ASEAN GLASS CONFERENCE 2007

Tank Furnaces – latest technology

presented by Roland Wagenbauer / IWG

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Content:

- History of glass melting furnace building
- Glass melting tank furnaces – today
- Glass melting tank furnaces – tomorrow

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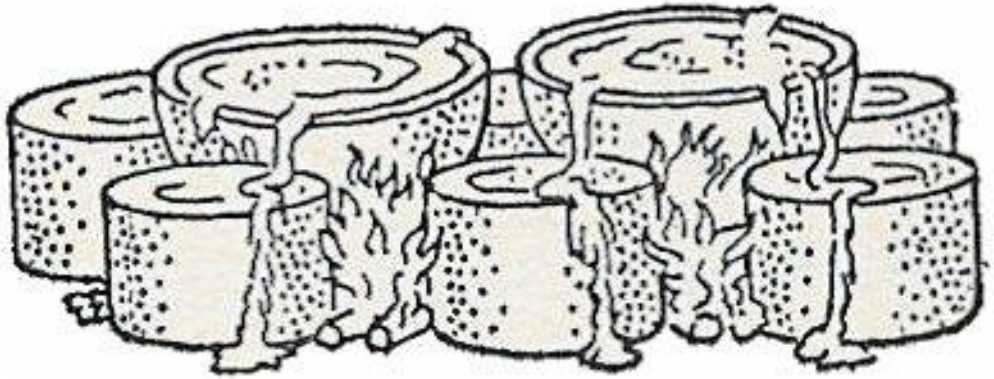
The history of glass melting furnace building can be divided in five main historic eras:

➢ 1st era:

Fritting and melting in pans on wood fires in pre-Christian times



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History

- **2nd era:**

  Glass melting pot furnaces fired with wood from the beginning of our time era until the 17th century

Glass melting furnace
according to Agricola

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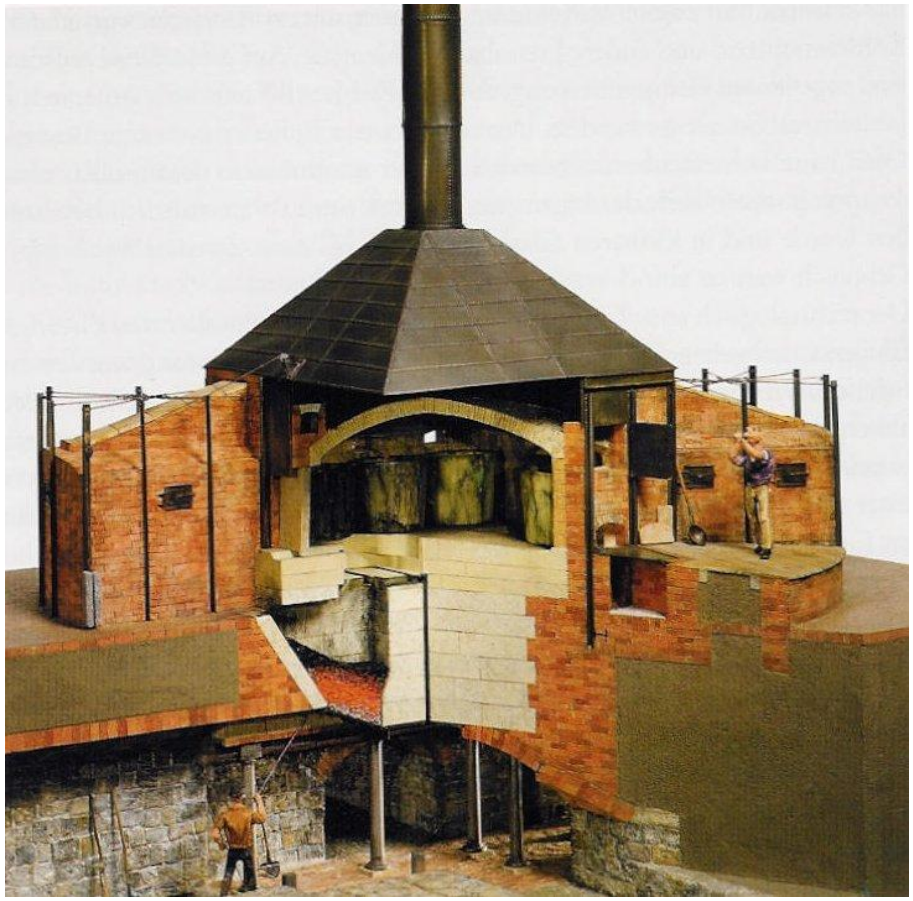
History

- **3rd era:**

  Glass melting furnaces with grillage for operations with wood and also partly with hard coal (1600 – 1850)



Boetius furnace – with a so-called half gas firing

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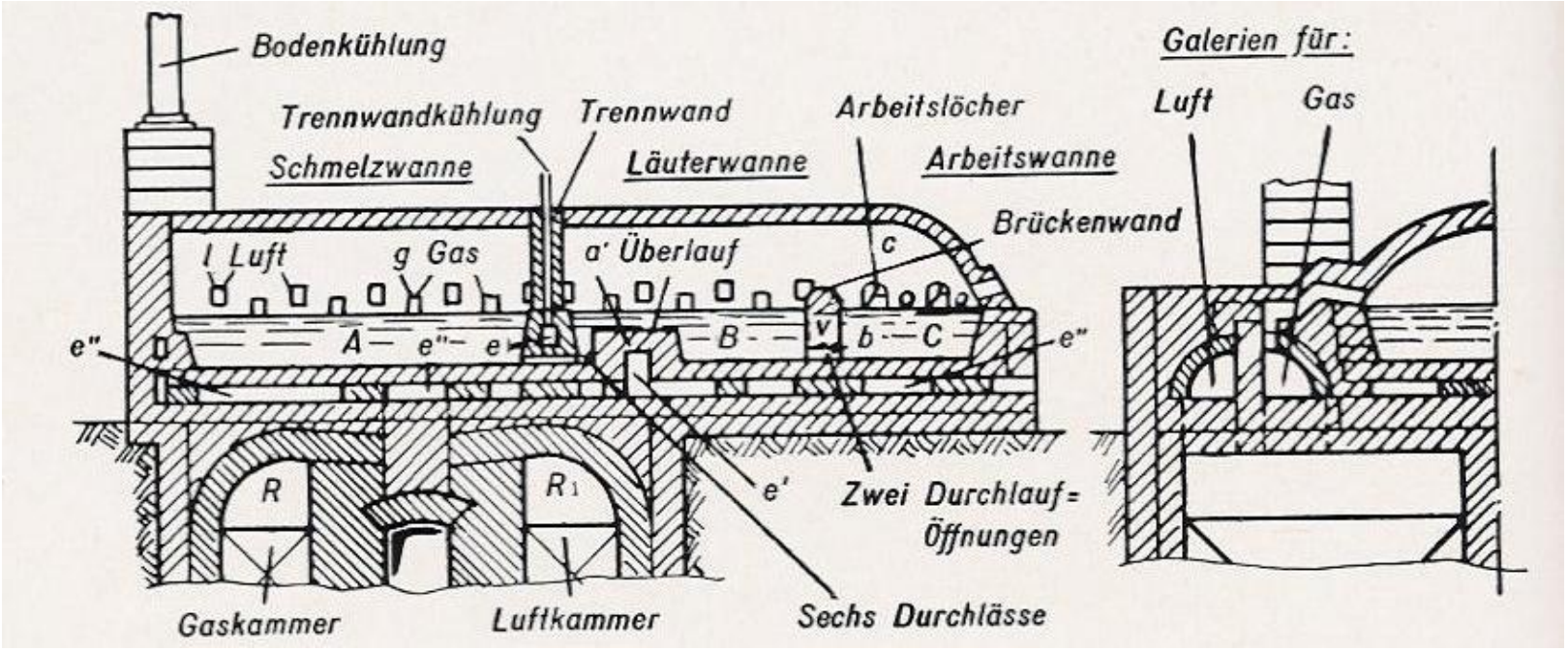
History

- **4th era:**

Gas fired glass melting pot and tank furnaces, from 1860 until around 1960, with generator and gas coke oven



Regenerative tank furnace according to Friedrich August Siemens

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History

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➢ **5th era:**

- ✓ From 1920: first all-electric furnaces in Norway and Sweden
- ✓ From 1950: introduction of the oil fired glass melting furnaces
- ✓ From 1960: use of natural gas for glass melting furnaces
- ✓ From 1990: use of oxygen as energy source for tank furnaces

⇒ **Continuous Development**

⇒ **Tank furnaces today**

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➢ Requirements on modern tank furnaces:

- ✓ Low energy consumption
- ✓ High flexibility in terms of pull rate
- ✓ High glass quality
- ✓ Low CO_2- and NOx- emissions
- ✓ Low operation / running costs
- ✓ Long lifetime

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➢ Oxy-Fuel Tank Furnace:

✓ **General Design**

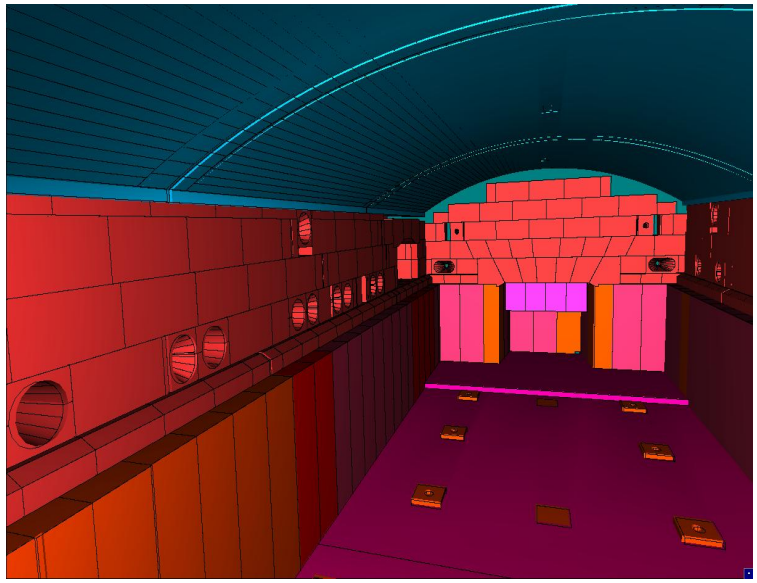
⇒ **Unit Melter type**
⇒ **Melting and refining part divided by air cooled barrier wall**

✓ **Heating System**

⇒ **High efficient oxy-fuel burner**
⇒ **Individual burner control**

✓ **Electric Boosting**

⇒ **Melting area**
⇒ **Thermal barrier**



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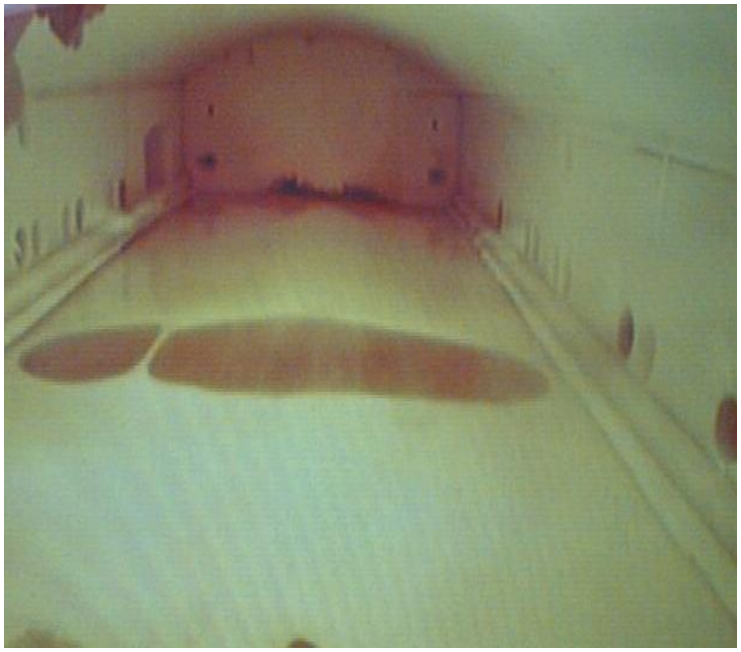
➢ Oxy-Fuel Tank Furnace:

✓ **Oxygen Bubbling**



✓ **Draining units**

⇒ **permanent or periodically**

⇒ **direct or indirect heated**

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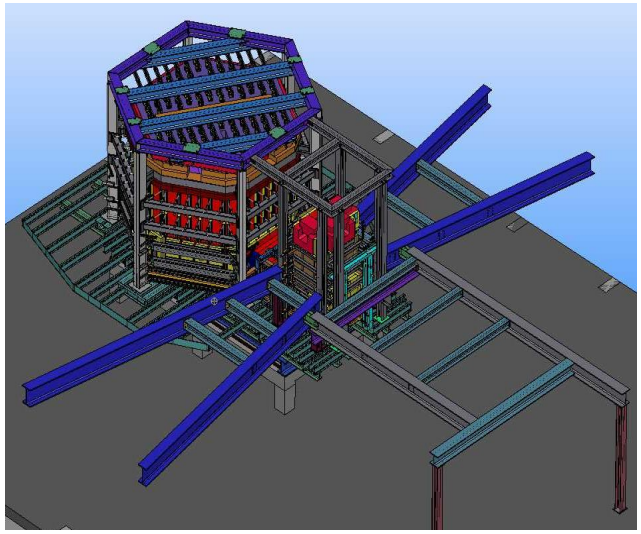
➢ All-Electric Tank Furnace:



- ✓ **General Design**
  - ⇒ Cold-Top with hexagonal shape
  - ⇒ Cold-Top with rectangular shape

- ✓ **Electrical Heating**
  - ⇒ 3 independent heating levels
  - ⇒ Top-electrodes
  - ⇒ Side wall-electrodes
  - ⇒ Bottom-electrodes (start-electrodes)
  - ⇒ Single phase-, two phase- or three phase transformer

- ✓ **Electrodes**
  - ⇒ Tin-oxide electrodes
  - ⇒ Molybdenum electrodes

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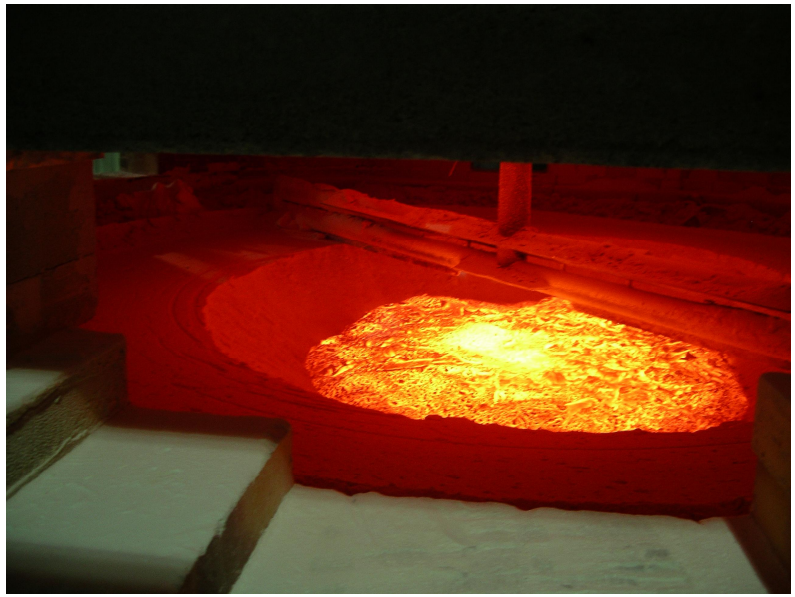
➢ All-Electric Tank Furnace:

- ✓ **Batch Charging**
  - ⇒ **X-Y batch charger**
  - ⇒ **Rotating distributor**



- ✓ **Draining units**
  - ⇒ **permanent or periodically**
  - ⇒ **direct or indirect heated**

- ✓ **Advantages of this system**
  - ⇒ **Temperature profile adjustable**
  - ⇒ **Higher flexibility concerning pull rate**
  - ⇒ **Easier changing of batch composition**

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Comparison: Oxy-Fuel ⇔ All Electric

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➢ Both technologies in compare:

	Oxy-Fuel ⇔	All Electric
Specific energy consumption [kWh/kg glass]	higher, but dependent on furnace size and batch composition	lower, but dependent on furnace size and batch composition
Specific energy costs [€/kg glass]	higher, but dependent on energy prices [€/kWh]	lower, but dependent on energy prices [€/kWh]
Investment costs (furnace + filter)	higher	lower
Operation costs	lower	higher
CO_2- and NOx	higher	lower

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Comparison: Oxy-Fuel ⇔ All Electric

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	Oxy-Fuel	⇔	All Electric
Life time	6 – 10 years, depending on glass type		max. 4-6 years, depending on glass type
Flexibility pull rate	higher flexibility		lower flexibility
Glass quality: - flexible pull rate - constant pull rate	higher lower		lower higher
Increase of pull rate	possible with electric boosting		difficult
Changing glass type	much easier		more difficult
Reconstruction time	longer		shorter
Furnace control	equal		equal
+ other specific criterias of customers	....		....

➢ Platinum Feeder System:

- ✓ **General Design**
  - ⇒ Platinum tube system
  - ⇒ Stirrer cell with stirrer
  - ⇒ Draining nozzle
  - ⇒ Connecting tube
  - ⇒ Plunger cell with stirrer-plunger
  - ⇒ Orifice or outflow nozzle
- ✓ **Stirrer Cell**
  - ⇒ Reduction of cords
  - ⇒ Temperature homogenization
- ✓ **Draining Nozzle**
  - ⇒ permanent or periodically

➢ Platinum Feeder System:

- ✓ **Connecting tube**
  - ⇒ Conditioning of glass temperature
- ✓ **Plunger Cell**
  - ⇒ Conditioning of glass temperature
  - ⇒ Reduction of cords and shear marks
- ✓ **Orifice/Outflow Nozzle**
  - ⇒ Forming of Gobs
- ✓ **Type of Heating**
  - ⇒ Direct heating
  - ⇒ Indirect heating
  - ⇒ Inductive heating
  - ⇒ Mixture of the different heating systems

➢ Technology of the future:

- ✓ Microwave – Technology in refining part
- ✓ Iridium as new electrode-materials
- ✓ New energy-sources ?

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Contact

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