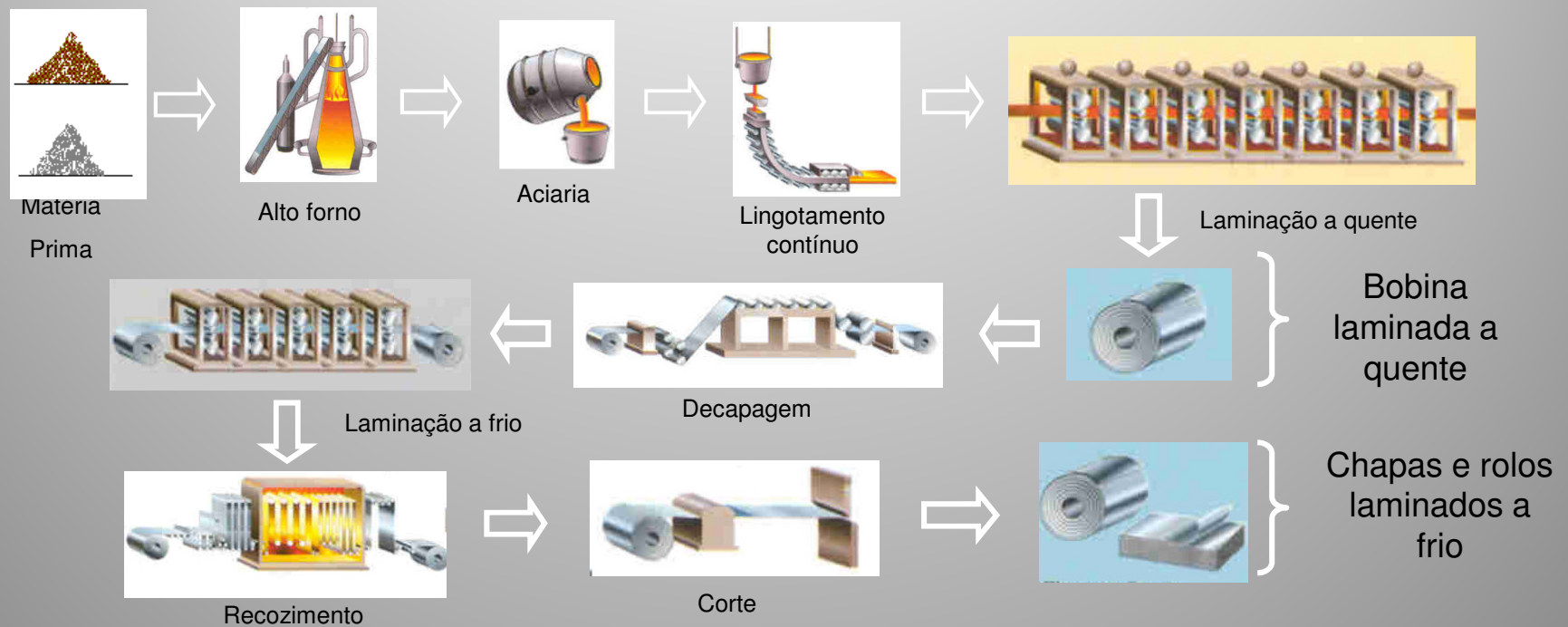
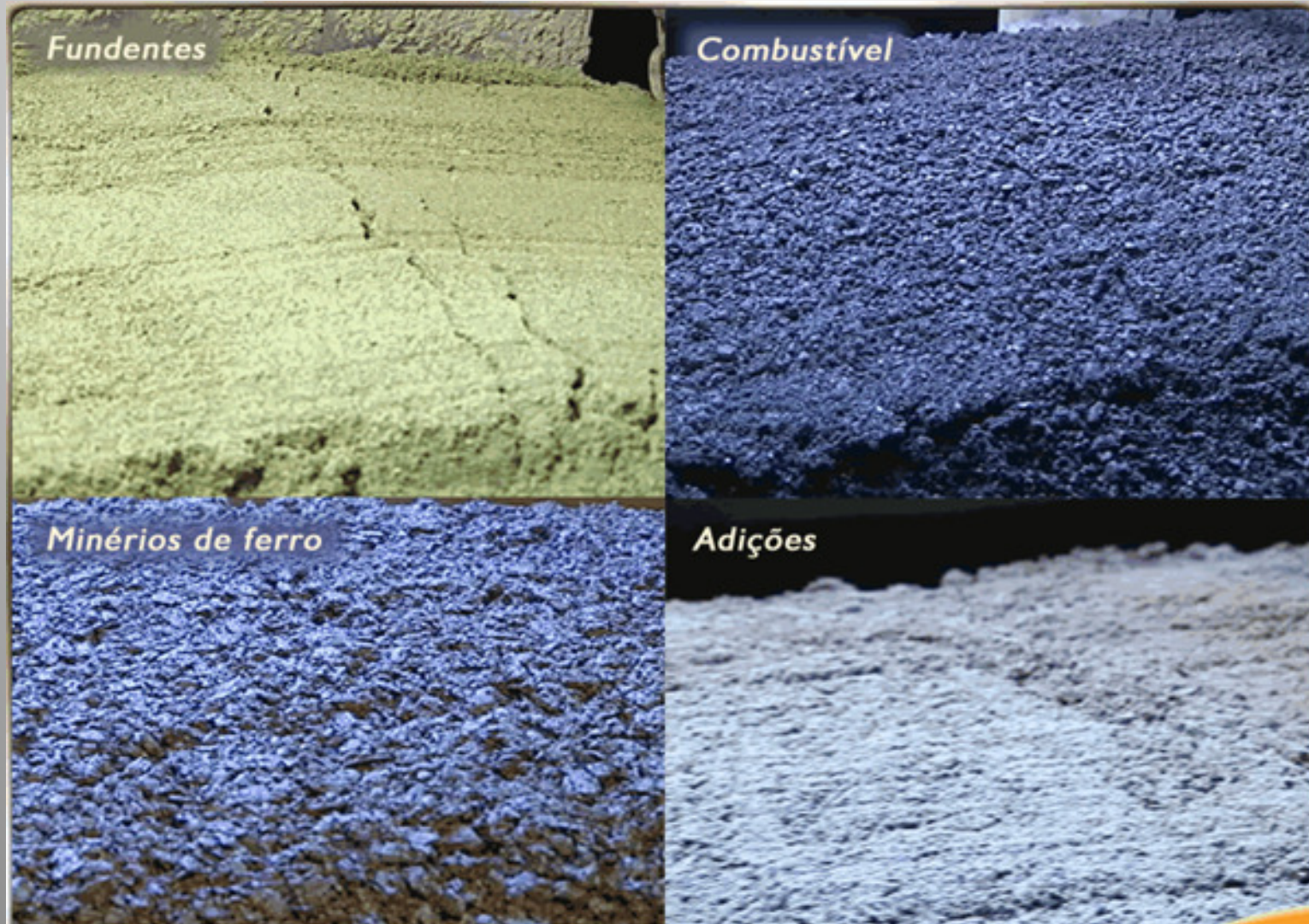


# Fluxo de Processo - Usina

## Usina siderúrgica



# Matéria Prima



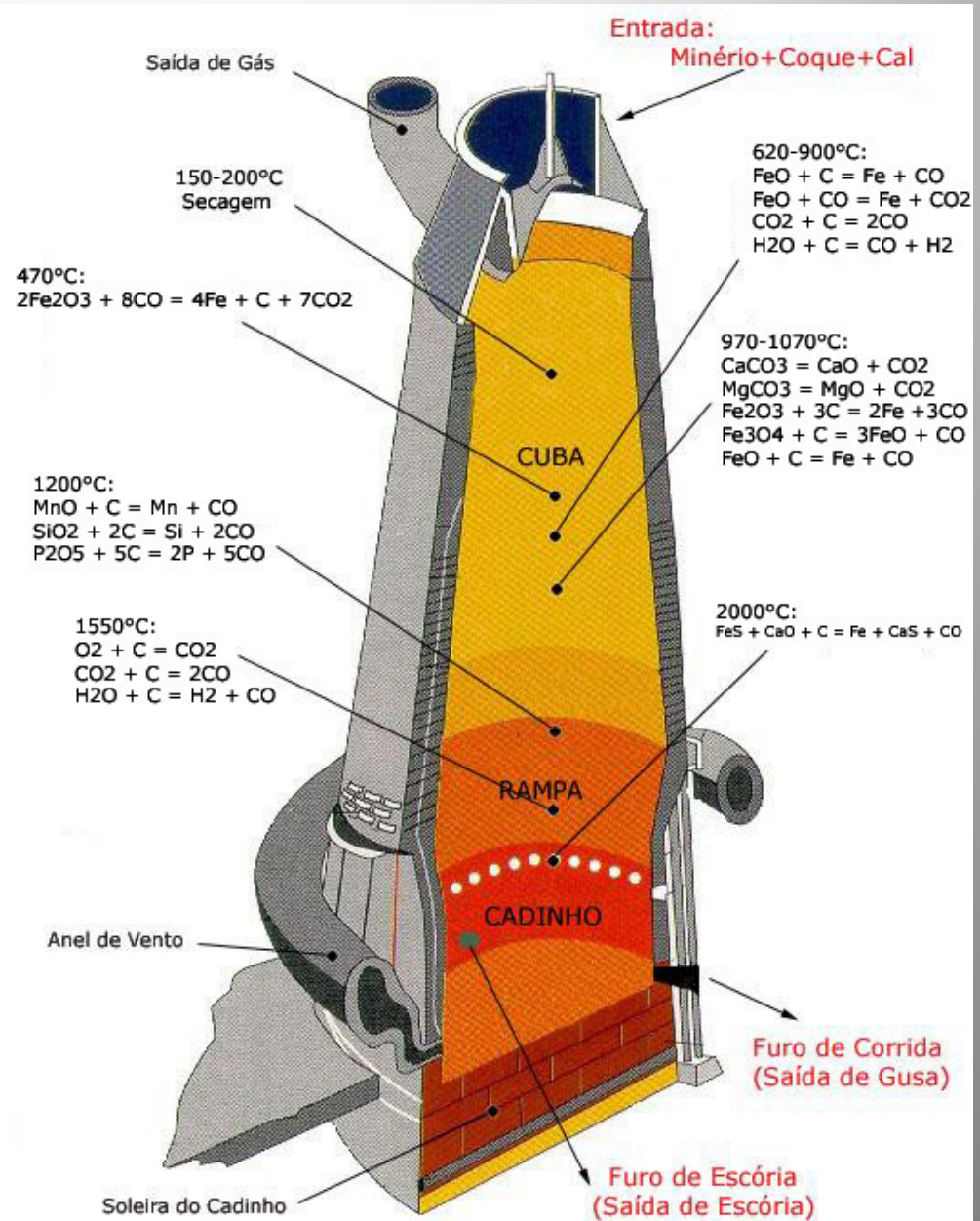
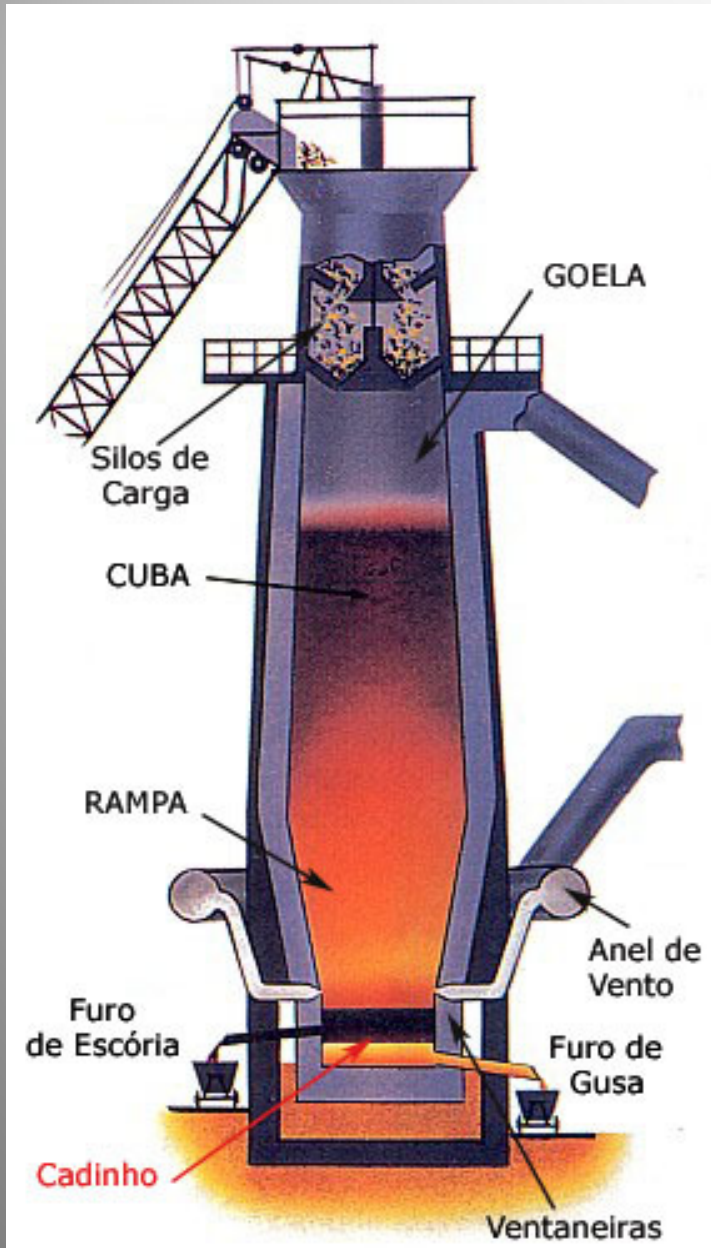
# *Matéria Prima*



# ***Alto Forno***



# Partes do alto-forno



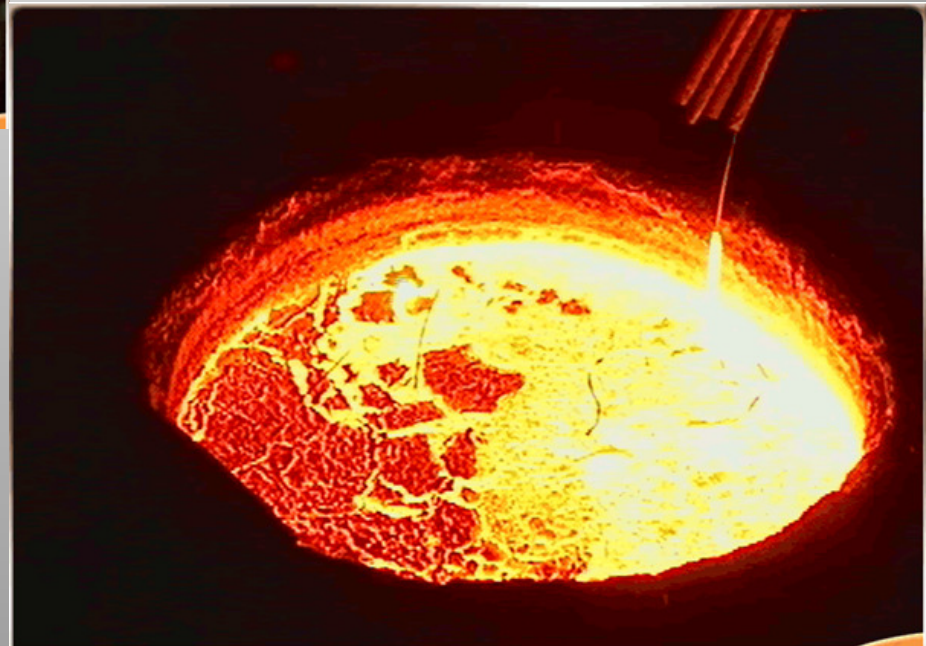
# Aciaria



Ferro Gusa = 4%C  
+  
Sucata

Redução da %C

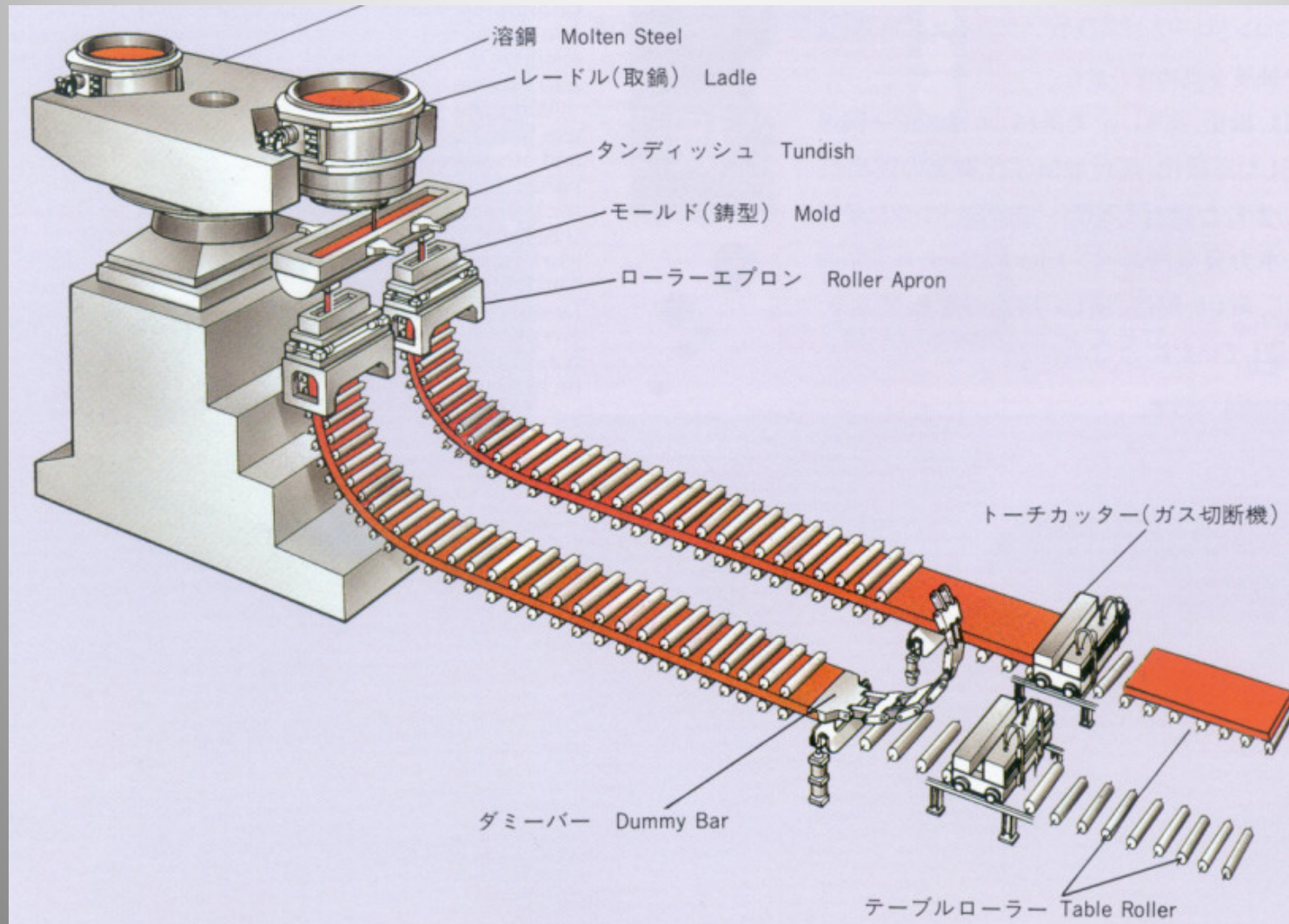
Acerto Composição Química



# *Lingotamento Contínuo*

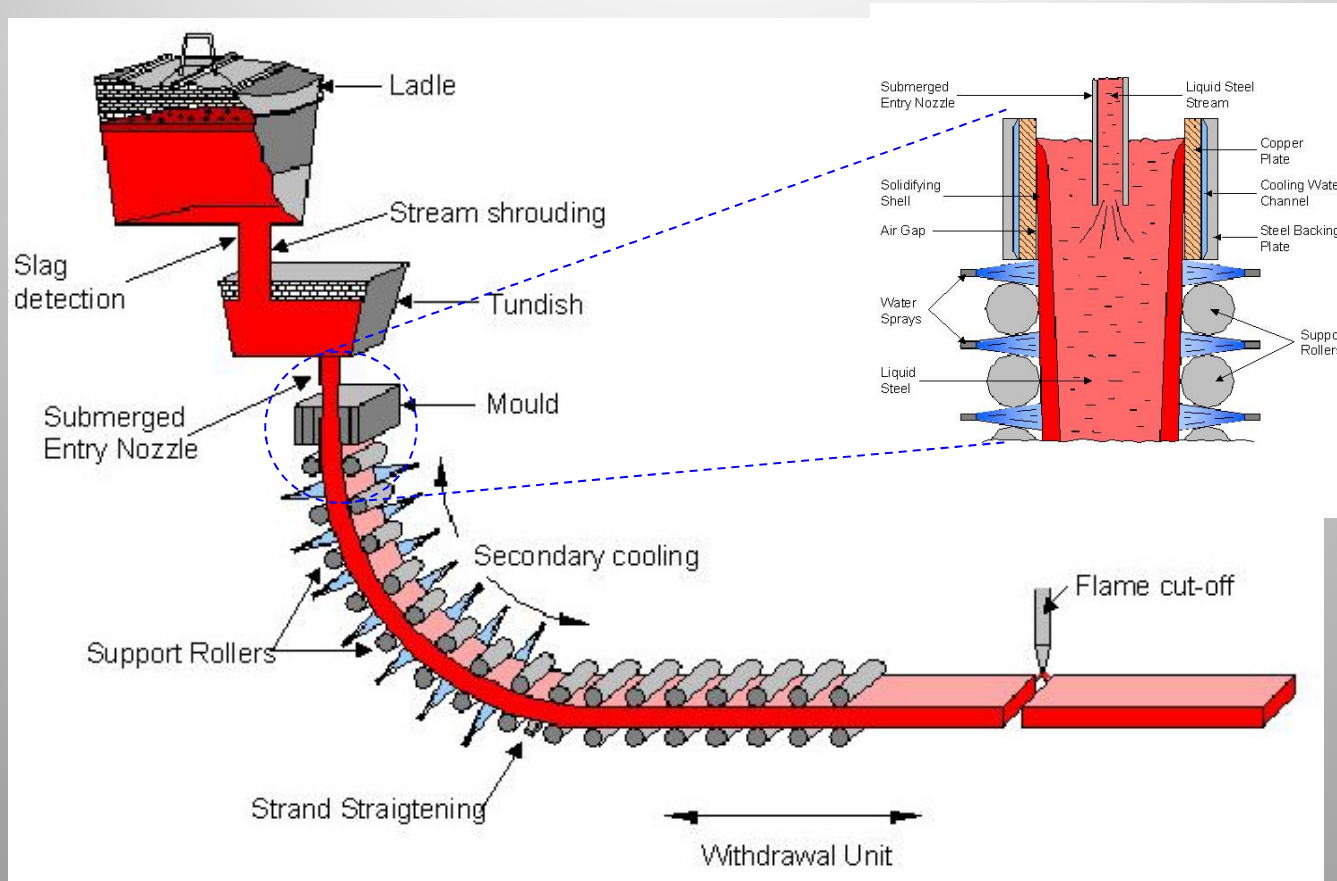


# Lingotamento Continuo

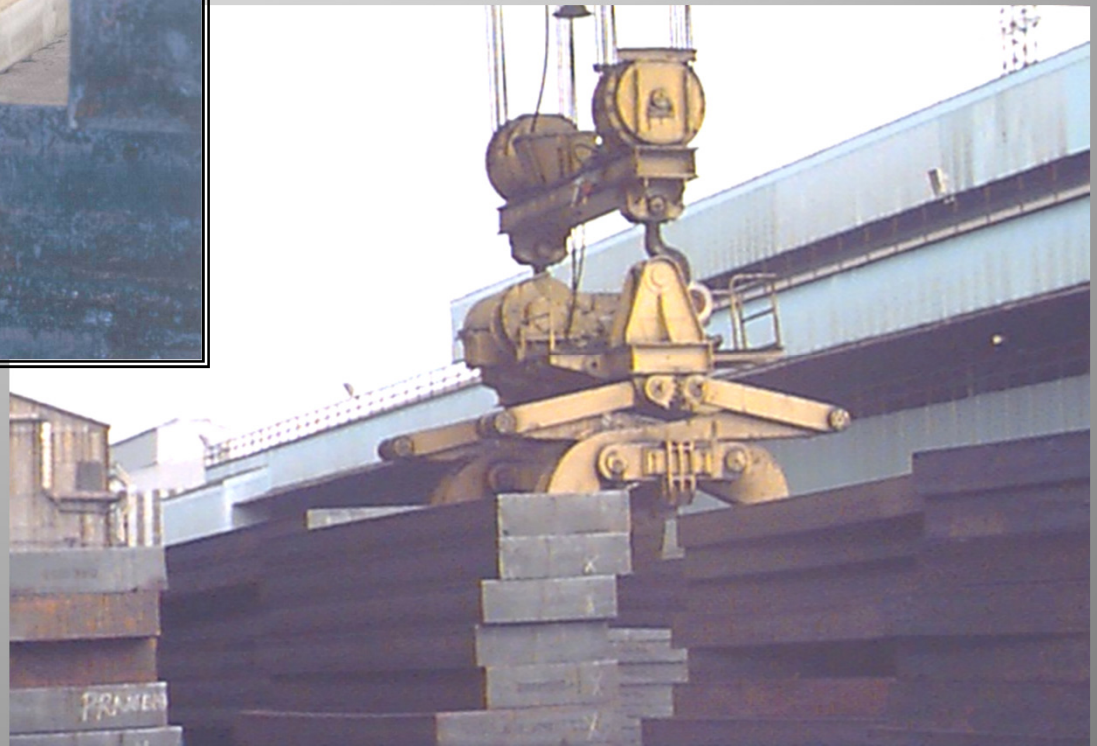
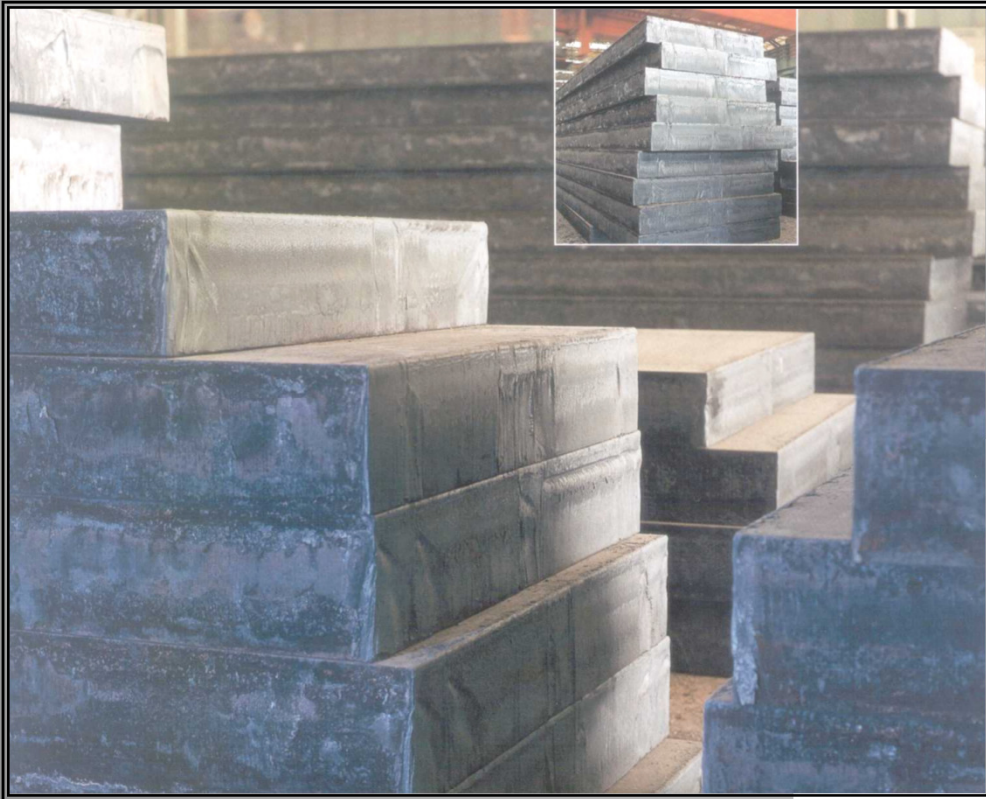




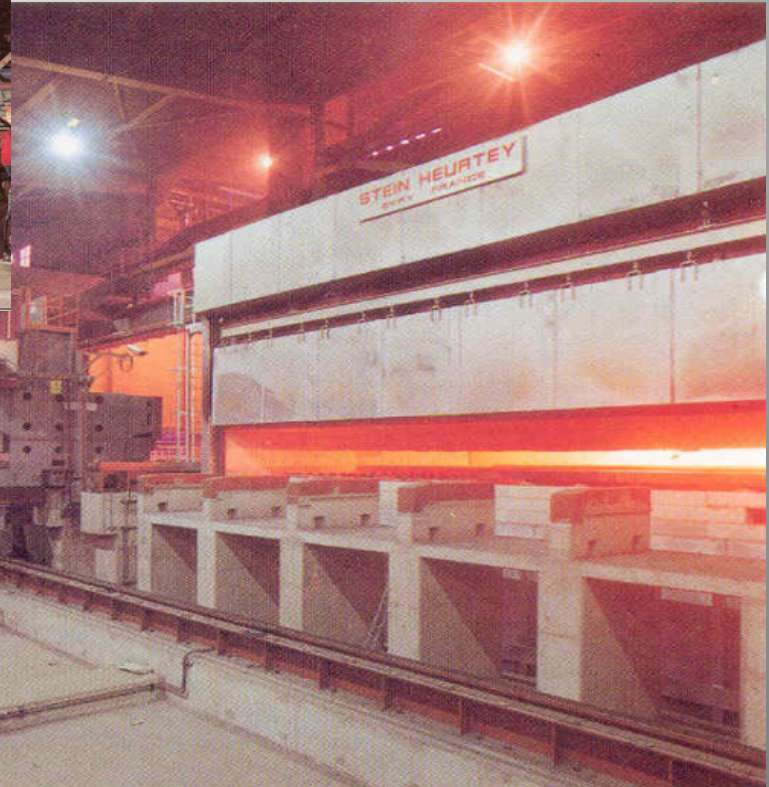
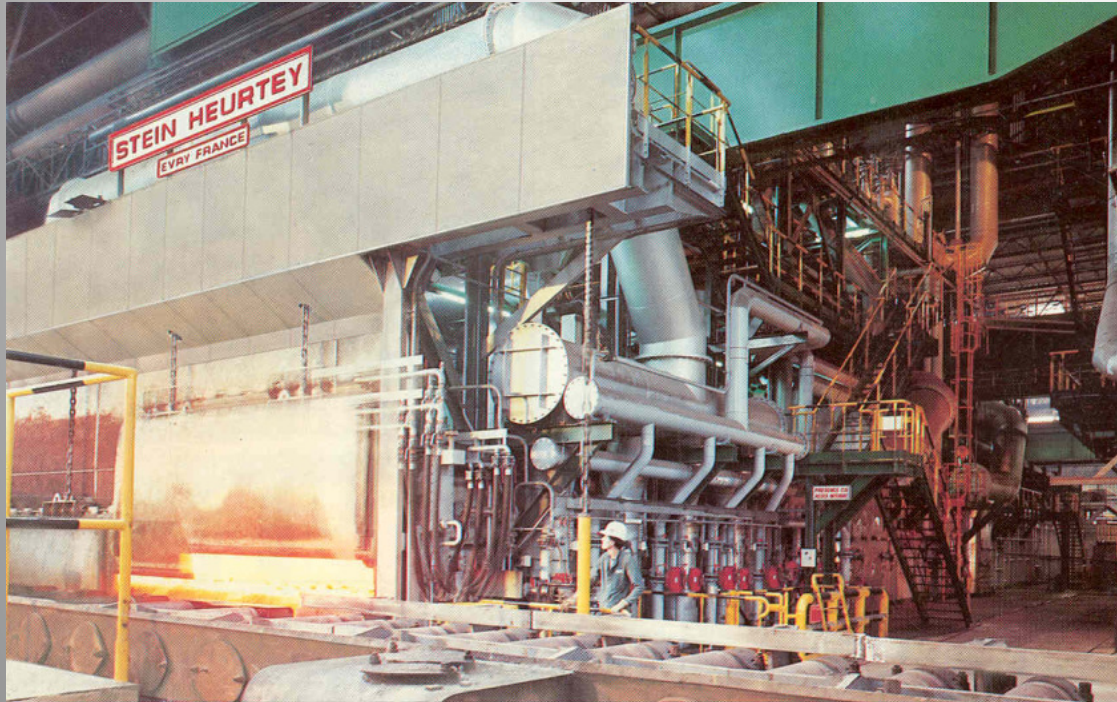
# Lingotamento Continuo



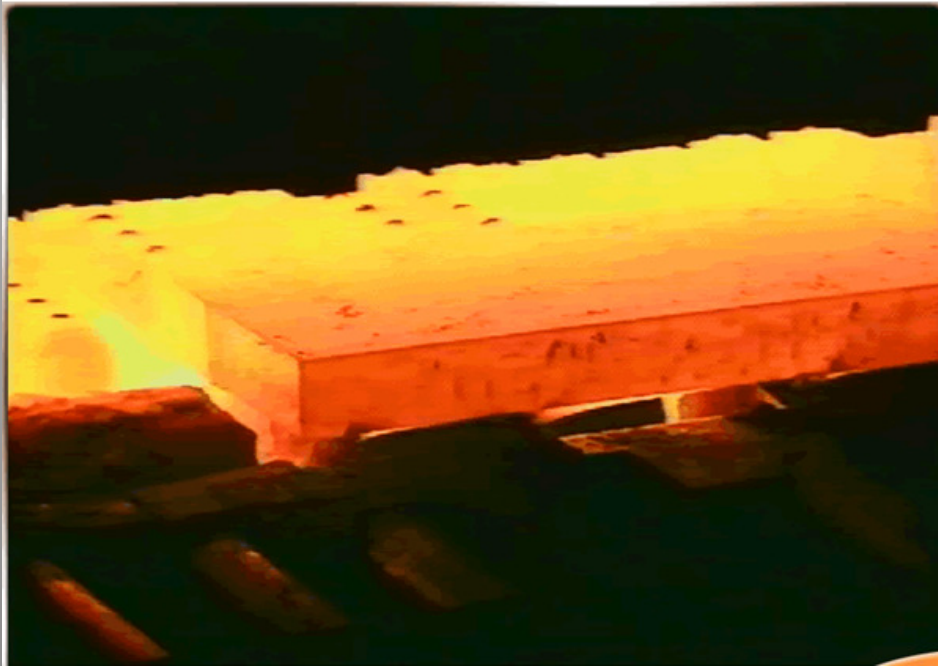
# *Placas*



# *Forno reaquecimento de placas*



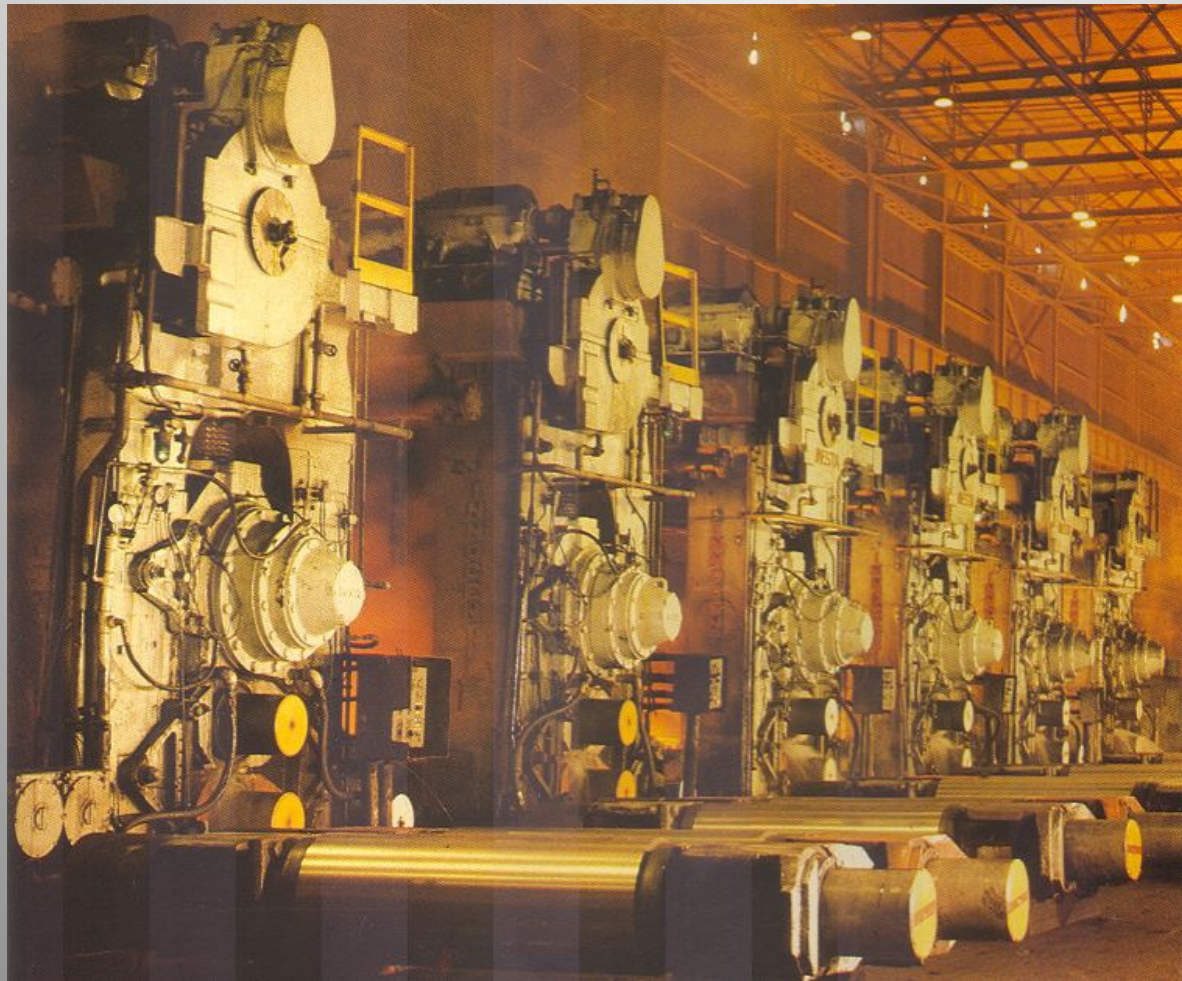
# *Forno reaquecimento de placas*



# Laminação a Quente



## *Trem contínuo de laminação a quente*



# ***BQ – Bobina Laminada a Quente***

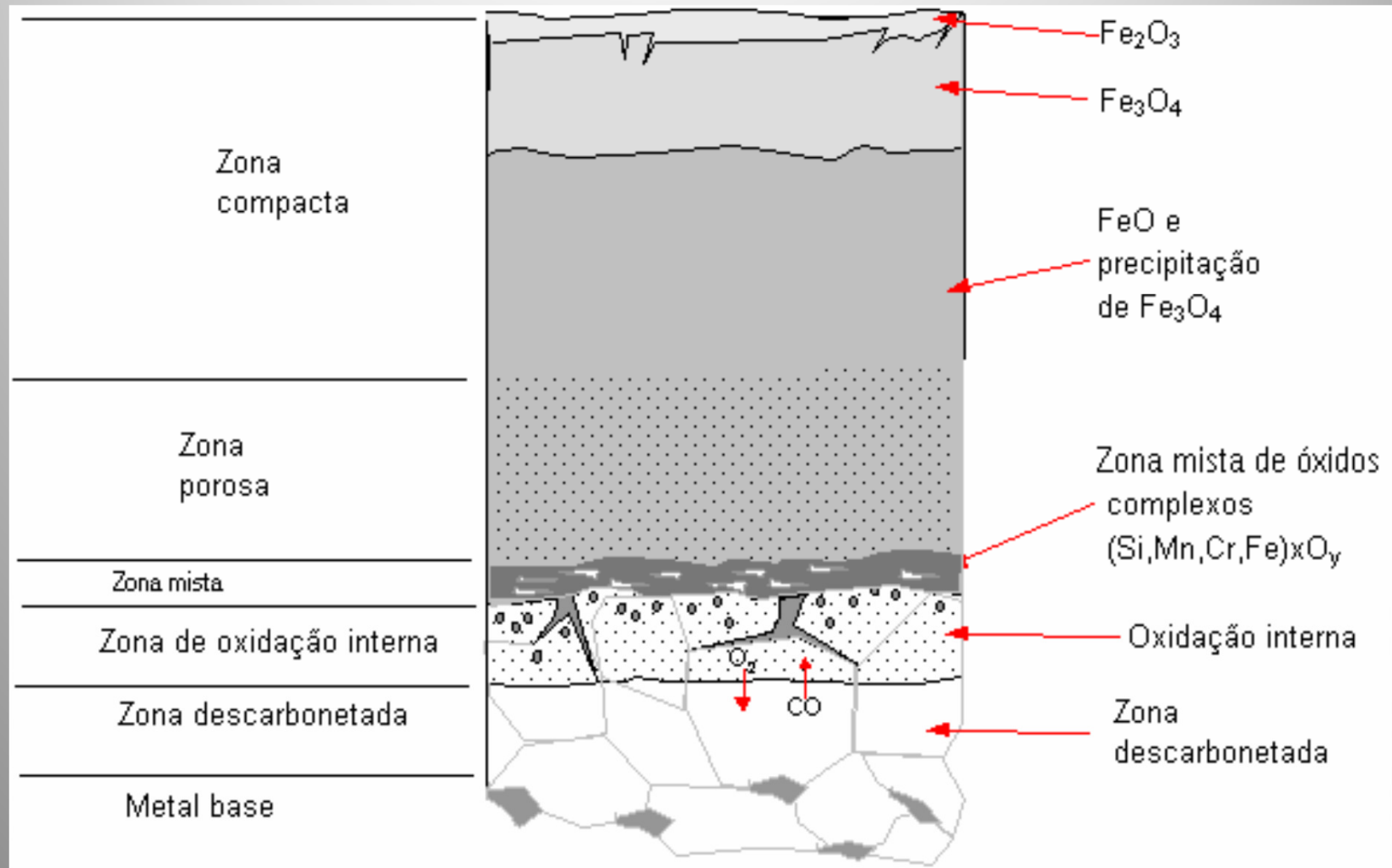


# *Decapagem*





# Decapagem



# *Decapagem*

- 1º tanque (ácido) - tem como função aquecer e iniciar o ataque na chapa.
- 2º tanque (ácido) - nessa etapa é removida grande parte da camada de óxido.
- 3º tanque (ácido) - restante da camada de óxido é removida e a chapa estará totalmente decapada,
- 4º e o 5º tanque (água) - limpeza da chapa.

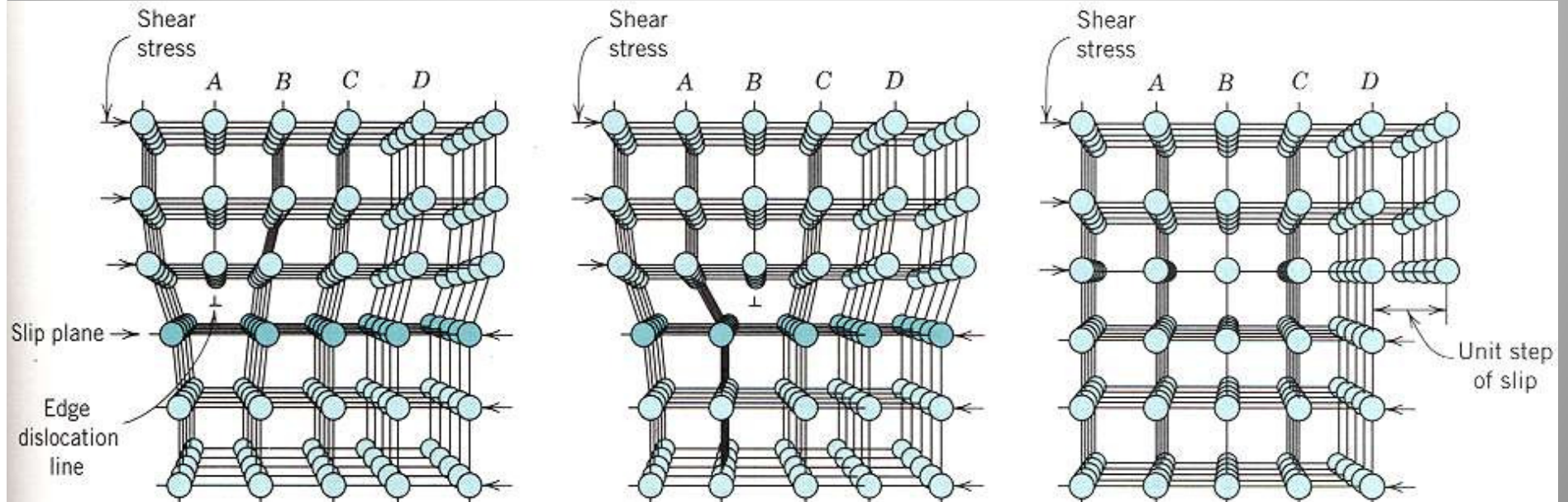
# ***BF – Bobina Laminada a Frio***



# ***Mecanismos de deformação***

- Deformação elástica
- Deformação plástica

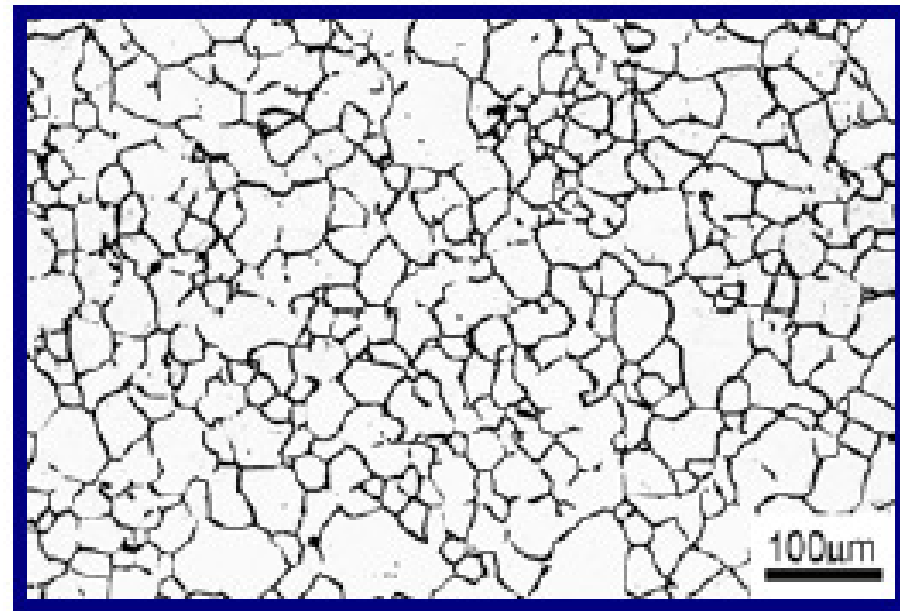
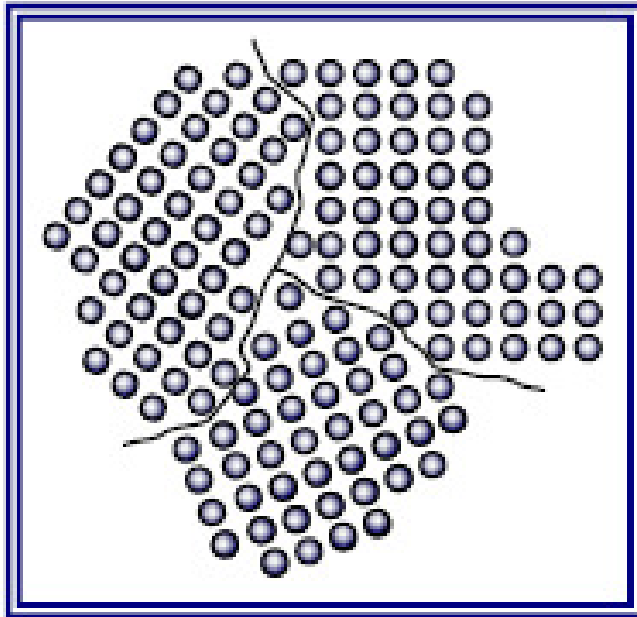
# Discordâncias



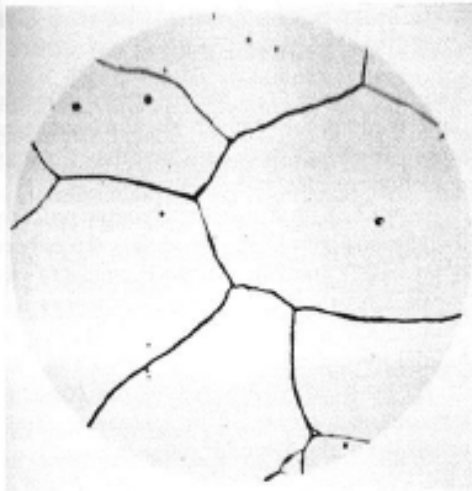
# ***Mecanismos de endurecimento***

- ***Contorno de grão***
- ***Solução Sólida***
- ***Deformação a frio (encruamento)***

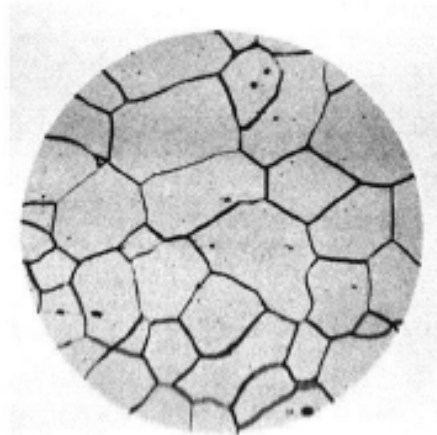
# *Contorno de Grão*



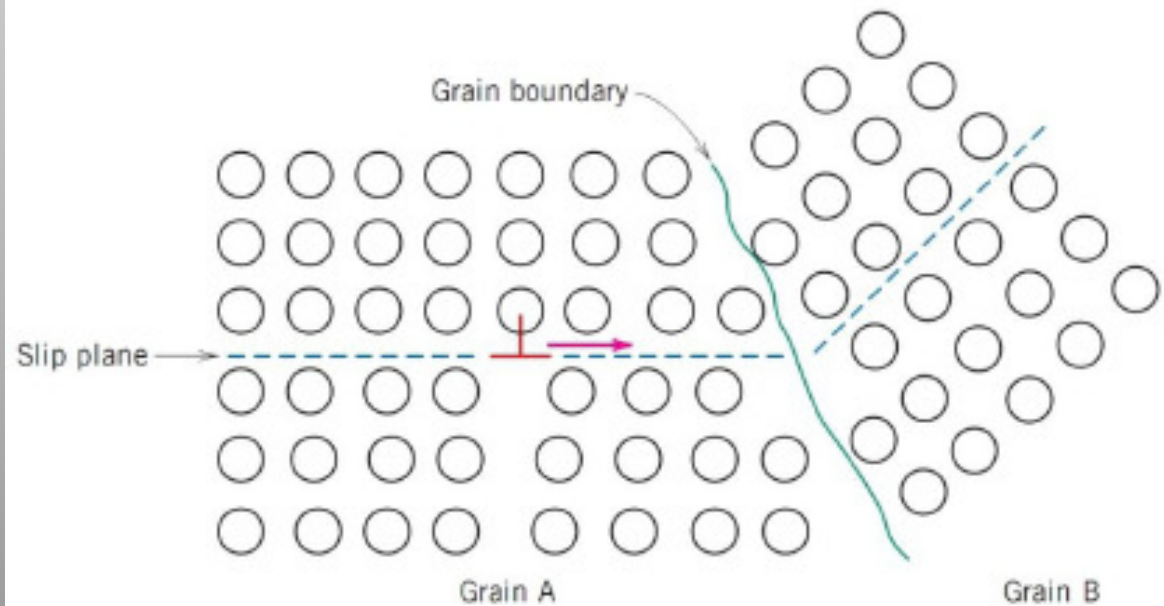
# Contorno de Grão



(a) Grain Size,  $G = 1$

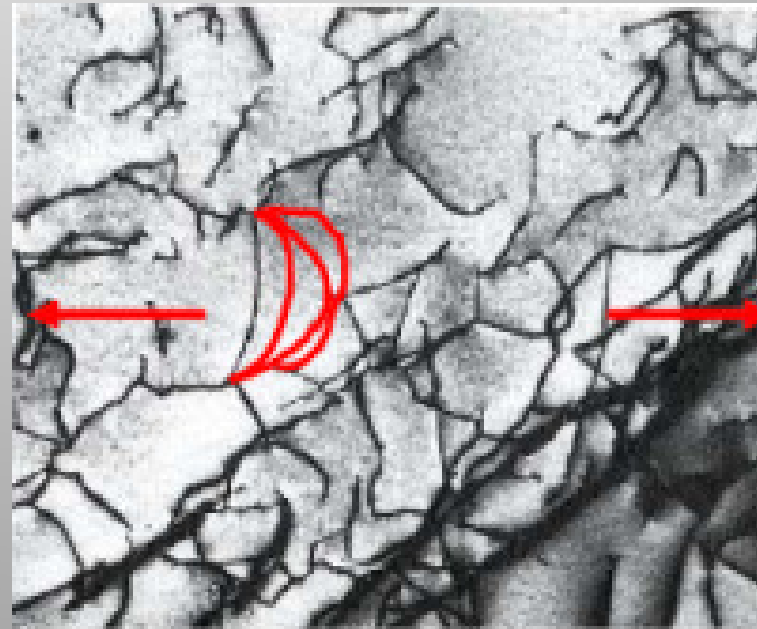
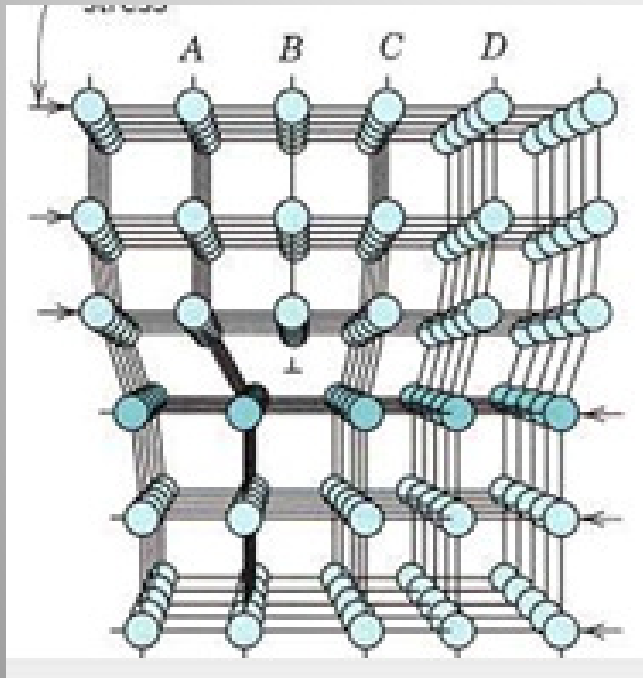


(b) Grain Size,  $G = 4$

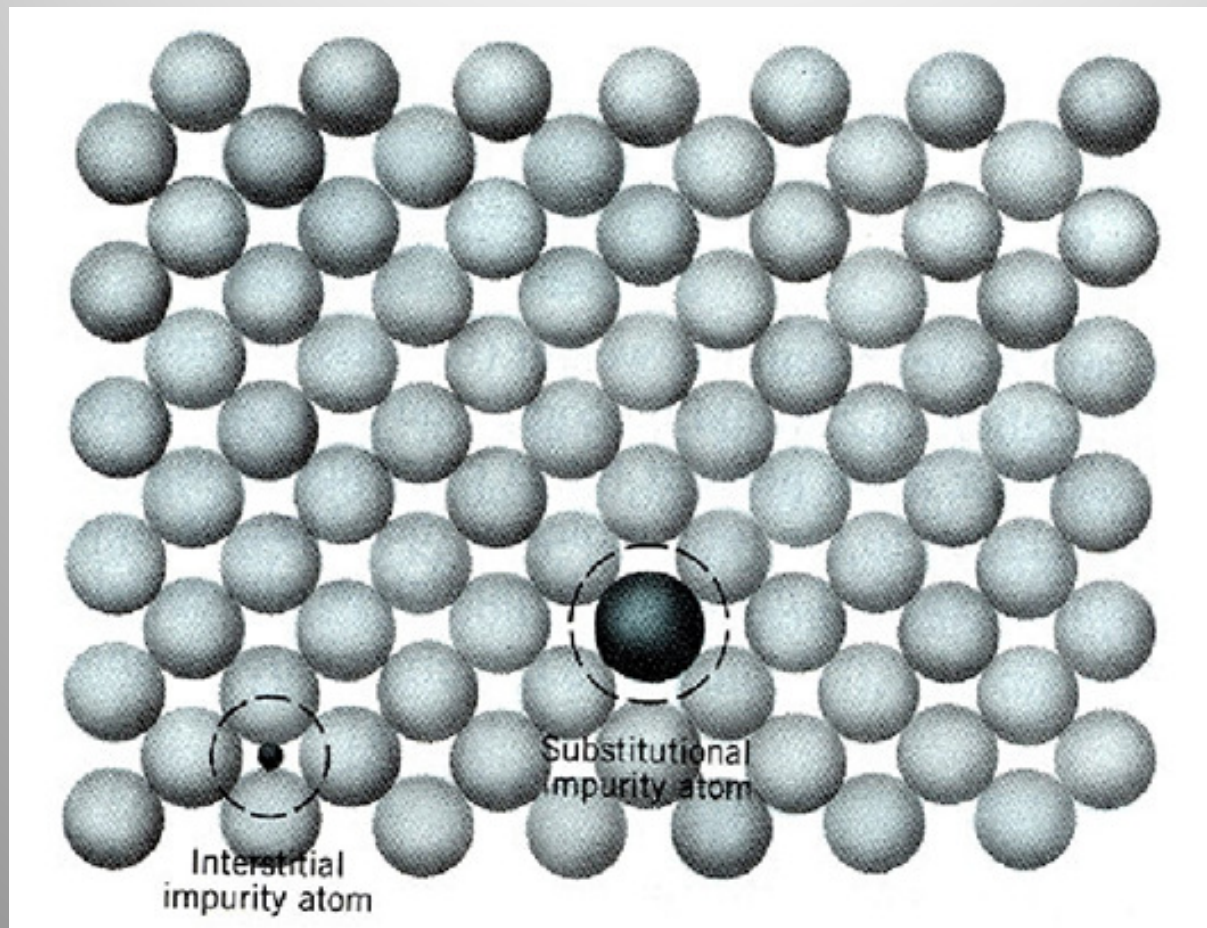




# *Deformação a frio*



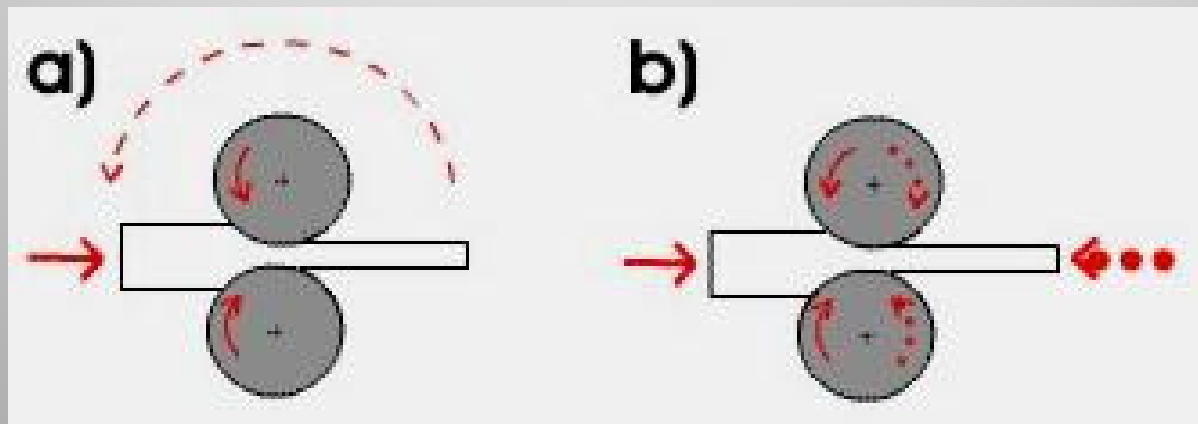
# *Efeito do carbono*



# *Classificação dos Aços*

- *Aço baixo teor de carbono ( $\% C \leq 0,30\%$ )*
- *Aço médio teor de carbono ( $0,30 < \% C < 0,50$ )*
- *Aço alto teor de carbono ( $\% C \geq 0,50$ )*

# Laminação - Objetivo



**Espessura inicial > Espessura final**

# ***Laminação a frio***

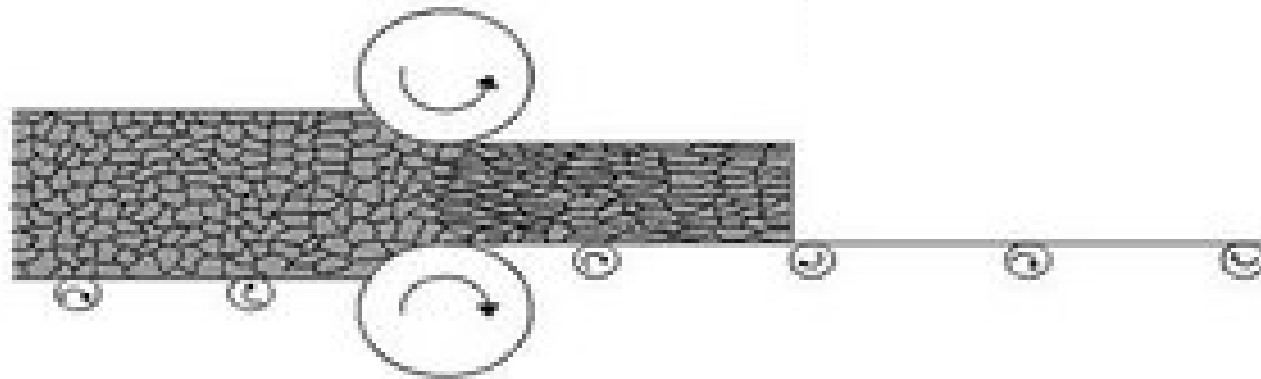
- ***Boa qualidade superficial;***
- ***Boa tolerância de espessura;***
- ***Aumenta dureza, limite de escoamento e limite de resistência;***
- ***Diminui alongamento, ductilidade;***

# *Tipos laminadores*



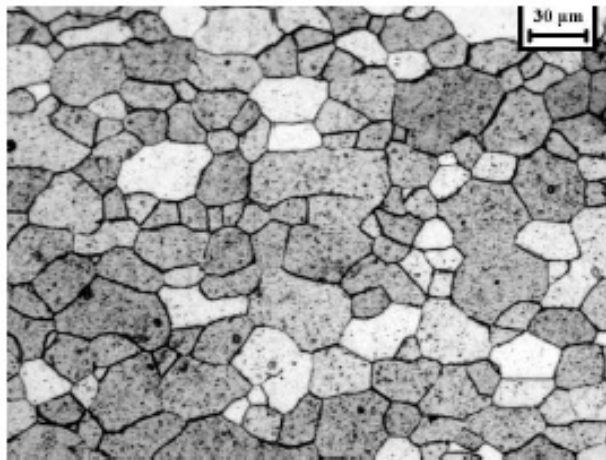
# *Encruamento*

## Processo de Laminação a Frio



# Encruamento

## ENCRUAMENTO



Material original

⇒  
Laminação  
à frio



Material encruado



# Encruamento

