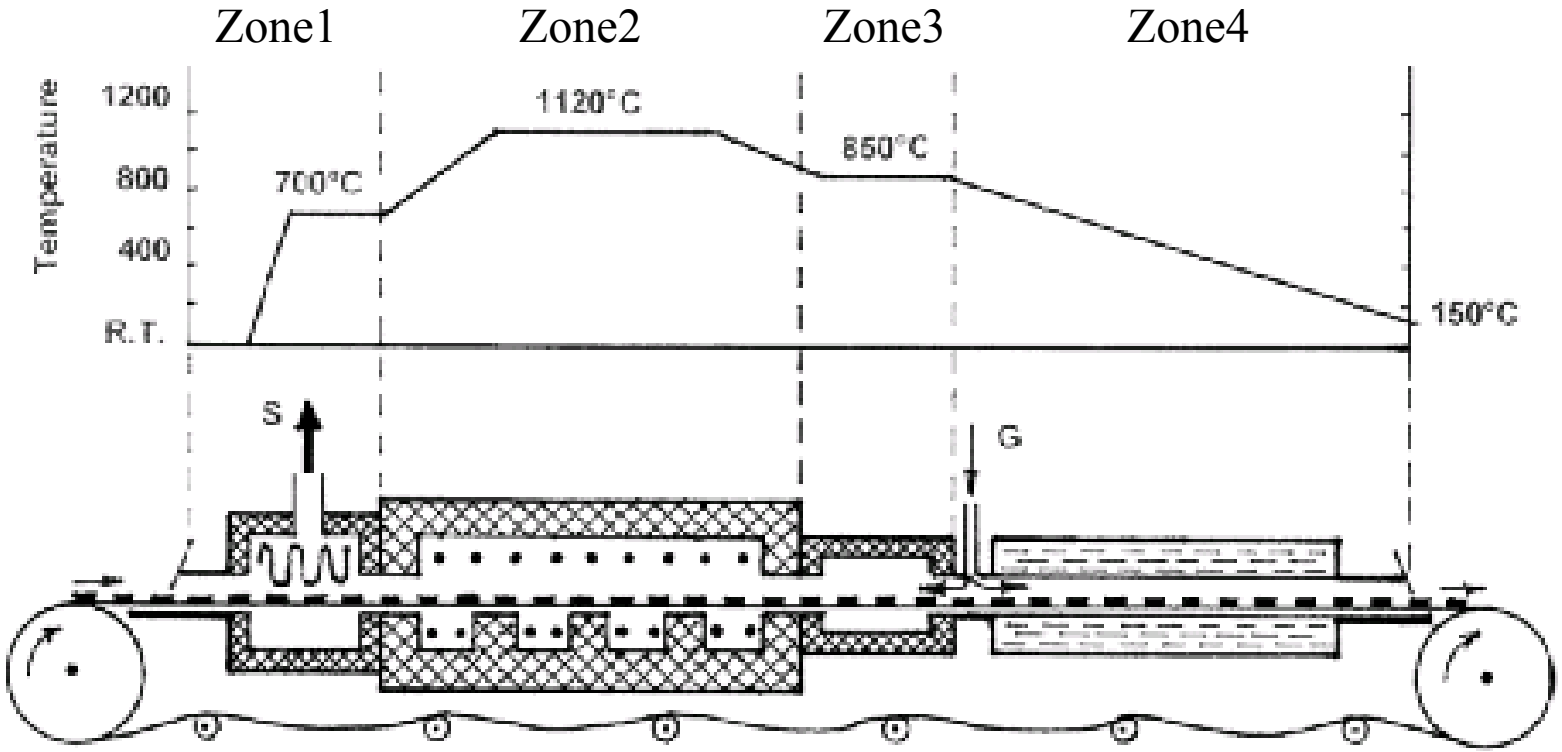
Sintering Atmosphere

- Functions of sintering atmosphere
- Atmosphere control in the sintering furnace
- Main reactions during sintering
- The Ellingham-Richardson (ER) diagram
- Equilibrium of Fe-sintering atmosphere
- Sintering atmosphere for carbon containing steels

Functions of Sintering Atmosphere

- Remove lubricant residuals from the delubrication zone
- Reduce oxides and avoid oxidation
- Avoid decarburization and carburization
- Avoid oxidation in the cooling zone
- Maintain positive pressure particular in the furnace exit
- Permit safety purging
- Buffer air leaks
- Give a consistent and uniform result

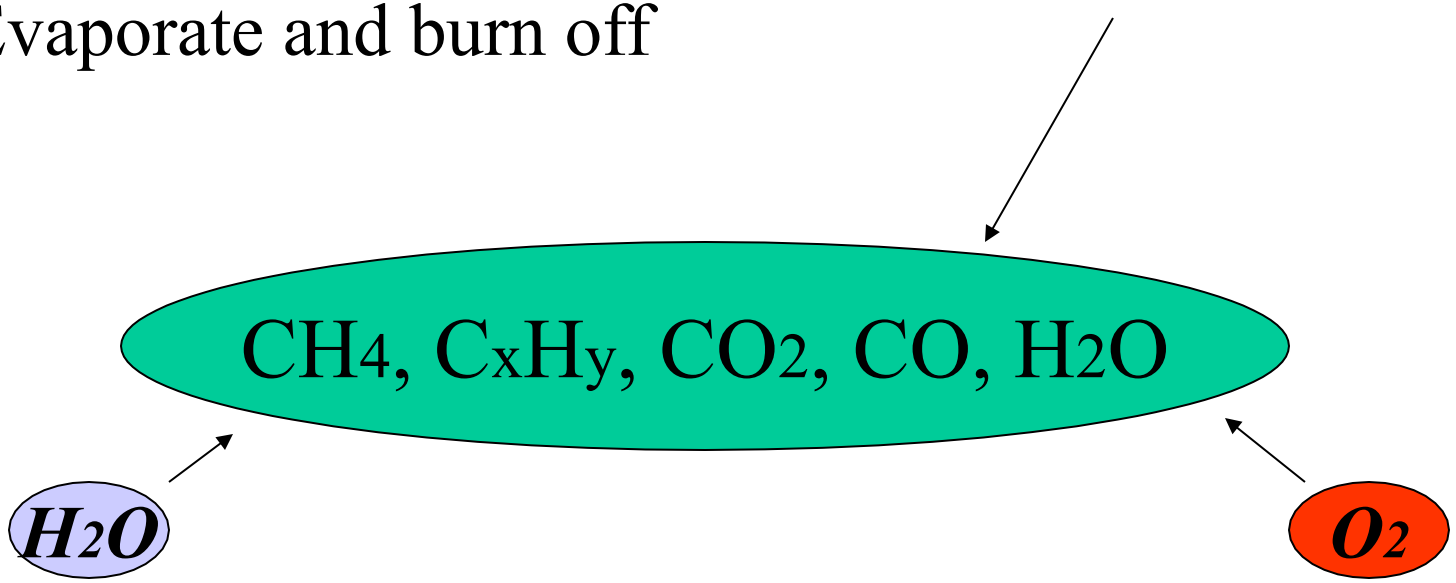
Atmosphere Control in the Sintering Furnace



Zone1 = Burning-off Lub, 2 = Sintering, 3 = Re-carburizing, 4 = Cooling
G = Gas inlet, S = Smoke and gas outlet

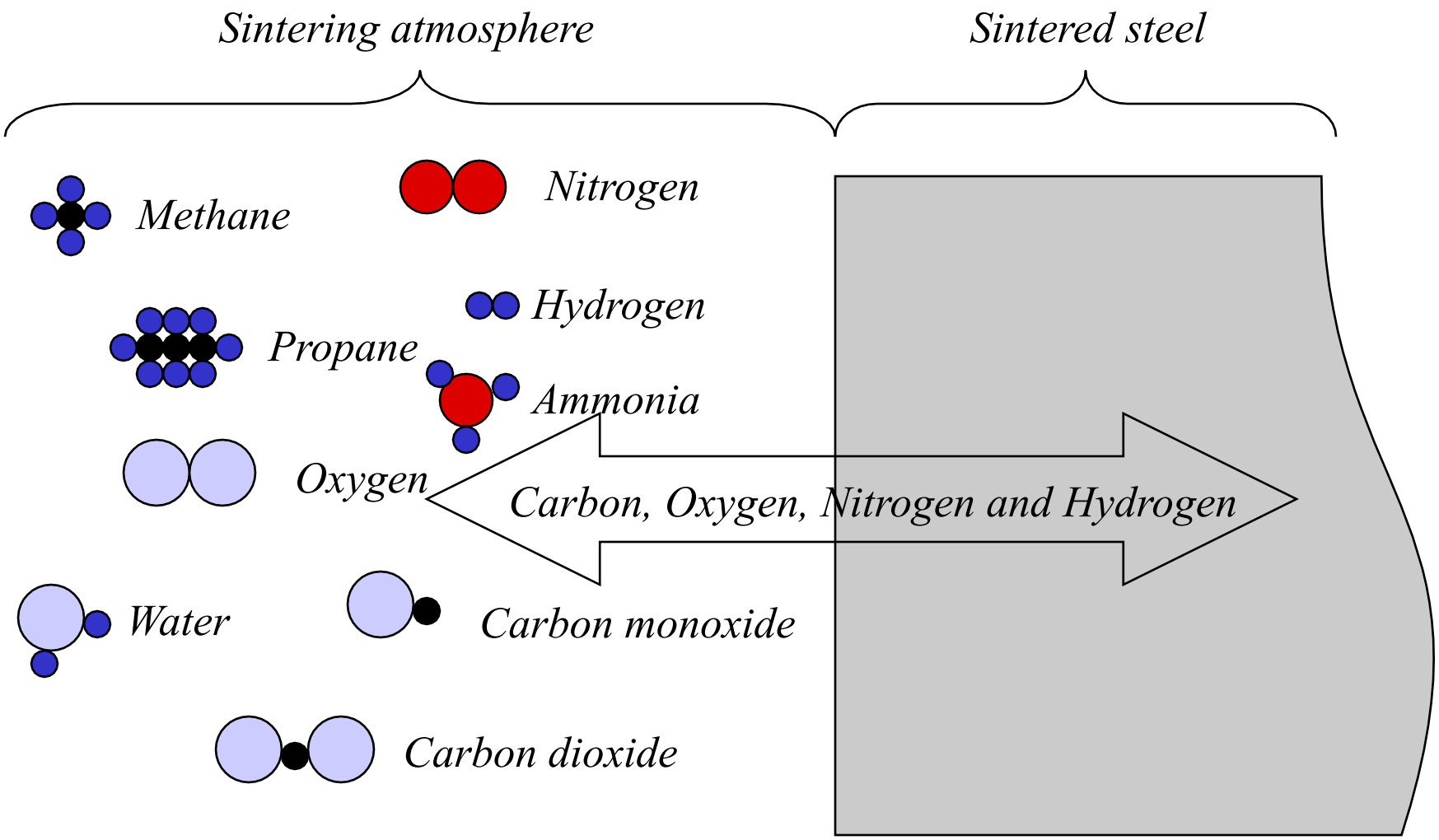
Zone1: Burning-off Lubricants

- Lubricates: *Polymers - large molecules*
- Melt ⟶ break down ⟶ small molecules
- Evaporate and burn off



An oxidation atmosphere is needed

Zone2: Sintering Atmosphere



Zone 3: Re-carburization

Problem in Zone2: Decarburization

- Purpose: Restoring carbon to the sintered components
- Atmosphere: CH_4, CO
- Temperature : 800 - 900C

Zone 4: Cooling

Why atmosphere control of the cooling zone ?

Outside door openings → high O_2- levels

Benefits

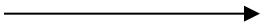
- Prevents oxidation of the parts (black or blue parts) after sintering
- Better stability and reproducibility of the cooling process.

Main Reactions during Sintering

- Oxidation and Reduction
- Decarburization and carburization

Oxidation and Reduction

Oxidation



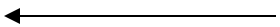
Equilibrium Constant

$Me + 1/2O_2 \longleftrightarrow MeO$ → (P_{O_2})

$Me + H_2O \longleftrightarrow MeO + H_2$ → (P_{H_2O} / P_{H_2})

$Me + CO_2 \longleftrightarrow MeO + CO$ → (P_{CO_2} / P_{CO})

Reduction



Carburization and Decarburization

Carburization →

	Equilibrium Constant
$2CO \longleftrightarrow 2C + O_2$	(P_{O_2} / P_{CO}^2)
$2CO \longleftrightarrow C + CO_2$	(P_{CO_2} / P_{CO}^2)
$CH_4 \longleftrightarrow C + 2H_2$	$(P_{H_2}^2 / P_{CH_4})$
$2CO + H_2 \longleftrightarrow C + H_2O$	$(P_{H_2O} / P_{CO}^2 P_{H_2})$

← Decarburization