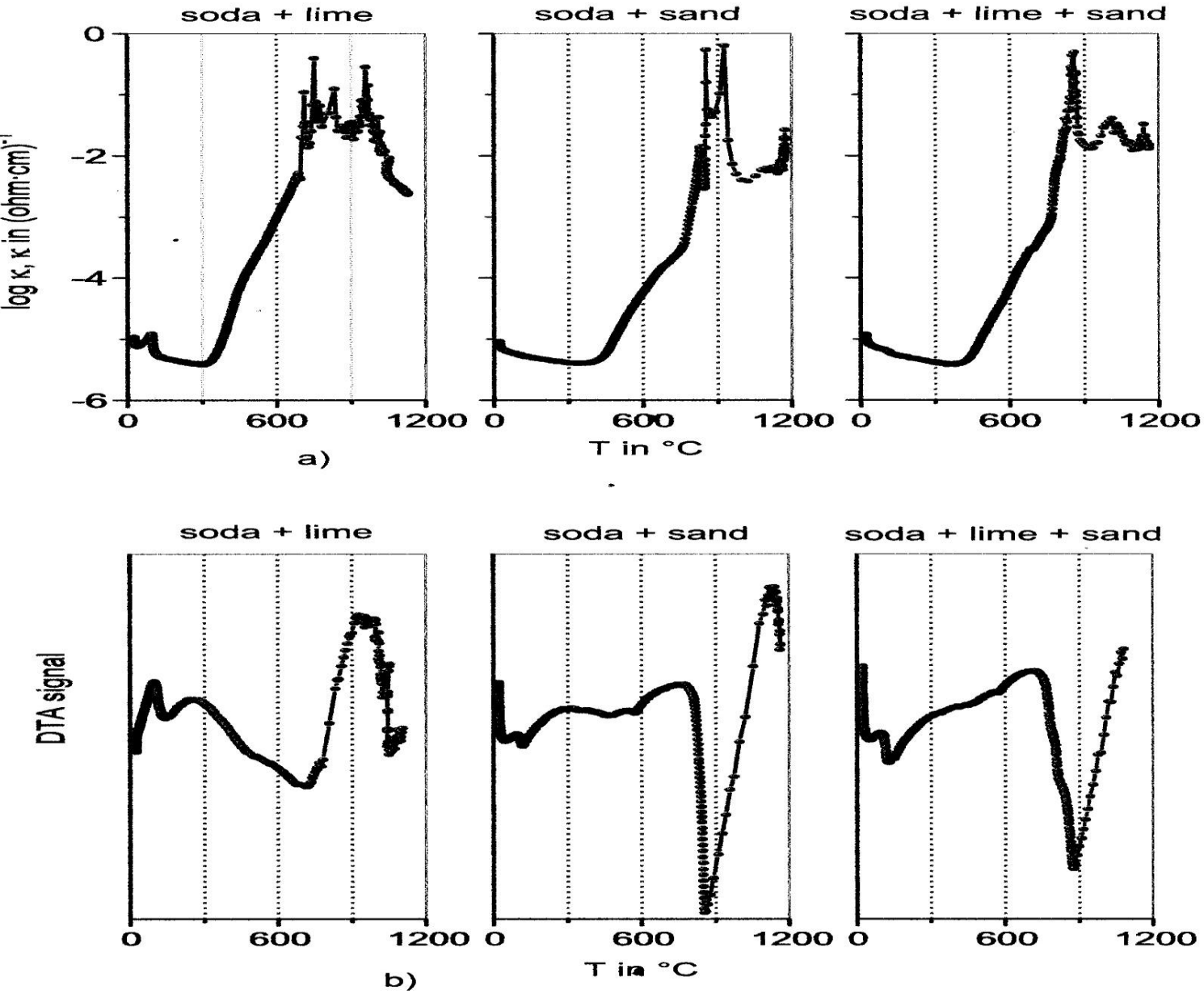
Ways to increase performance and durability all-electric furnaces Can melt 7 t / m2 day? Can increase durability up to 10 years?

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47. Investigation of soda-lime-sand system showing a) electrical conductivity and b) DTA signals

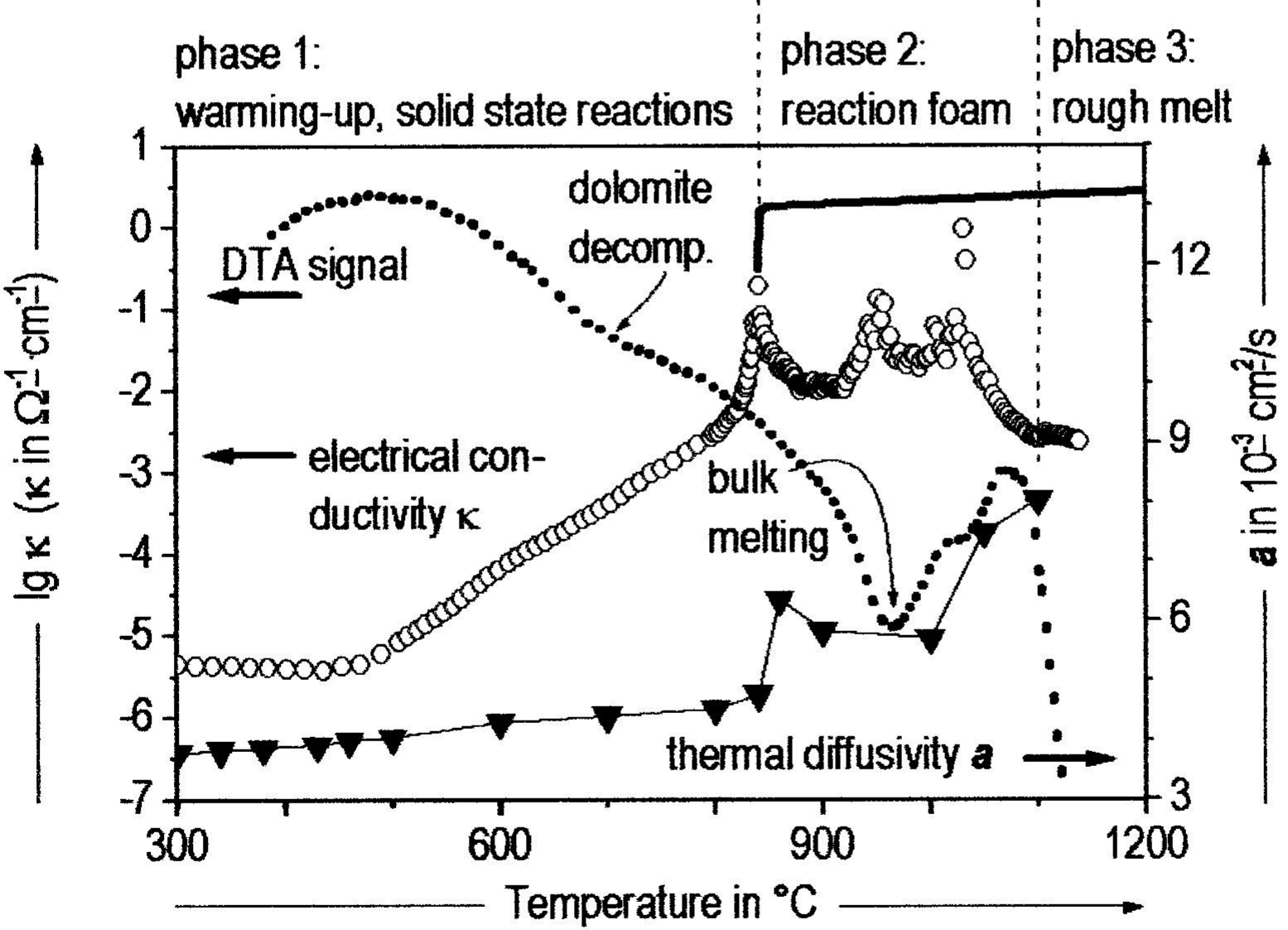


Fig. 75. Plot of electrical conductivity and thermal diffusivity of white glass [70]

Nang Sam Kham Disertation RWTH Aachen 2005

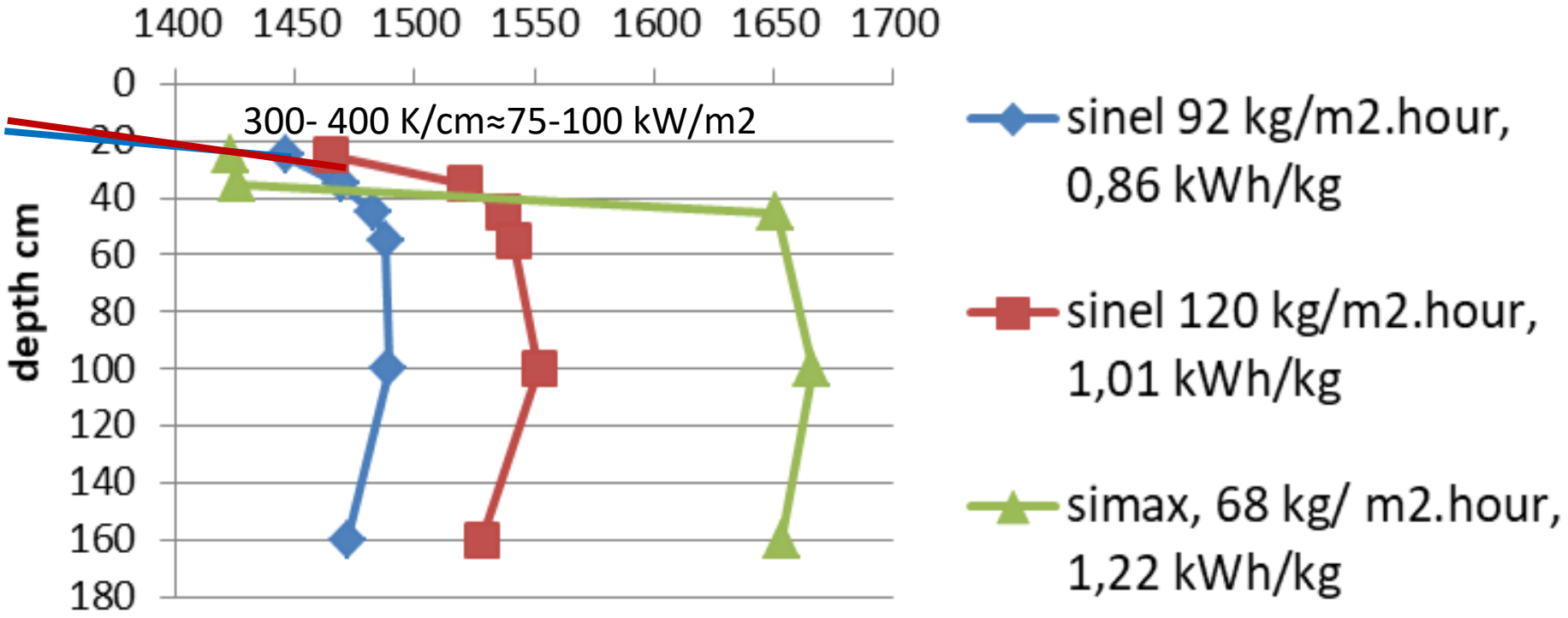
Soft glass sinel. 30% increasing output

about 12% to 2,9 kg/m2.day =

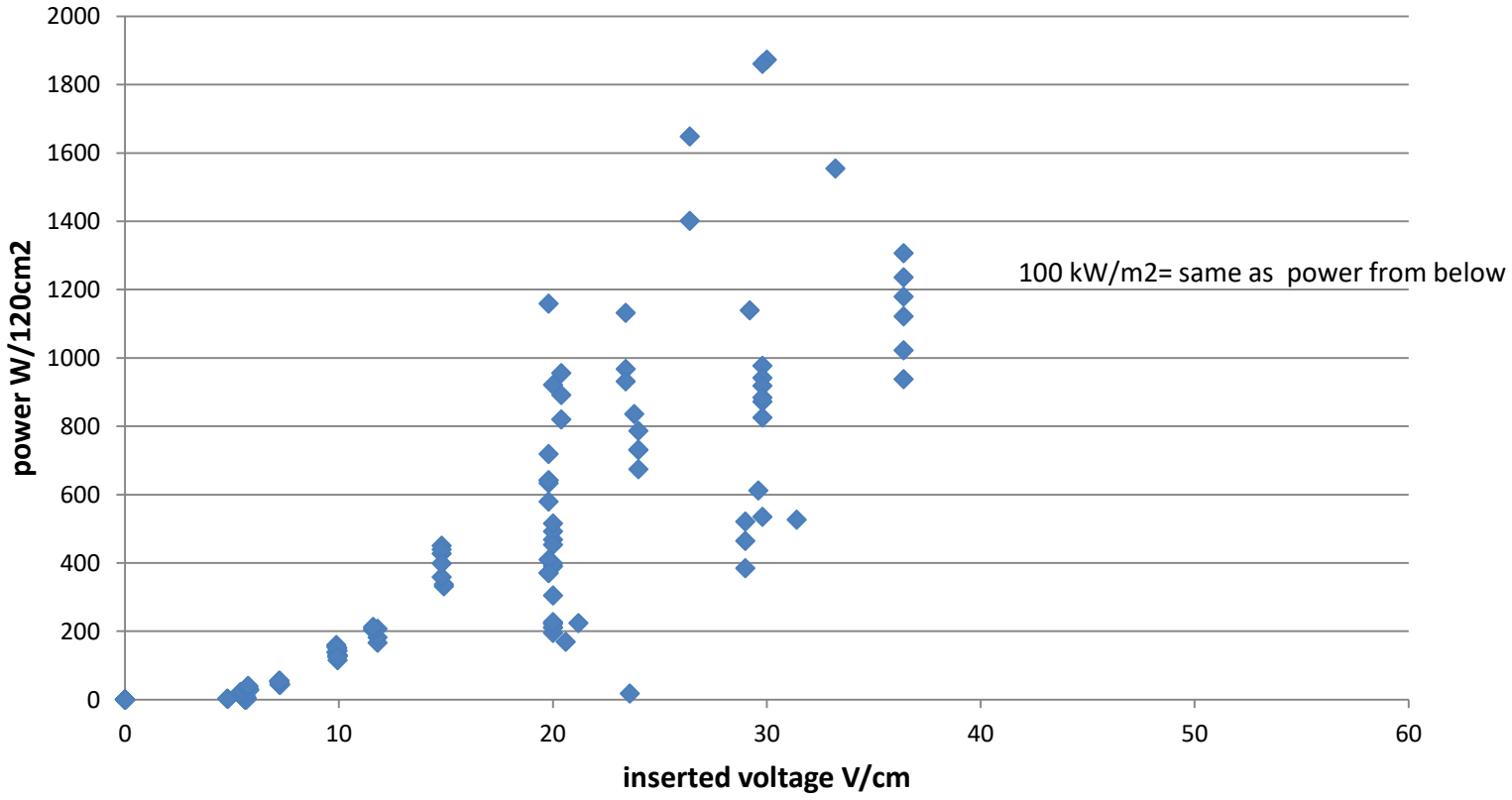
19% increasing consumption+

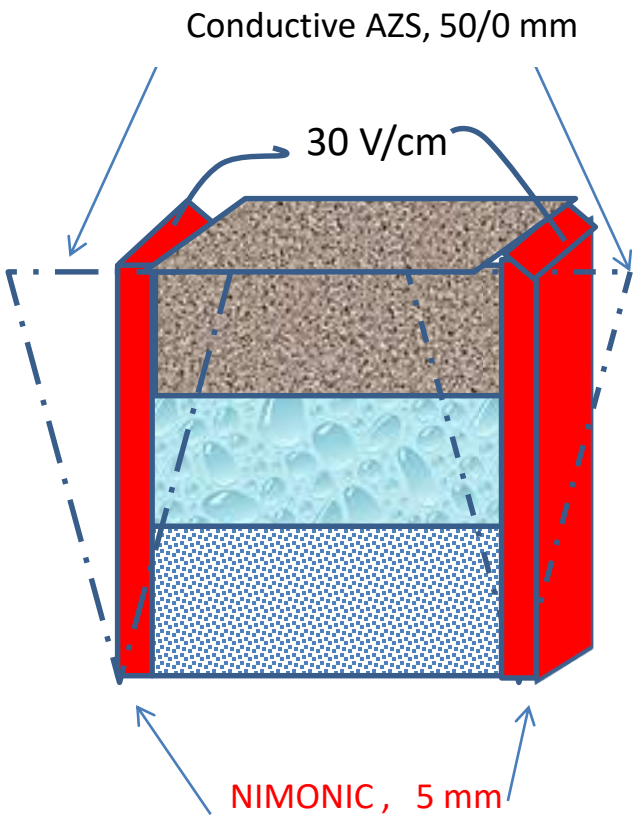
+ 50 K increasing temperature

Simax = low output,high consumption



Electrical power against inserted voltage into batch layer within 800-1000°C -deregulations effect – exponential increase of power

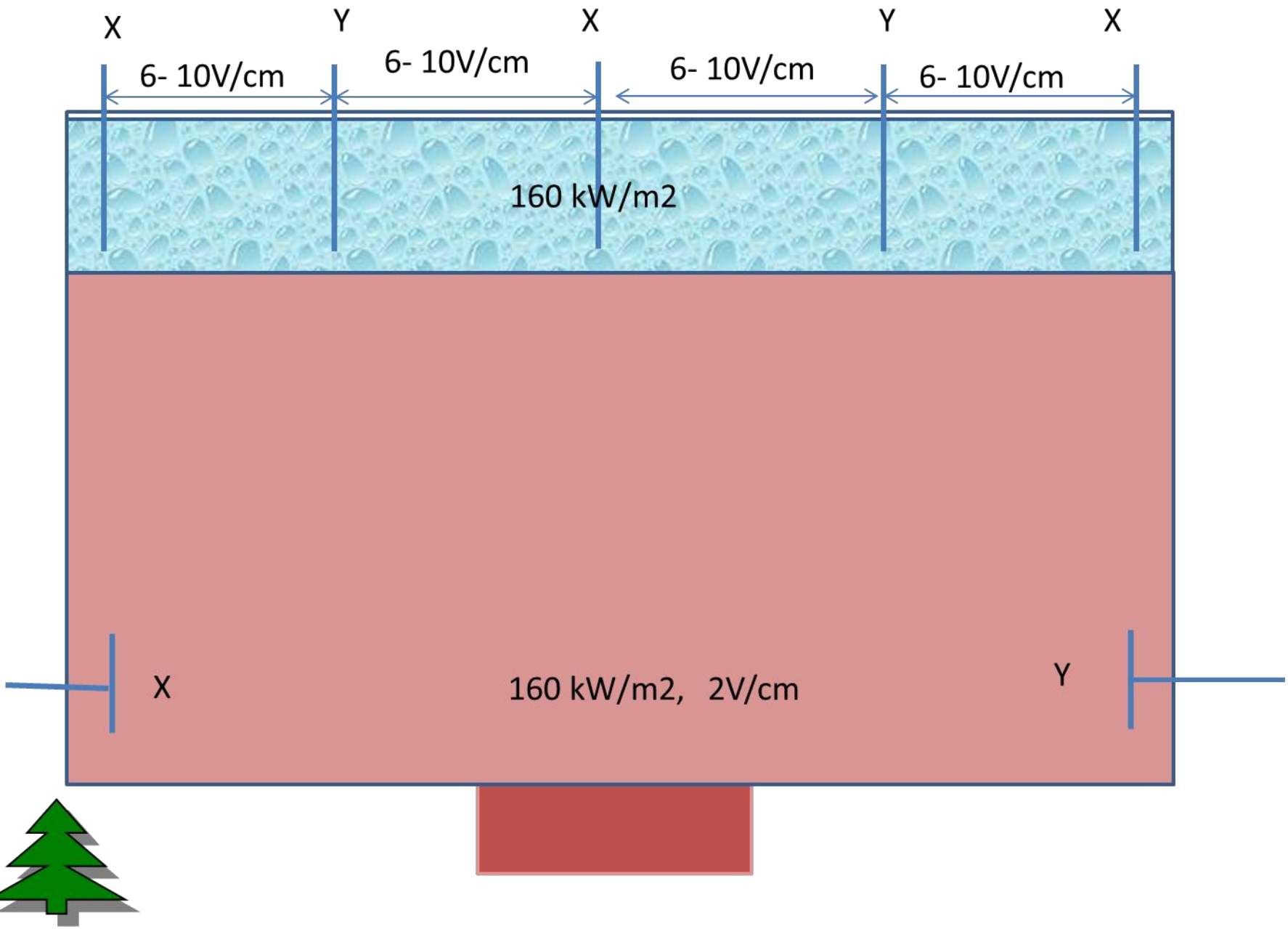




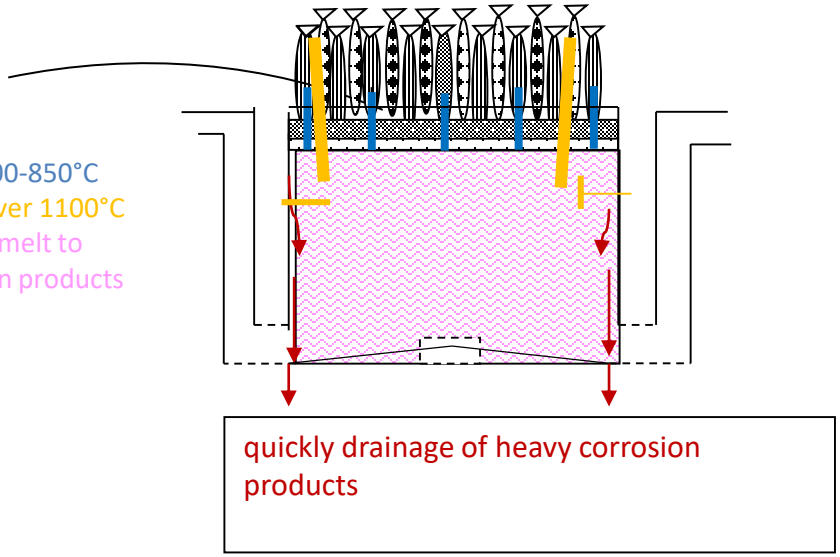
750°C	5000 ohmcm	0,18 kW/m2
850°C	500 ohmcm	1,8 kW/m2
950°C	10 ohmcm	900 kW/m2 (48 t/day.m2)
1000°C	50 ohmcm	180kW/m2

Arrangement of ribbon metal or ceramic electrodes in the charge, crust and glass melt.
By 850- 900°C began melt soda, bubbles decreases conductivity,
by 950 °is conductivity the highest,
by 1000°C react soda with sand, conductivity go down.
As eletrode is possible NIMONIC 80 (20 years used as mixer and elektrode in glassmelt by 950°C)
Using of conductive keramik (e.g. with Y, or AZS with more alkali) is also possible .

All electric tank 2025 : 400 kg/m2.h= 10t/m2.d, 0,8 kWh/kg



Support of batch and cullet
plate steel electrodes in batch 400-850°C
Mo electrodes in molten glass over 1100°C
10-20 hours delay for quiet glassmelt to fining from bubbles and corrosion products
Possibly throats



quickly drainage of heavy corrosion products

Piston flow all-electric furnace, 7-10 t/m2.day



Conclusions

1 / No more than 16 kW / m2 can be fed from below with radiation. Therefore, the convection is so strong in all-electric furnaces

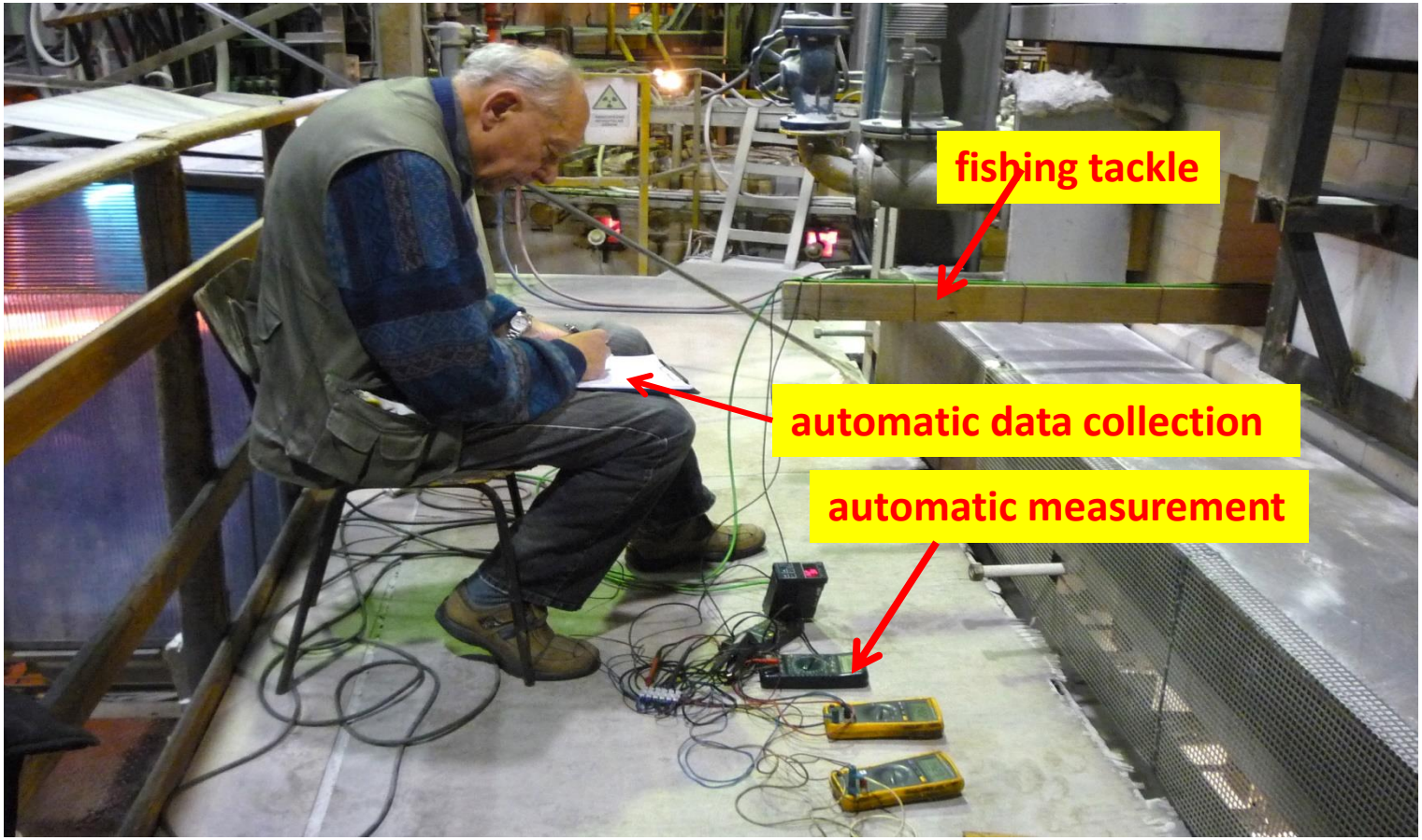
2 / There is a temperature range of 800-950 ° C in the batch where electrical conductivity increases (Smrček DGG Bayreuth2018, dissertation RWTH Nang Sam Kham 2005)

3 / to increase the melting capacity over 3t / m2.day is the only way to introduce energy directly into the batch,also to increase rather voltage gradient then increasing temperature in glass .

4/Cold batch layer have function :

- As recuperator (temperature of leaving gases is 100°C)
- as filter((take down SO3,NOx, Cl),is possible to use less fining agents
- - as isolator (surface losses are 1-3 kW / m2, masonry losses 6-12 kW / m2
- - no carbon
- it would be a damage to lose these useful features

- Thanks for your attention !!



Acknowledgment.

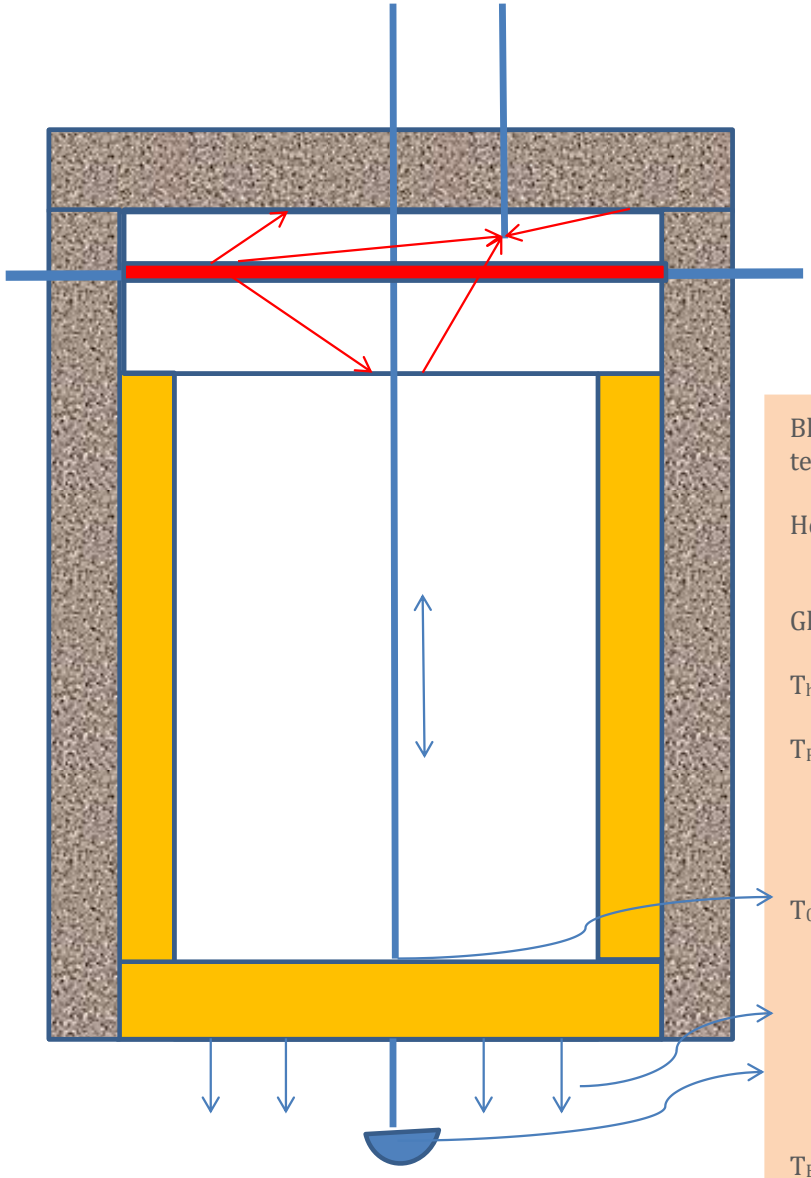
Author thanks to the firm Ing. Marie Smrčková, patent attorney for Grant No. 24061972

Further, thank to Mr. Starý and Šafařik for technical assistance

He also thanks the listeners for their patience



Bayreuth 2018



Black body with resulting temperature T_R

Heat elements with T_h

Glass level with T_0

$T_h > T_R > T_0$

$T_R - T_0$ = max 15 K

$T_0 - T_B$ = 28 – 140 K/17 cm

T_B

q = 11 – 16 kW/m^2

T_{out}