SINGLE BUCKET CHARGING PRACTICE WITH TELESCOPIC EAF ROOF CLOSURE

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OUTLINE

› Introduction – INTECO GROUP
› Single bucket charging – ADVANTAGES
› Telescope EAF – DESIGN DETAILS and BENEFITS
› References – BASTUG METALLURGY TURKEY
› Upgrade – CONCEPT
› End – CONCLUSIONS
THE INTECO GROUP
In March 2015 the INTECO Group has acquired the Electric Arc Furnace and Ladle Furnace Technology, patents and other intellectual property rights of FUCHS Technology AG and FUCHS Engineering GmbH.

› Electric Arc Furnaces
  › Conventional Furnace
  › AC and DC solutions
  › Telescope System (patented)
  › COSS System (patented)
  › Ladle Furnace

› Current Conducting Electrode Arms
  › Injection and Oxygen Technology
  › Automation Lev.1 and Lev.2
  › Training
  › Services
PRODUCT PORTFOLIO

- MELTING & REFINING
  - EAF
  - LF
  - RH

- VACUUM TECHNOLOGY
  - VOD

- CASTING
  - CC
  - IC

- SPECIAL (RE)MELTING
  - VIM
  - ESR
  - VAR
  - PM

- ROLLING
  - HEAT TREATMENT

Integrated Electrics & Automation, ROBOTICS, LEVEL 2
SPECIAL Tools for Special Steel

Robotics
- Temperature measurement
- Sampling
- Camera inspection inside the vessel

SwingDoor
- Improved safety
- Reduced consumption figures
- Increased yield

EBT CleanDrill
- Safe and efficient taphole cleaning
- Fully automated
- Compact design

TempBOx
- Temperature measurement
- Sampling
- Closed slag door

JetBOx
- Close distance to steel bath
- High oxygen efficiency
- Robust and reliable

ISEC
- Less energy consumption
- Less electrode consumption
- Reduced power-on-time

IFOB
- Holistic process control
- Dynamic furnace set-points

IMAS
- Determination of the present state
- Material & Data tracking
- Reporting of deviations
SINGLE BUCKET CHARGING
Fast and highly productive steel melting tools

Tap-to-tap times of 35 minutes and power-on times below 30 minutes

Minimum power-off times

High average power input
Key points

› Large furnace shell volume leading to longer off-gas residence time in the furnace
› Higher yield of chemical energy
› In-shell scrap preheating due to high scrap pile
WHY TELESCOPE EAF?

Key points

- Utilization of single bucket with average charge density even below 0.60 t/m³ without expanding shell diameter and height above acceptable limits.

- Possibility to reduce exposed area of shell walls in function of melting progress decreasing furnace thermal losses and increasing thermal efficiency.
WHY TELESCOPE EAF?

Key points

› Possibility to **reduce electrode columns length** decreasing elevated risk of accidental breakages which is typical for single charge EAF.

› Flexibility in using relatively **low average charge density** in function of the actual situation at local scrap markets with less limitations.
† Electrode stroke is the same than in conventional EAF applications

† Additional required stroke for high shell is realized by a gantry stroke

† Gantry stroke lifts the complete gantry with the electrode support structure & roof
TELESCOPE EAF - Design

- Flat roof design.
- Roof in upper position creates additional furnace volume.
- During melting, the roof gradually slides down to the lower position.
- Fully closed roof with almost complete overlapping of the roof and part of the upper shell.
- Electrode stroke similar to conv EAF.
- Additional roof stroke for high shell is realized by a gantry stroke.
- Gantry stroke lifts the complete gantry with the electrode support structure and the roof.
- Gantry swiveling through unique gantry design without roller bearing.
TELESCOPE EAF - Operation

- Larger distance between the top of the scrap pile and the horizontal part of the roof allows for bore-down higher power and longer arcs.
- As soon as the scrap mountain starts to melt, the roof with the electrode columns can be lowered to follow the gradual charge volume reduction.
- The complete cycle of telescope movement between the upper closing position after charging and fully closed position is reached after 30 – 40% of the total power on time.
GEOMETRY – scrap volume

Standard EAF | Telescope EAF

same short electrode length

Total scrap volume increase by >25 %
with overfilling >30 %

Bigger shell volume leads to extended off-gas residence time, better yield of chemical energy, and post-combustion.
SINGLE BUCKET CHARGE

Different scrap quality and density required by melting process can be charged in ONE single bucket.
**BENEFITS**

**Consumption Figures**

- Electrical energy minus 30 to 40 kWh/t
- Electrode consumption minus 0.6 kg/t
- Chemical energy consumption minus 10 %
- Yield increase plus 1%

**Performance Figures**

- Power-off time minus 2 to 3 minutes
- Power-on time minus 1 to 2 minutes
- Productivity increase by more than 10 to 15 %
- Longer lifetime of roof and panels
- Reduced dust amount
BENEFITS - OPEX

Cost savings up to 5 €/t

Higher Productivity
(based on steel plant cost structure in Europe)

OPEX Telescopic vs. Conv. EAF

- Scrap price corrected
- Refractory wear
- Fuel
- electrodes
- Oxygen
- Electrical energy

€ per tonne LS
REFERENCE
Bastug Metallurgy
Turkey
TELESCOPE EAF – Bastug

PRODUCTIVITY
220 ton/hour – 1,700,000 tpy

EAF DESIGN
Average tapping weight: 165t
Lower shell diameter: 8400 mm
Upper shell diameter: 8500 mm
Upper shell height: 5040 mm
Transformer: 165 MVA

RAW MATERIAL
100% scrap - 0.5 t/m³ - Single bucket charge

BOOST OF PERFORMANCES

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Telescopic EAF</th>
</tr>
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<tbody>
<tr>
<td>Capacity, t</td>
<td>165</td>
</tr>
<tr>
<td>Transformer, MVA</td>
<td>165</td>
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<tr>
<td>Tap to tap time, min</td>
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<tr>
<td>Power on time, min</td>
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<tr>
<td>Oxygen, Nm³/t</td>
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<td>Gas, Nm³/t</td>
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<td>Total carbon, kg/t</td>
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<td>Electricity consumption, kWh/t</td>
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<tr>
<td>Electrode consumption, kg/t</td>
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<tr>
<td>Gas for post combustion, Nm³/t</td>
<td>0</td>
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</tbody>
</table>

SPECIFIC ELECTRODE CONSUMPTION
Average 0.85 kg/ton with Ø 711 mm electrodes

Process Optimization
UPGRADE CONCEPTS
TELESCOPE EAF - Upgrade

 CASE 1
 - Upper shell ring
 - Roof, elbow, sliding sleeve
 - Gantry
 - Necessary piping
 - Necessary hydraulic components

 CASE 2
 - Upper shell
 - Lower shell
 - Roof, elbow, sliding sleeve
 - Gantry and columns
 - Tilting platform
 - Necessary hydraulic components and cylinders
 - Necessary Piping, Instrumentation

 CASE 3
 - Upper and lower shell
 - Roof, elbow, sliding sleeve
 - Gantry and columns
 - Tilting and EBT Platforms
 - Hydraulic unit and cylinders
 - Electrode arms, cables
 - Secondary system
 - Level 1.5
 - Piping, Instrumentation
 - Pulpits
The Telescope EAF obviously represents higher efficiency than other single charge furnaces.

The specific energy consumption can be 30 – 40 kWh/t lower than for a standard EAF operating with the same oxygen and gas reference consumption.

In-shell charge preheating efficiency entirely depends on proper set-up of electrical and chemical energy input parameters.

The influence of scrap quality on the furnace performance is clearly visible and can be influenced by optimized scrap bucket filling recipes.

Upgrade from existing standard EAF to Telescope EAF is possible.