Latest Developments in EAF steel making w.r.t. Indian situations

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NISST SERVICES TO THE STEEL SECTOR

- *In-Plant Training Programs for existing employees*
- *In-Plant Training Programs for fresh recruits*
- *Seminars/Workshops*
- *Energy Audits (Accredited by BEE)*
- *M&V Audits (Accredited by BEE)*
- *Techno-Economic studies*
- *Overall cost control*
- *Problem solving*

NISST SERVICES TO THE STEEL SECTOR- ENERGY AUDITS / M&V Audits

- *Conducted detailed/ comprehensive Energy Audits on behalf of BEE*
- *Advantage with NISST is that, being experts in iron and steel sector, we can provide complete solution*
- *M&V Audits in many Plants*
- *Normal Energy Audits as per requirement of industry*

NISST SERVICES TO THE STEEL SECTOR- Process Improvement

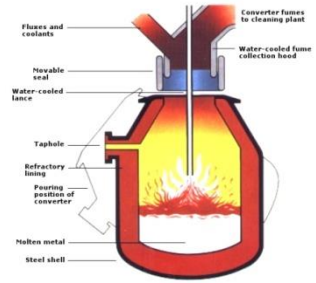
- *Sponge Iron industry*
- *Electric Arc / Induction Furnace*
- *Reheating Furnaces*
- *Rolling*
- *Quality Improvement*
- *Development of SOPs specific to the Plant*
- *Development of SMPs specific to the Plant*

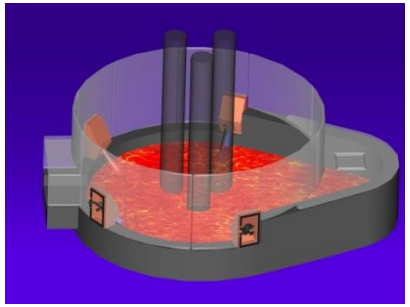
NISST SERVICES TO THE STEEL SECTOR- Overall Cost Analysis and Techno-Commercial Approach

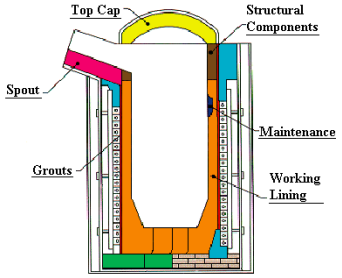
- ***Sponge Iron** – Iron ore, Pellets, domestic coal, imported coal, power generation, Quality of DRI*
- ***Electric Arc / Induction Furnace** – Charge materials, power consumption, productivity*
- ***Reheating Furnaces** – Minimizing fuel consumption*
- ***Direct Rolling**- Achieving the best*
- ***Rolling** – Best plan for Rolling schedule*

STEEL MAKING

- Routes of steel making
  - BOF (BOS, LD)
  - EAF
  - Induction Furnace



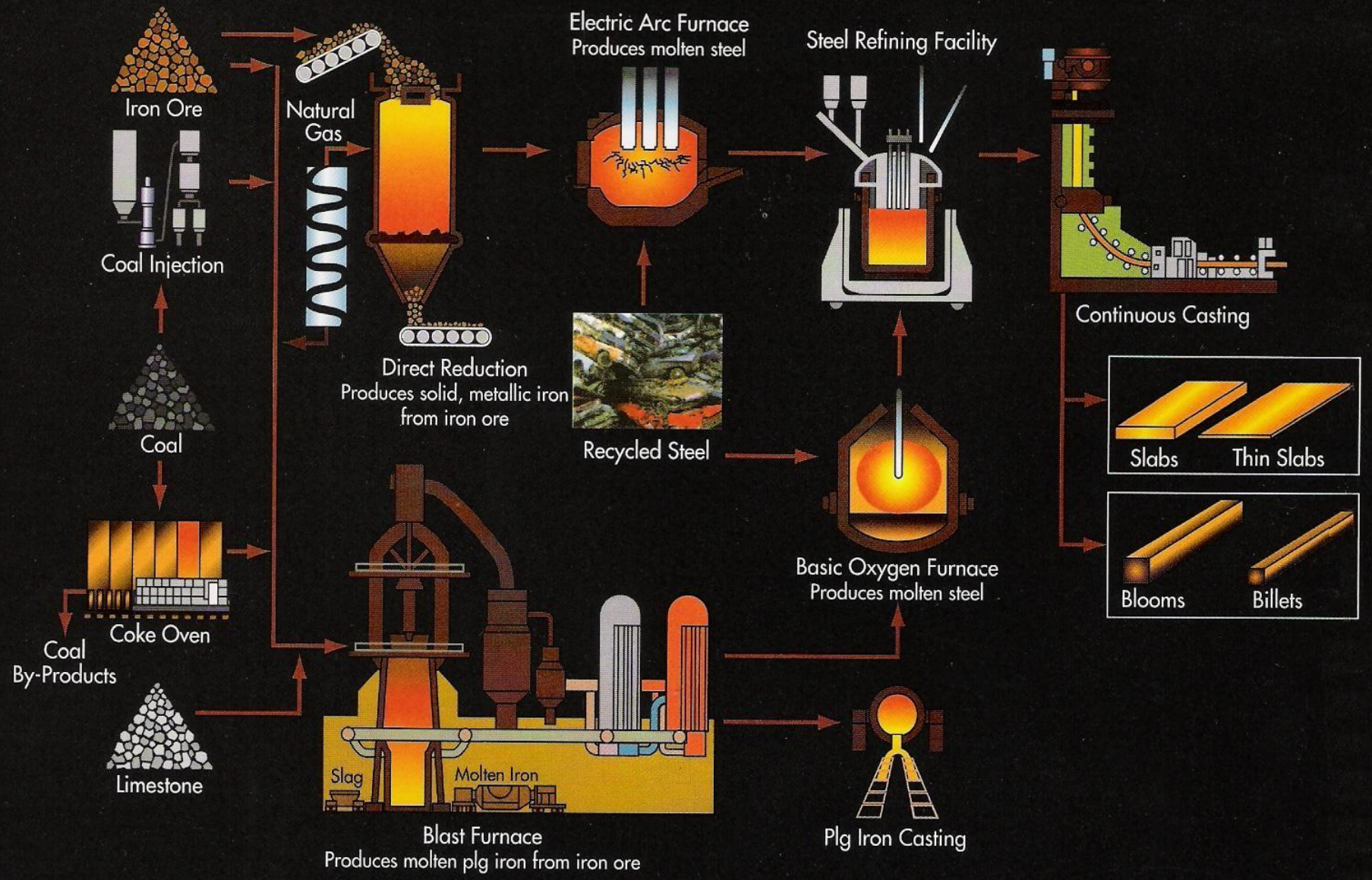




Status of EAF Sector in India

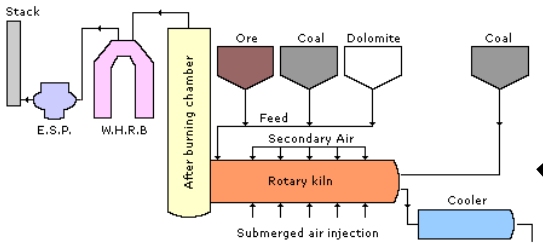
- *Contributes more than 25% of total steel production in India*
- *By 2018-19, no. of EAF working units in India are 48.*
- *Production capacity is >41 mT*
- *Production by EAF route is >28 mT*
- *Mostly producing Alloy steels – value added steels.*
- *Most of the Alloy steels are produced by EAF sector.*
- *EAF is very flexible w.r.t. raw material situations*

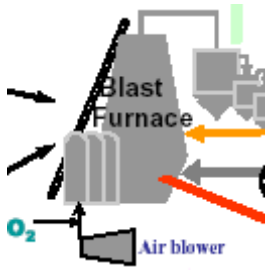
STEEL MAKING PROCESS FLOW DIAGRAM



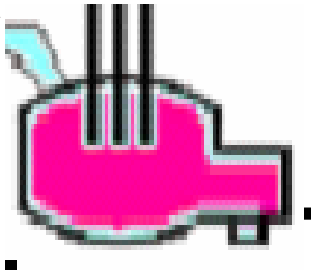
Steel Making through EAF

DRI

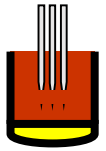




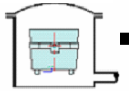
Blast Furnace



EAF

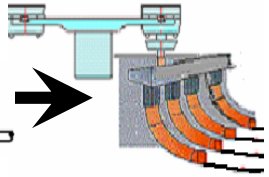


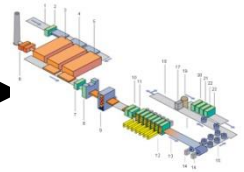
LRF



VD

Casting





Rolling

EAF- earlier design

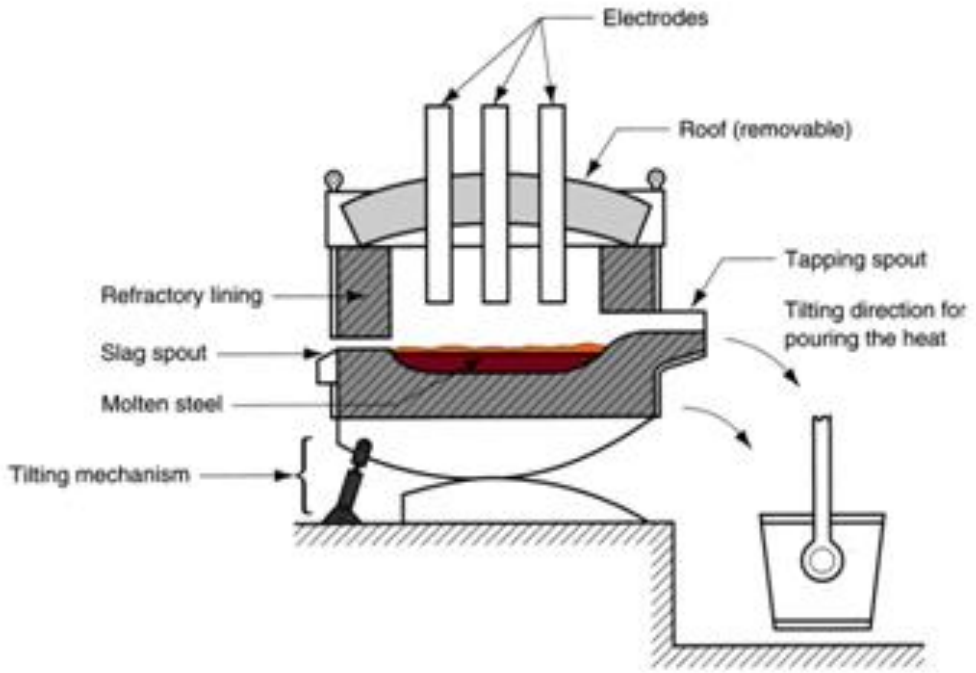
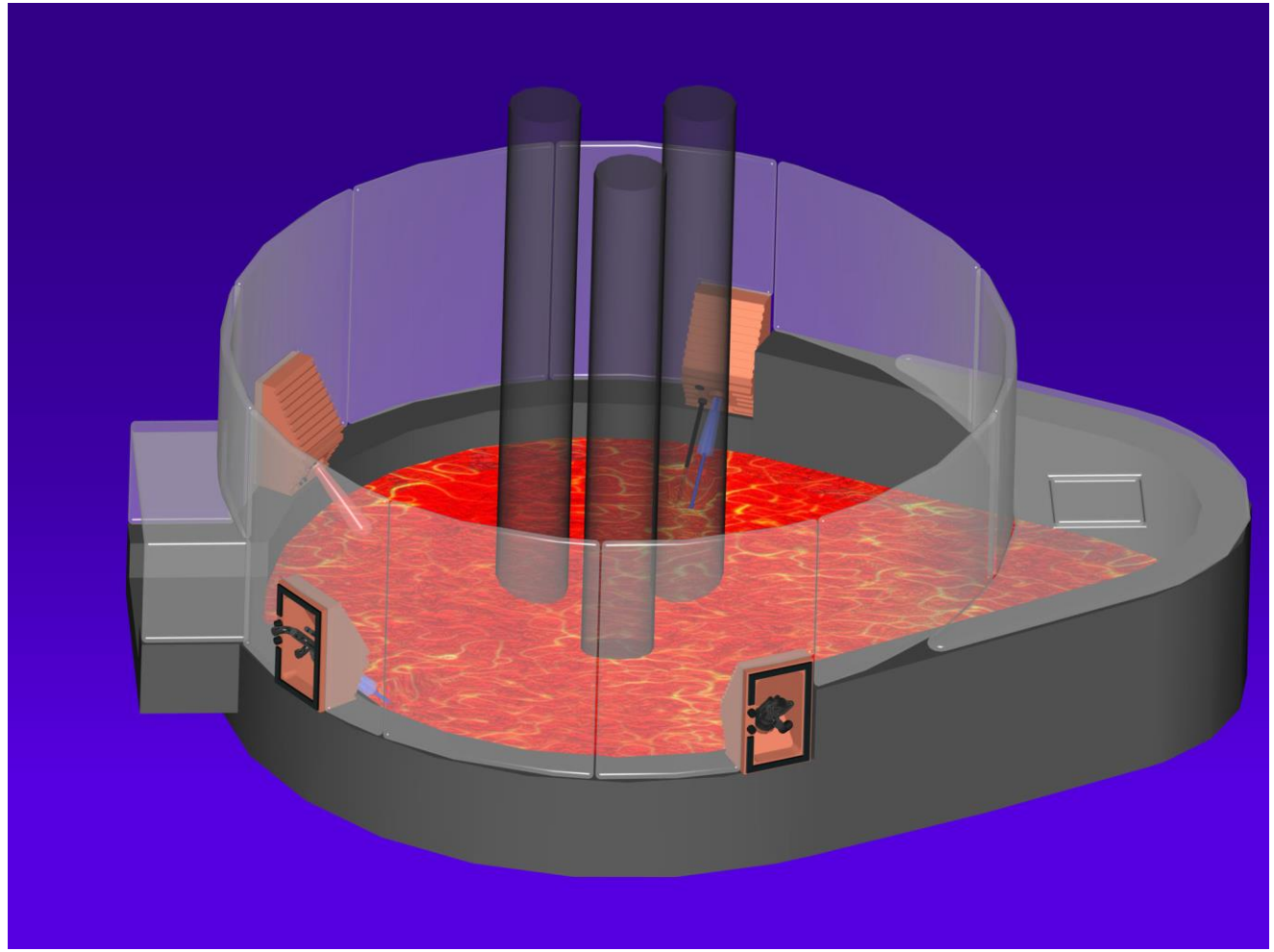


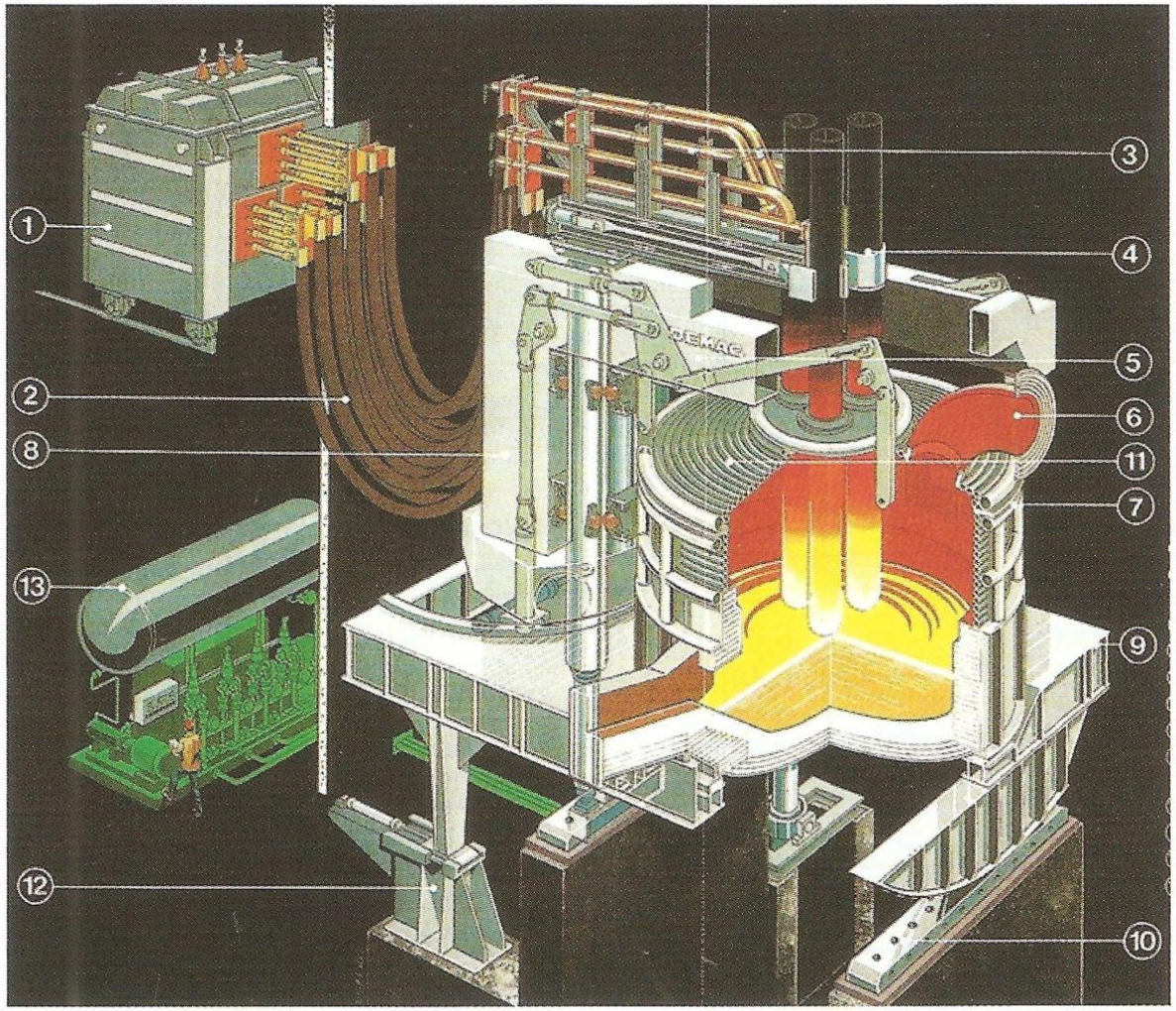
Figure 6.9 - Electric arc furnace for steelmaking


SMS
DEMAG



EAF-Detailed View

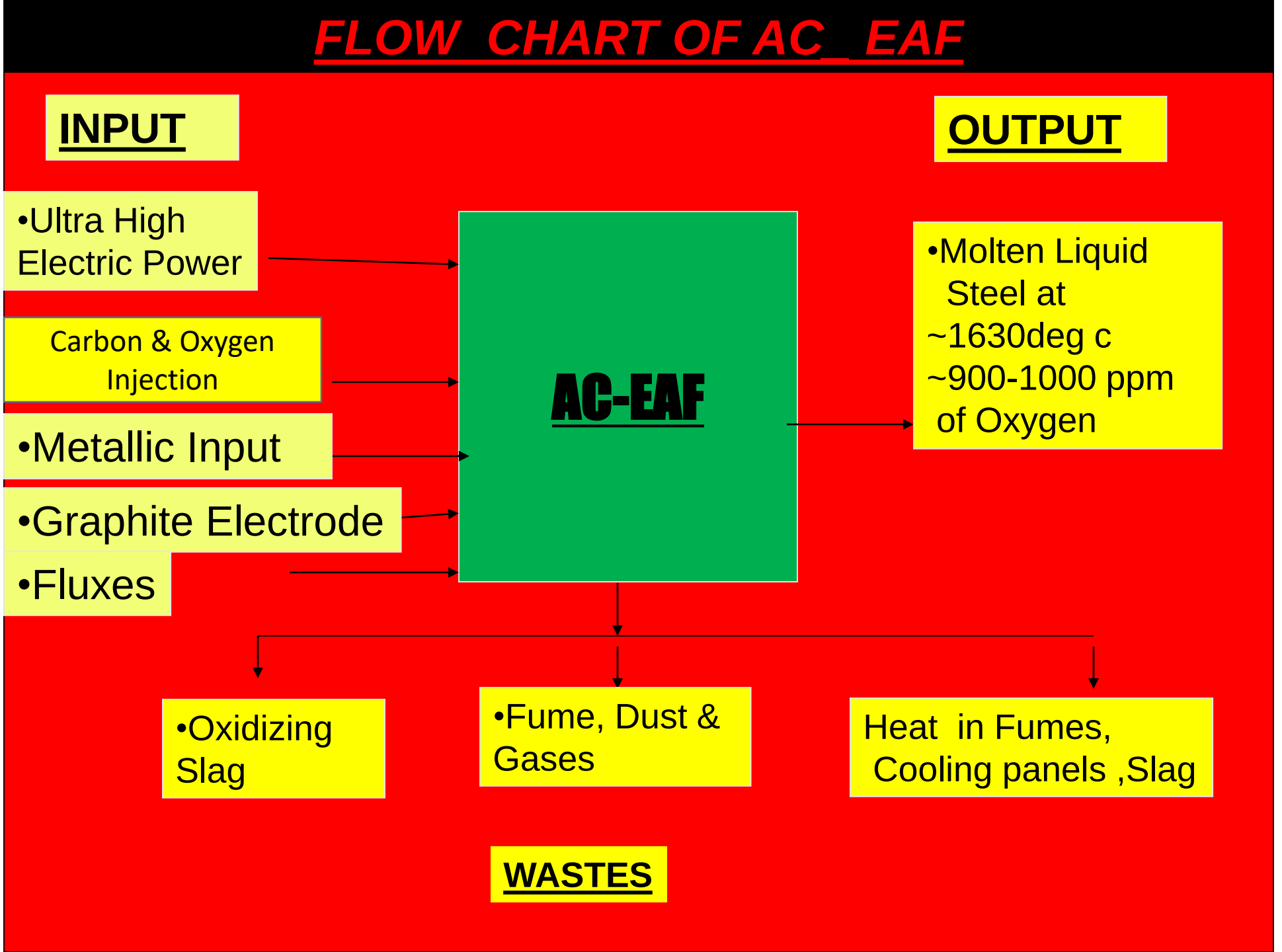
EAF Detail View



1. Furnace transformer
2. Flexible cable connection
3. Electrode arms with secondary bus bar system
4. Electrode clamp
5. Gantry with arms
6. Water cooled elbow
7. Tube cage shell
8. Super structure
9. Baseframe with tilting rocker
10. Rocker rail
11. Water cooled roof
12. Tilt interlocking
13. Hydraulic power pack

EAF Steelmaking

FLOW CHART OF AC_ EAF



Transformer Capacity

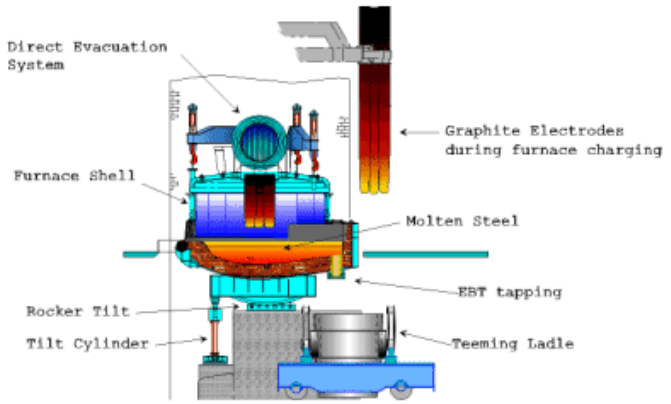
- ***Based on transformer capacity, EAFs are categorized as***
  - ***Low Power***
  - ***Medium Power***
  - ***High Power***
  - ***Ultra High Power***
- ***Transformer determines Productivity from EAF***

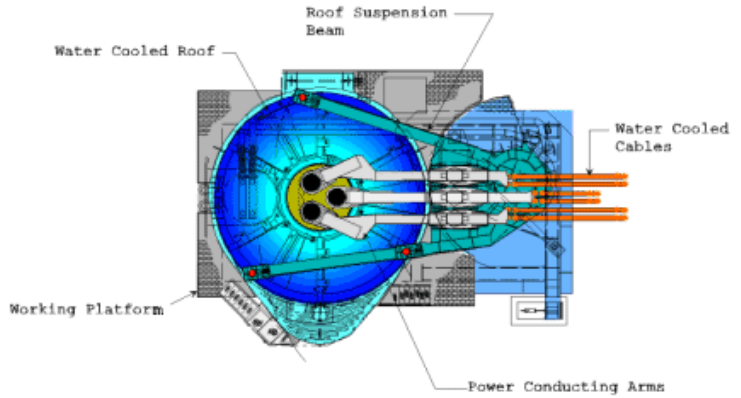
EAF - Productivity

- ***Productivity of EAF depends on :***
  - ***Holding capacity of EAF***
  - ***Tap to Tap time***
  - ***Tap to Tap time further depends on :***
  - ***Nature of charge material***
  - ***Transformer rating***
  - ***Oxygen flow rate***

ELECTRODES

- **Diameter – selection depends on current density and quality of electrodes.**
- **PCD of electrodes – depends on furnace diameter.**





Recent innovations in Steelmaking Technologies

2) EAF :

- **Use of hot metal**
- **oxy - fuel burners**
- **Pulverised coal and oxygen injection**
- **Foamy slag practice**
- **Post combustion**
- **Recovery of chemical energy of off-gas.**
- **UHP Transformers**
- **Water cooled panels, roofs**
- **Scrap preheating**
- **Slag free tapping**

Recent innovations in Steelmaking Technologies

- hot heel practice
- Inert gas stirring at bottom
- reduction in electrode consumption
- oxygen injection
- Environmental control
- Use of alternative charge materials

Developments In EAF

- **Use of hot metal**

  Advantages :

  - Thermal heat

  - Chemical heat

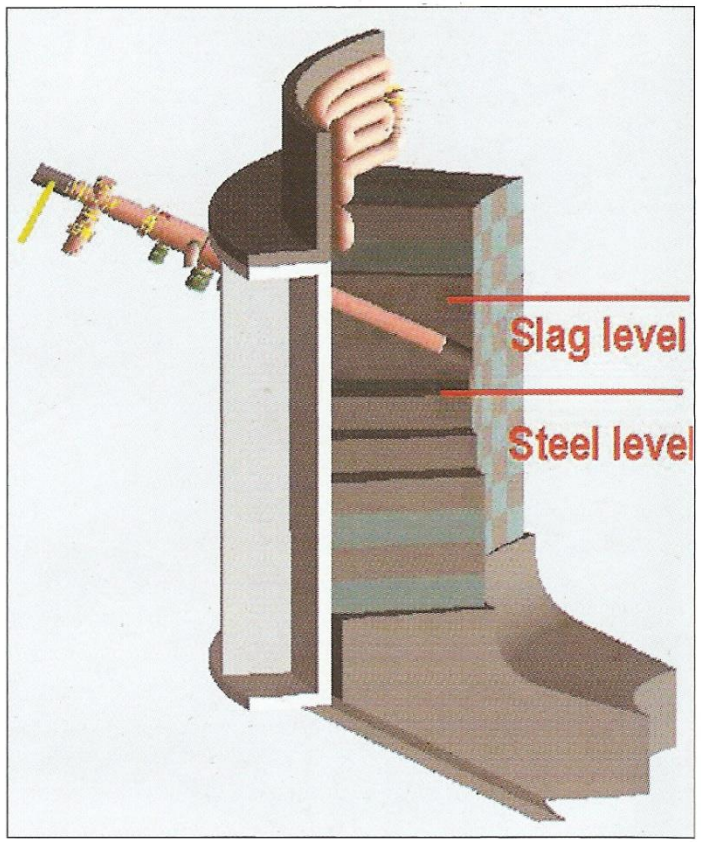
  - free of tramp elements

  - increased productivity

  - reduced power consumption (No Power)

Developments In EAF

- **Injection System**
  - **Inject O2 & carbon at slag just above metal bath via multiple lances strategically positioned.**
  - **Copper lances, do not project beyond refractory**
  - **Short distance between nozzle and bath**



● **Figure 1** ***KT injection system***

45° or more to avoid steel splashing on the electrodes

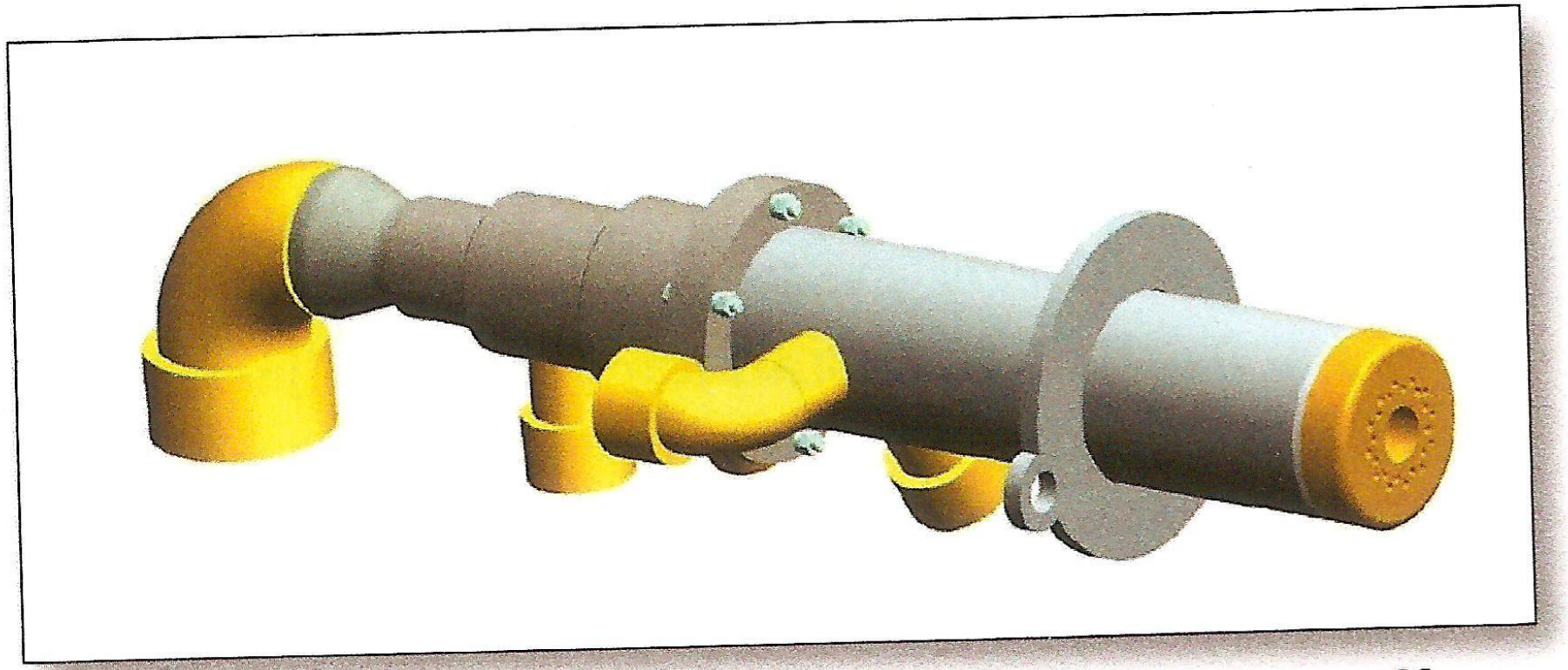
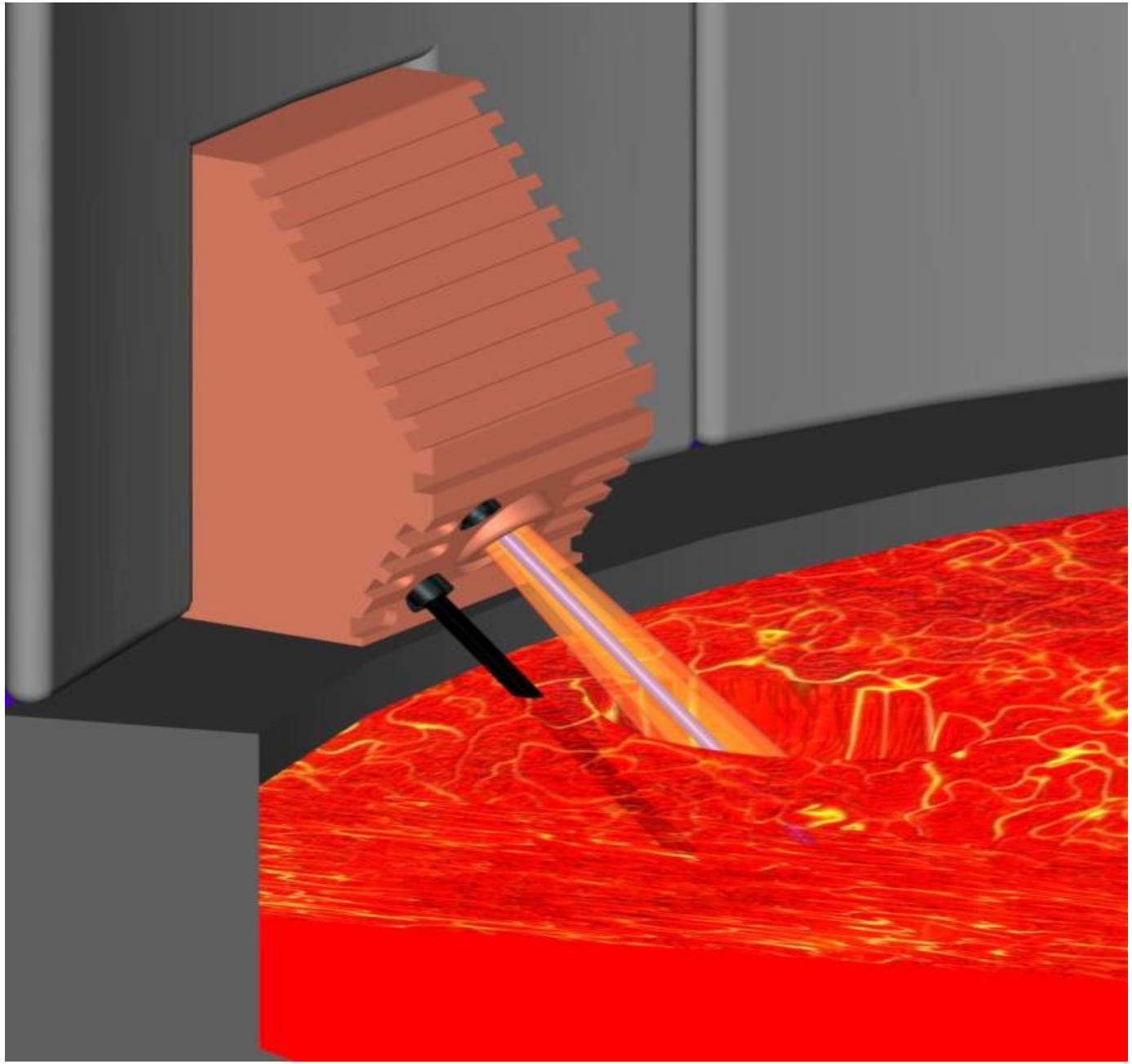


Fig 3b Oxygen jet + burner, with shrouding effect



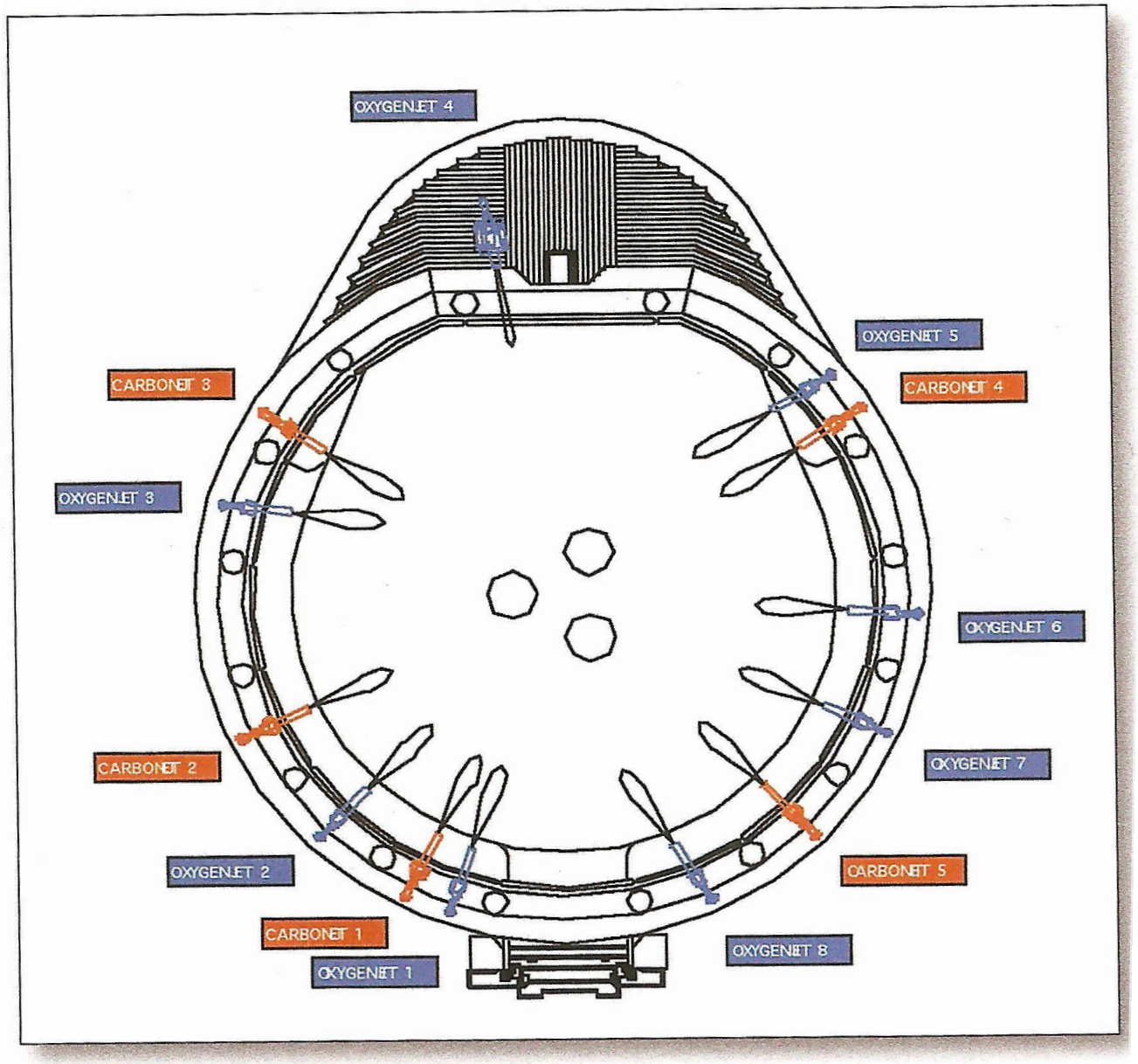
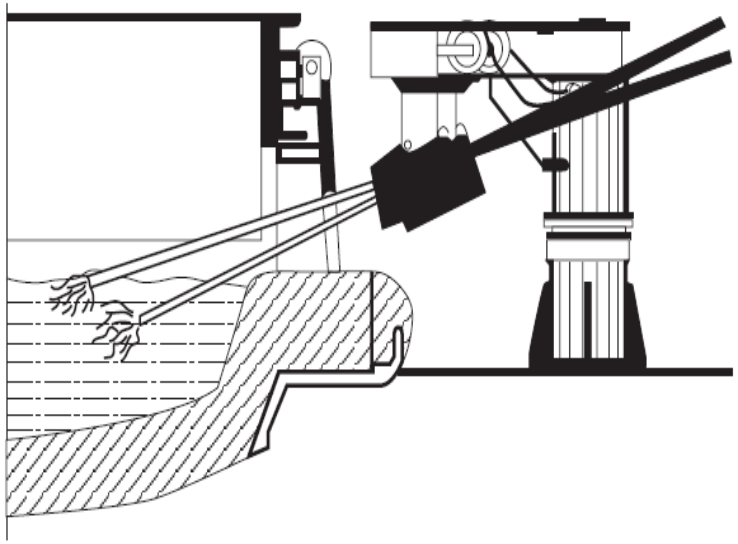
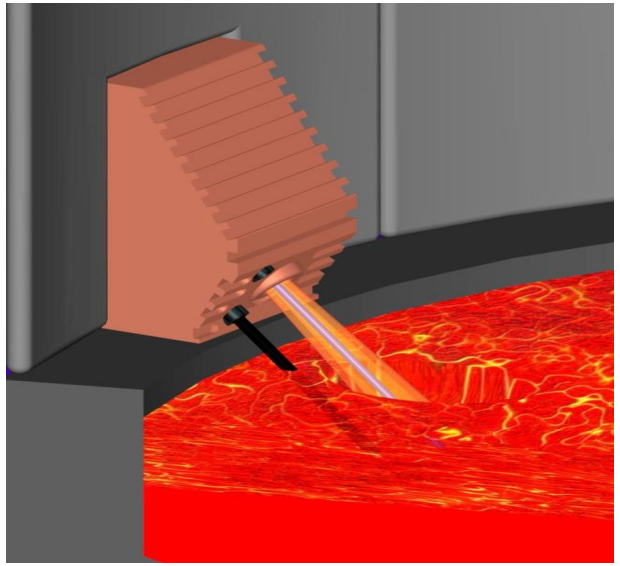


Fig 3a EAF layout with injector positions

EAF - Carbon Injection

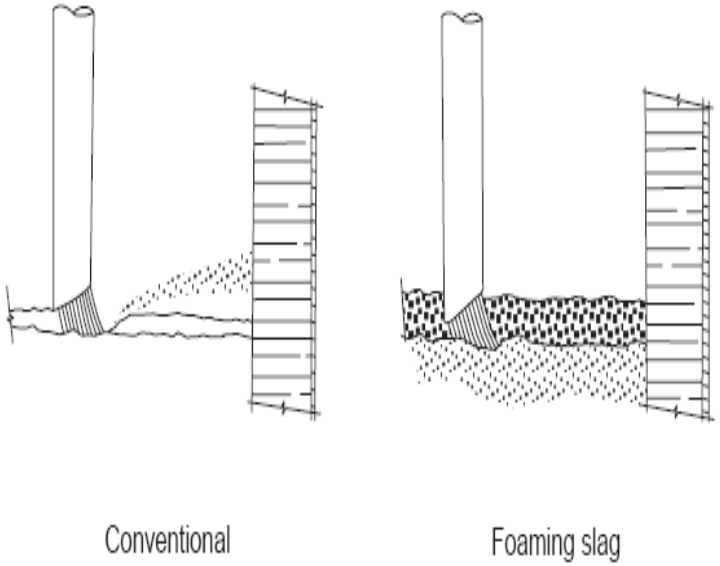
- *Carbon is injected in form of Coke fines*
- *In earlier designs, Coke powder was injected through slag door*
- *In present designs, in built carbon injectors*
- *Purpose is to reduce FeO in slag*
- *Also helps in formation of foamy slag*





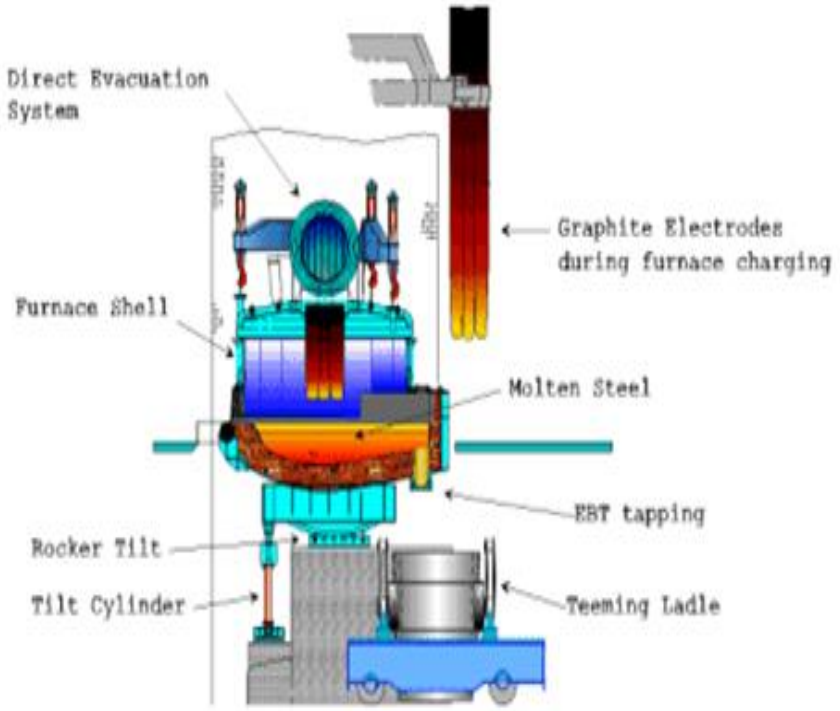
EAF – Foamy slag practice

- ***Advantages of Foamy slag :***
- ***Slag covers the Arc***
- ***Thermal efficiency is improved***
- ***Less nitrogen ppm***
- ***Better life of Water cooled panels and Refractories***



Slag Free Tapping, Hot Heel Practice

- **Minimum slag flow in ladle**
- **Retain hot heel in furnace.**
  - **provide efficient melting during next heat.**
  - **Increase arc stability**
  - **Improve refractory life**

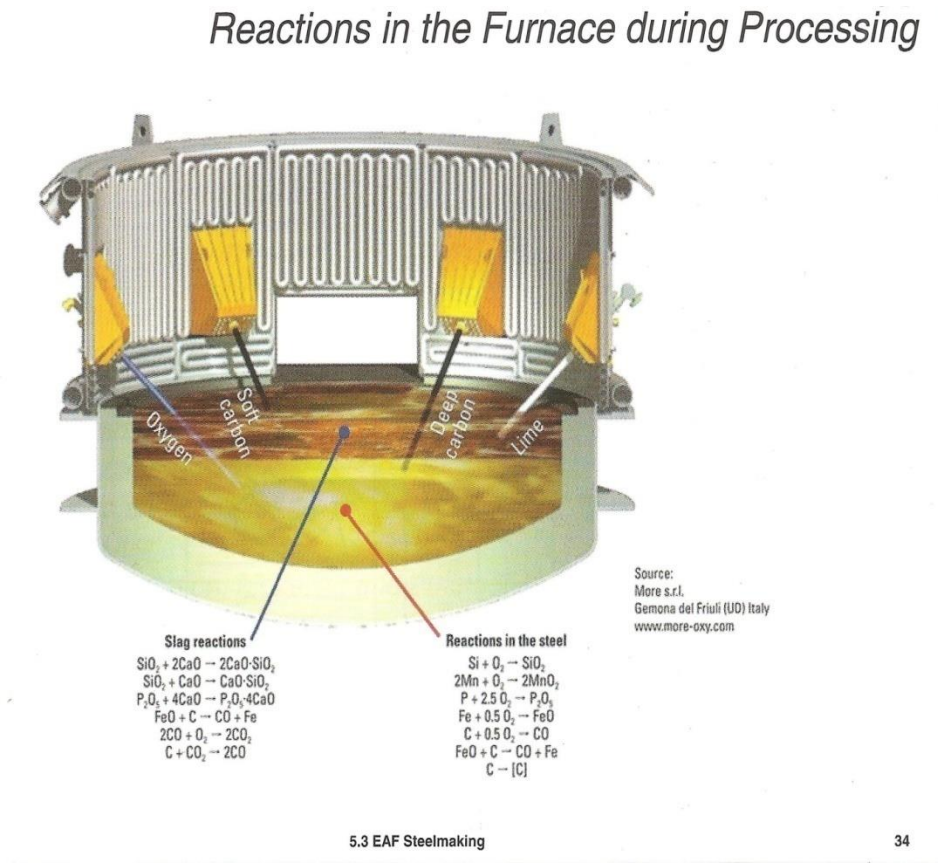


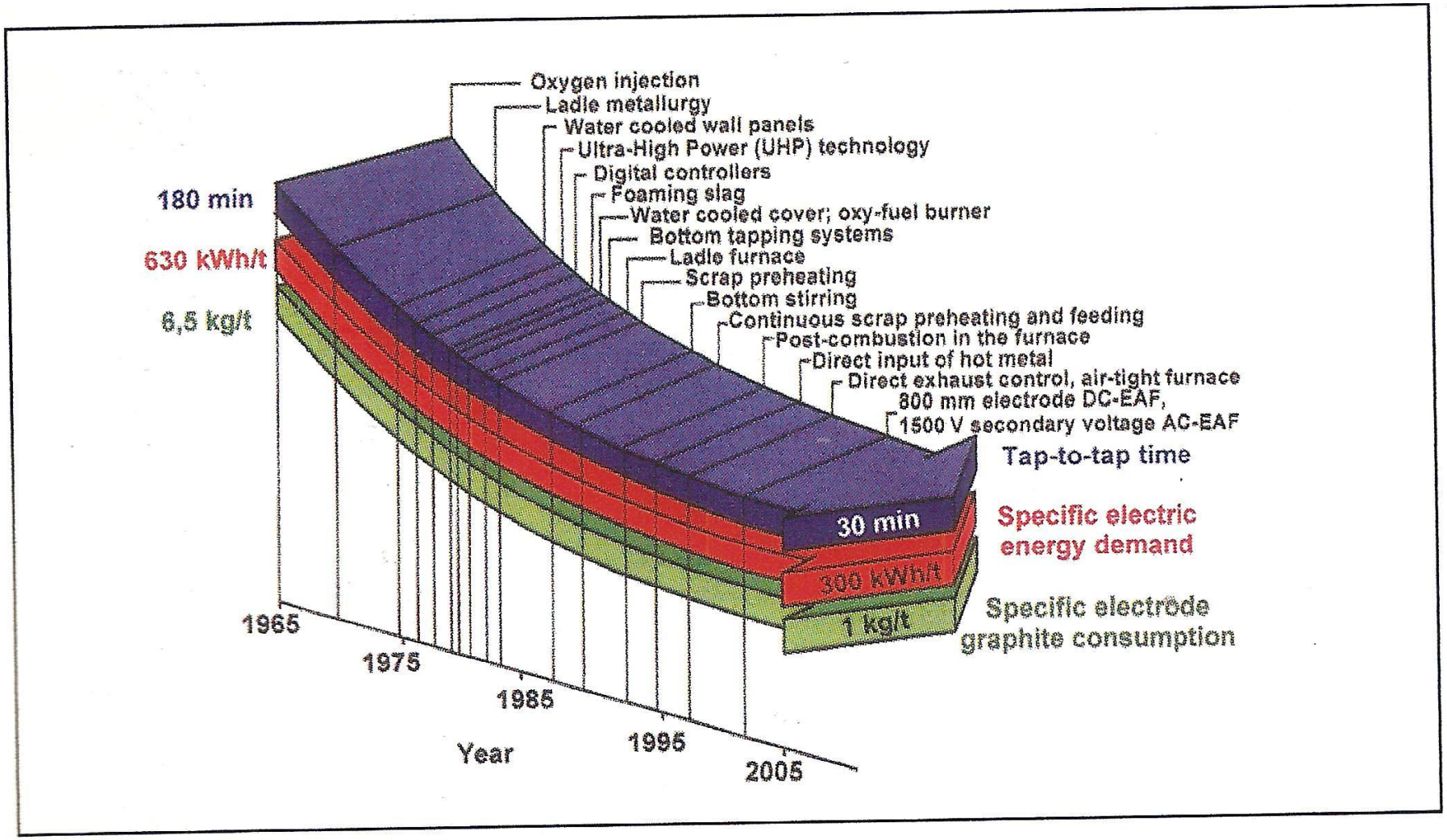
Scrap Heating

- **Objective : - to reduce power consumption**
  - improving productivity
- **Methodology : by using sensible heat in furnace waste gases.**
- **Benefits : - Productivity improves**
  - Low power consumption
  - Flat bath operation, low flicker, low furnace noise
- **Processes Developed : - EOF**
  - Consteel
  - Finger shaft furnace

Water Cooled Panels

- **Main advantage – Eliminates requirement of refractory in the side walls.**
- **But, increases heat losses. Still preferred.**





Picture 2: Development Of Ttt-times, Electr. Power Consumption And Electrode Consumption/1/

Cost of Steel making

- ***Fixed cost***
- ***Variable cost***
- ***fixed cost is usually fixed, once the equipments and technology is selected,***
- ***Significant changes in technology, w.r.t. equipments and process have taken place over the years***
- ***There is wide scope in controlling the cost by controlling variable cost***
- ***Overall economics of production strongly depends on process dynamics.***
- ***Selection and use of raw materials is a key factor***

Raw Materials and their Impact on Cost

- *Choice of Raw Materials and their impact on Quality of Steel, Power Consumption and cost w.r.t. their advantages and disadvantages, yield, flux requirement and cost of Raw Material:*
  - *Steel Scrap*
  - *DRI – Coal Based, Gas Based*
  - *Pig Iron*
  - *Hot Metal- available from Mini Blast Furnace/CPC/Coke*

Raw Materials in EAF and their Impact on Cost

Raw Material	Yield	Power Consumption	Quality	Refractory Consumption	Campaign life	Impact on costing
Steel Scrap						
Coal based DRI						
Gas Based DRI						
Pig Iron						
Cast Iron						
Hot Metal						

Process efficiency in EAF

- *Proper initial charging of raw materials*
- *Proper feeding during melting process*
- *Feeding w.r.t. power input*
- *Suitable selection of electrical power*
- *Tap-Tap time*
- *Tapping temperature and composition of liquid steel w.r.t. grade*
- *Ladle additions and Recovery of Ferro-Alloys*

CONCLUSION

Market situation is always dynamic and Techno-Economic analysis must be done on continuous basis depending on availability, price, specific consumption, productivity and other direct and indirect benefits.

By suitable techno-economics, Rs 200/MT saving is easily possible without any investment

For 1.0 million MT plant, savings could be Rs. 20 Cr/year

Your manpower must be skilled enough to take on these challenges

Thank you and Best wishes

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