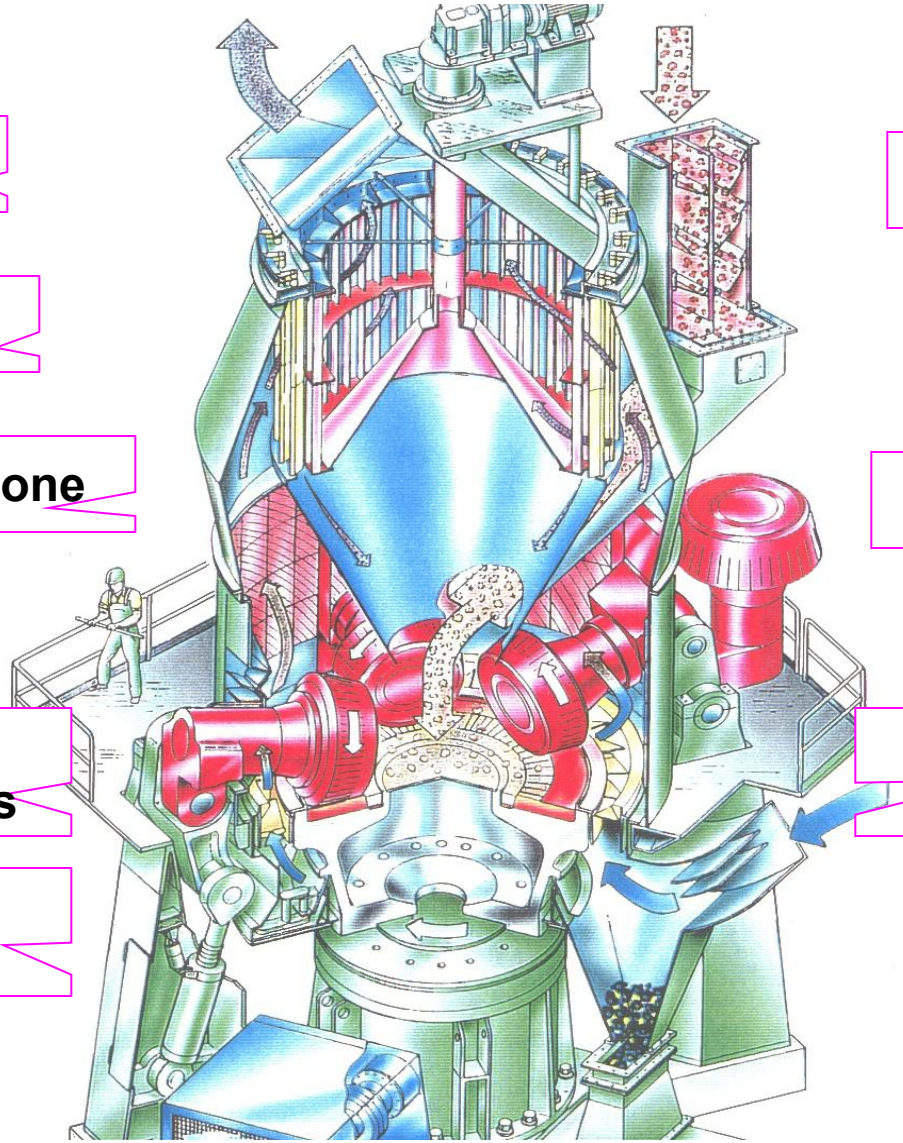
Maintenance

- Wear - Rollers & Table
  - Separator (sealing!) & Housing
- Lubrication & Hydraulics (filters and seals)

VRM - Control


[kW]
grinding aid DEG [l/h]
[t]
[min-1]
[t/h]
[mbar]
[°C]
[mbar]
[%]
[min-1]
[mbar]
[%]
[min-1]
[bar]
[l/h]
[mbar]
[°C]
[kW]
sampler
[cm²/g]
[% R]
to cement silo
Hot gas
[°C]
Clinker
[t] [%]
Gypsum
[t] [%]
[t/h]
[t/h]
[%]
fresh air

Vertical roller mill internals suffering from wear



Outlet duct

Separator

Separator cone

Armour & nozzle rings

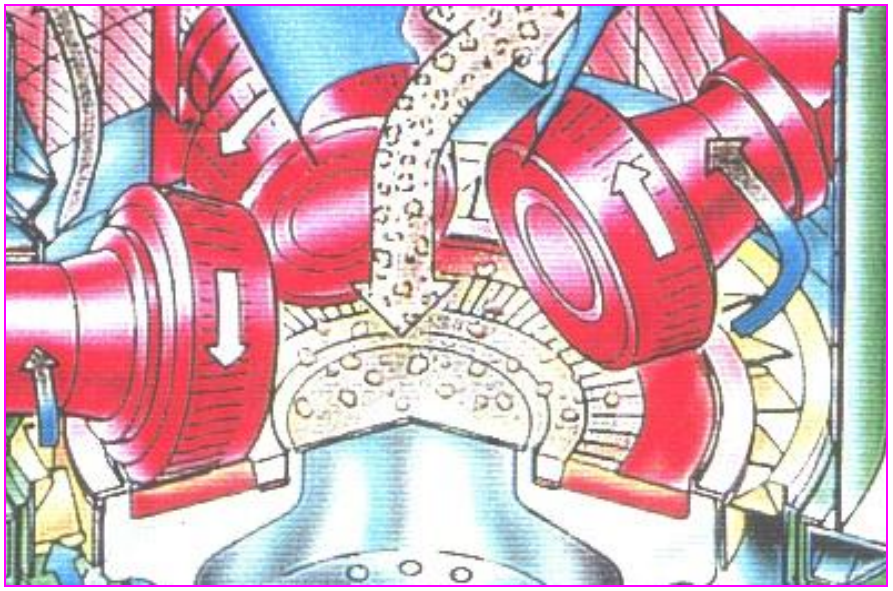
Scrapers

Inlet chute

Mill housing

Rollers and table liners

Roller and grinding track liners



Roller liners:

- **Monobloc**
- **Segments**

Grinding track liners:

- **Monobloc**
- **Segments**

Wear resistance material alternatives

- **Nihard 4**

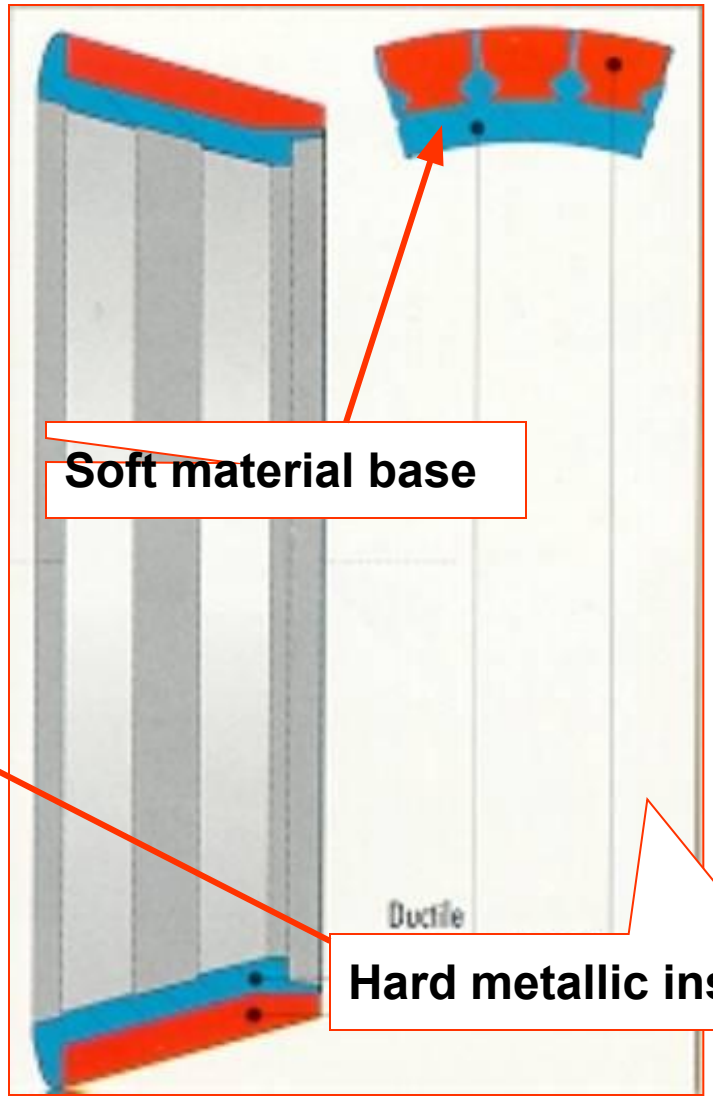
% C	% Cr	% Ni	Weldable
< 3.5	< 10	< 6.5	yes

- **High Chromium alloys**

% C	% Cr	% Other	Weldable	Example
< 3.6	< 17	Mo + Ni	yes	Chromodur, FMU18, VegalineV16
< 2.6	< 20	Mn	No	FMU 52
< 3.5	< 28	< 1.2	No	FMU 46

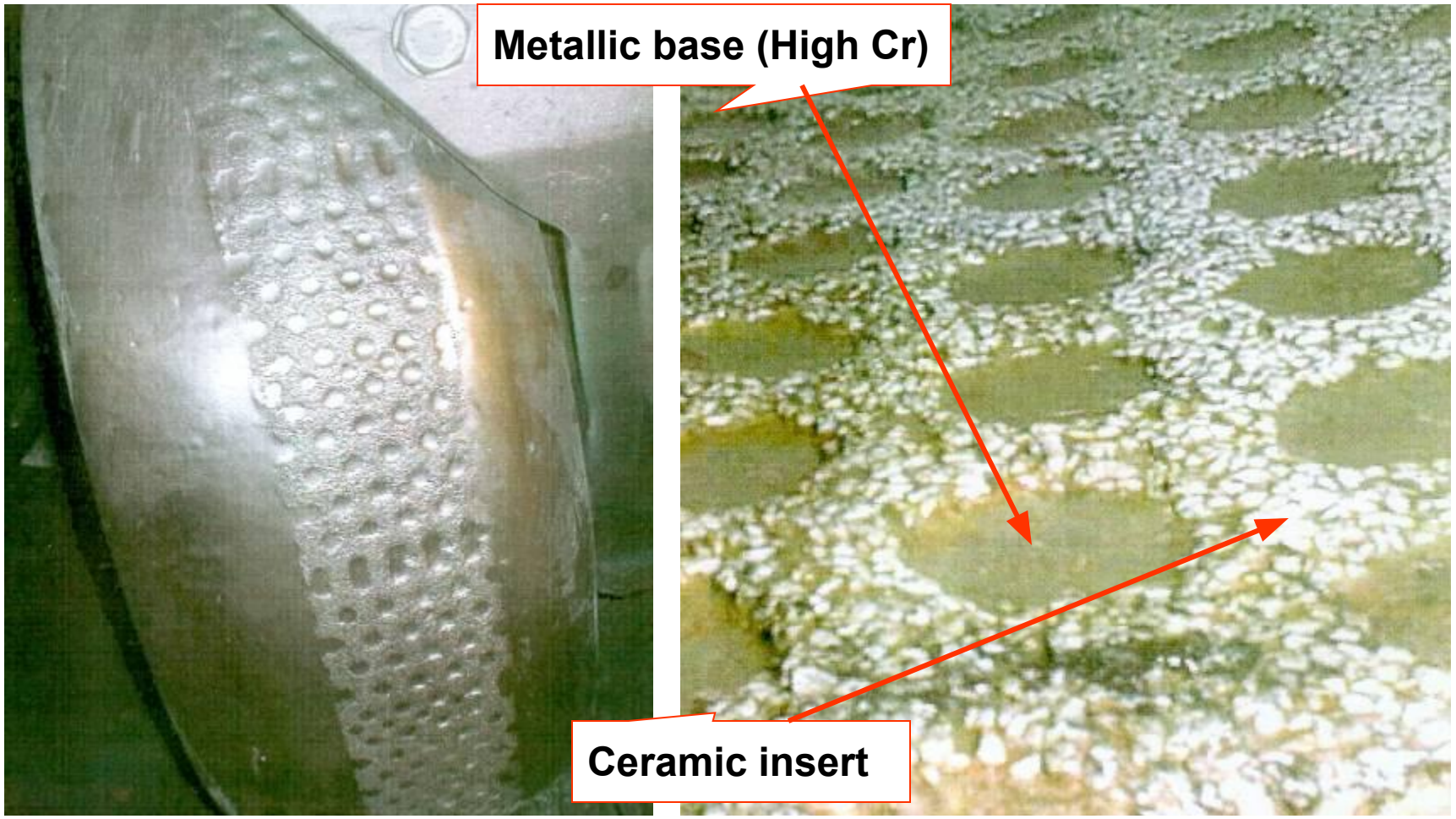
Wear resistance material alternatives

- Metallic inserts roller liner

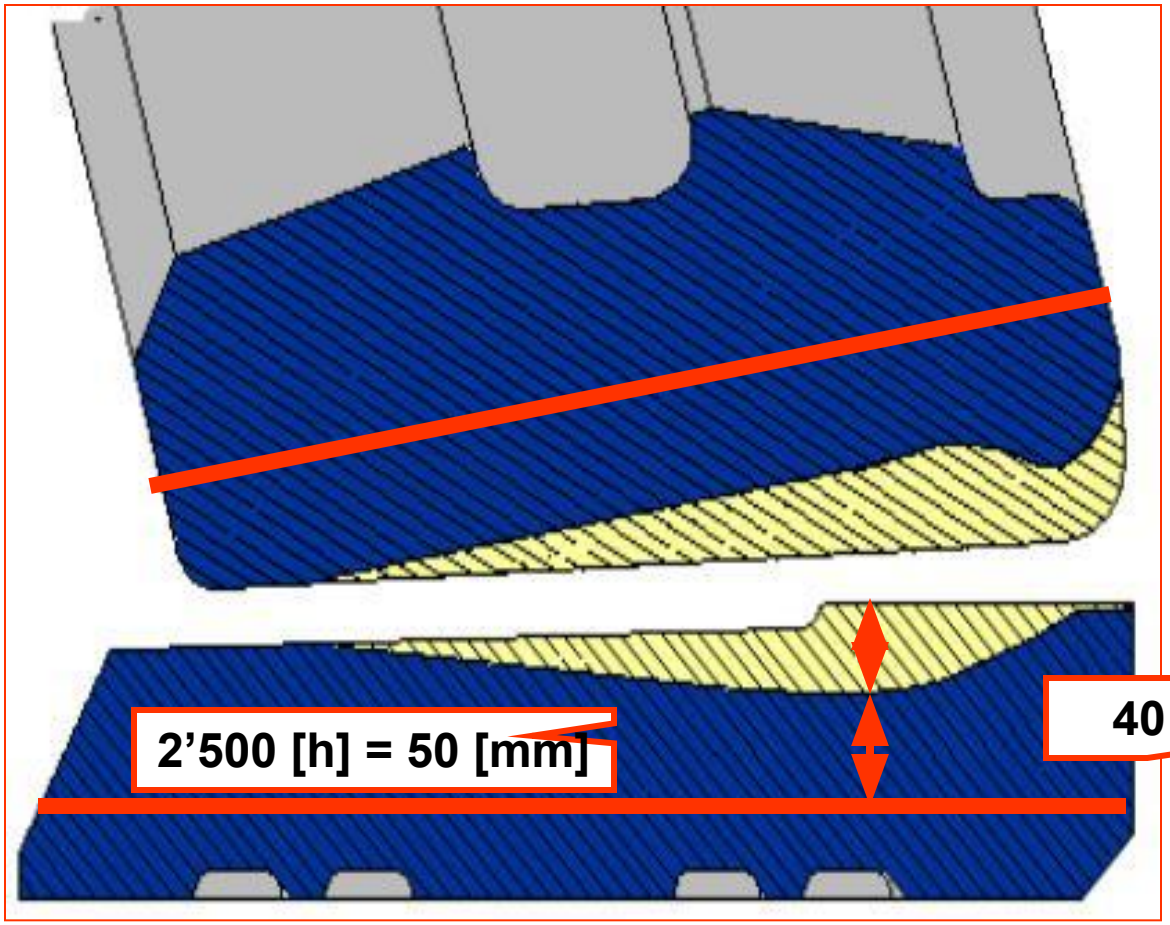


Wear resistance material alternatives

- **Ceramic inserts roller and grinding track liners**



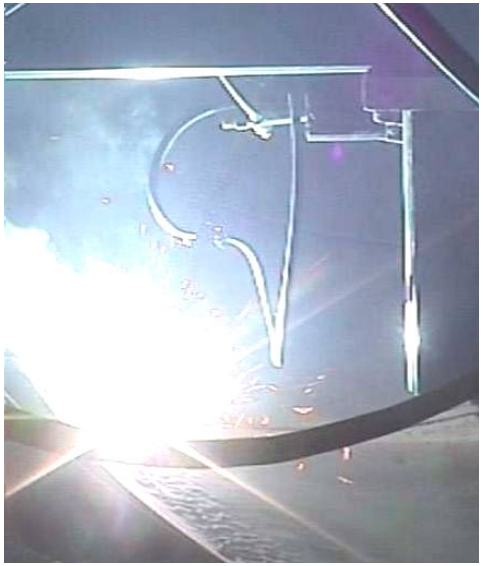
Wear rate monitoring



Wear resistance material alternatives

- Surface reconditioning on grinding track and roller liners

% C	% Cr	% Others	Weldable	Example
< 5	< 29	Ni, Mo	yes	Vautid 100, HC-O
< 5.5	~ 22	6 – 7 Ni	yes	CN-O, CNV-O

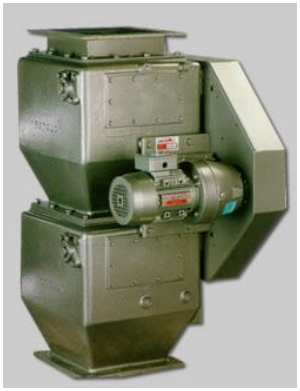


VRM - Accessories

Rotary valve

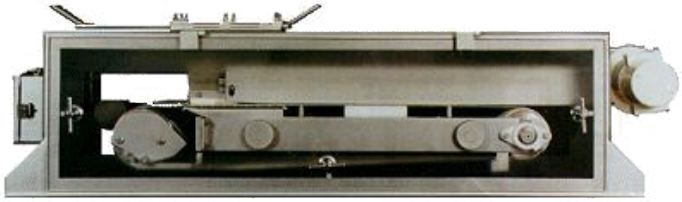
Reduces false air entering with feed material. Good for dry, small size material.

Pendulum valve



Reduces false air entering. Better for lumpy or humid feed material.

Weigh belt



Weighs the passing material ensuring a continuous grinding bed in the mill

DESIGN

SELECTION

RANGE OF APPLICATION

METHOD OF OPERATION

Metal extraction

Metal objects damage the roller & table. The magnet removes them