ELECTRIC MELTING AND THE VALUE OF MODELLING

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14TH INTERNATIONAL SEMINAR ON FURNACE DESIGN
VELKÉ KARLOVICE, 21ST–22ND JUNE 2017
ELECTRIC FURNACES AND MODELLING

WHY DISCUSS ELECTRIC MELTING?
ELECTRIC FURNACES AND MODELLING

WHY DISCUSS ELECTRIC MELTING?

BECAUSE WE HAVE TO!!
ELECTRIC FURNACES AND MODELLING

WHY DISCUSS ELECTRIC MELTING?  BECAUSE WE HAVE TO!!

EU 2030 – 40% REDUCTION cf 1990

Most of G7+1 group of nations agree
ELECTRIC FURNACES AND MODELLING

WHY DISCUSS ELECTRIC MELTING? BECAUSE WE HAVE TO!!

EU 2050 – 80% REDUCTION cf 1990

Most of G7+1 group of nations agree

British Glass Roadmap

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ELECTRIC FURNACES AND MODELLING

ARE ELECTRIC FURNACES SUITABLE FOR MAINSTREAM USE?
ARE ELECTRIC FURNACES SUITABLE FOR MAINSTREAM USE?

BECAUSE THEY ARE

• EXPENSIVE
• HAVE SHORT LIFE
• LACK FLEXIBILITY
ELECTRIC FURNACES AND MODELLING

EXPENSIVE ??
CAPITAL COST IS LOW but operating cost can be high due to electricity pricing, BUT this is changing!
THERMAL EFFICIENCY is considerably better. DOUBLE
SHORT LIFE – NOT NECESSARILY, could be an advantage
FLEXIBILITY – FAKE NEWS!!
ELECTRIC FURNACES AND MODELLING

CURRENT STATE OF THE ART

ENERGY EFFICIENCY COMPARISONS
Primary energy consumption container glass furnaces (123) versus production rate and furnace type in 1999

F.I.C. (UK) LIMITED
Furnace Size and Energy Efficiency

- Electric Furnace Energy Efficiency
- Fuel-Fired Furnace Energy Efficiency

Pull Tonnes/Day vs. Electric Furnace Energy Efficiency %

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ELECTRIC FURNACES AND MODELLING

WHERE ARE WE NOW?  SIZES

SMALL       1 to 30 tpd
MEDIUM      30 to 100 tpd
LARGE       100 to 250 tpd
<table>
<thead>
<tr>
<th>TYPES OF ALL-ELECTRIC FURNACES</th>
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<tbody>
<tr>
<td>COLD TOP, HOT TOP, SEMI-HOT TOP</td>
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<table>
<thead>
<tr>
<th>GEOMETRY</th>
<th>TRANSFORMERS</th>
<th>ELECTRODE POSITIONS</th>
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<tbody>
<tr>
<td>SQUARE</td>
<td>THREE PHASE</td>
<td>TOP ELECTRODES</td>
</tr>
<tr>
<td>RECTANGULAR</td>
<td>DELTA:— OPEN/CLOSED/PARTIAL</td>
<td>SIDEWALL ELECTRODES</td>
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<tr>
<td>HEXAGONAL</td>
<td>STAR</td>
<td>SHELF ELECTRODES</td>
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<tr>
<td>DUODECAGONAL</td>
<td>TWO PHASE</td>
<td>BOTTOM ELECTRODES</td>
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<tr>
<td>ROUND</td>
<td>SCOTT SQUARES (BALANCED)</td>
<td>PLATE ELECTRODES</td>
</tr>
<tr>
<td>SHELF</td>
<td>SINGLE PHASE</td>
<td></td>
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</tbody>
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OPTIONS: 1) TYPES

SQUARE
RECTANGULAR
HEXAGONAL & VARIANTS
SHELF
SQUARE FURNACE
RECTANGULAR FURNACE
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OPTIONS:  
2) ELECTRODE PLACEMENT
  TOP
  SIDE
  BOTTOM
  COMBINATION
  PLATES

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ELECTRIC FURNACES AND MODELLING
WHAT IS THE FUTURE?

SO WHAT DO WE DO AND WHERE DO WE GO
WHAT ARE OUR OPTIONS?
WHAT ARE OUR OPTIONS?

STEP CHANGE REQUIRED

U.S.A – G.M.I.C NEXTGEN MELTER PROJECT

SUBMERGED BURNERS?

INFLIGHT PLASMA FURNACES

WE HAVE TO CONSIDER THE ENVIRONMENT! CO2 NOX SOX

FOSSIL FUEL LONG TERM AVAILABILITY
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WHAT IS THE FUTURE?

STATUS QUO

• CONTINUE TO FINE TUNE EXISTING METHODOLOGY
• TAKE A CAUTIOUS STEPWISE APPROACH
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WHAT IS THE FUTURE?

STATUS QUO

• THE INDUSTRY IS NOTORIOUSLY CONSERVATIVE
• SOME OF YOUR COMPETITORS ARE THINKING RADICALLY
• THEY ARE SEEKING STEP CHANGES
• WE NEED TO WAKE UP BEFORE ITS TOO LATE!
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WHAT IS THE FUTURE?

MAINTAIN STATUS QUO
AND GET LEFT BEHIND??

!!
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WHAT IS THE FUTURE?

WHAT ARE OUR OPTIONS?
ELECTRIC FURNACES AND MODELLING
WHAT IS THE FUTURE?

WE NEED A SAFE STEP CHANGE
ELECTRIC FURNACES AND MODELLING
WHAT IS THE FUTURE?

O.O.B.T.

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WHAT IS THE FUTURE?

O.O.B.T. = OUT OF THE BOX THINKING

• WE NEED TO RE-EXAMINE OLD WAYS WITH NEW TECHNOLOGY
• WE NEED TO THINK CREATIVELY – START FROM SCRATCH
• WE NEED A STEP CHANGE (A PARADIGM SHIFT)
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WHAT IS THE FUTURE?

HOW?
ELECTRIC FURNACES AND MODELLING DREAMS

HOW?

MODELLING OF COURSE
DREAMING OF MODELLING AND MODELLING DREAMS

MODELLING FROM SCRATCH IS NOT THE WAY FORWARD

BECAUSE WE NEED TO BUILD FROM AN RELIABLE BASE CASE
DREAMING OF MODELLING AND MODELLING DREAMS

GLASS SERVICE/ FIC

HAVE THE KNOWLEDGE AND EXPERIENCE
DREAMING OF MODELLING AND MODELLING DREAMS

BUT WE NEED TO BE SMART
DREAMING OF MODELLING AND MODELLING DREAMS

MODEL FOR LONGER FURNACE LIFE

DESIGN FOR LONGER FURNACE LIFE

OPERATE FOR LONGER FURNACE
DREAMING OF MODELLING AND MODELLING DREAMS

MODEL FOR LONGER FURNACE LIFE

BORMIOLI DID JUST THIS

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Observations

- Irregular corrosion
- Energy transmission
- Current density
- Irregular thermal distribution
Strategic parameters

- Energetic Efficiency
- Lifetime
- Pull range and flexibility
- Cullet recycling
- Maximum pull

Aim of the study is to verify the impact of design and materials evolution in the last 30 years and 20 furnaces on the strategic parameters of the furnace, by comparing at least three evolution steps, and understand if electrical melting is becoming more competitive in the hollow glass market.
Lifetime

- In the analyzed period it was obtained a good improvement in the heat extraction from joints (+13%)

- Lifetime for the palisades is increased by 85%.
- Some other elements are now more critical
- Introduce the concept of Minor Repair
DREAMING OF MODELLING AND MODELLING DREAMS

DESIGN FOR LONGER FURNACE LIFE

ELIMINATE THE THROAT

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ELECTRIC FURNACES AND MODELLING
WHAT IS THE FUTURE?

BUT I’M FORGETTING
YOU’RE ALL RISK
ADVERSE!!
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WHAT IS THE FUTURE?

SO A STRUCTURED, SAFE APPROACH IS REQUIRED
BY SOME OF YOU
ELECTRIC FURNACES AND MODELLING
WHAT IS THE FUTURE?

SUPERBOOSTING