SCARP PREHEATING SYSTEM
ISMELT®
Inteco Scrap MELting Technology
and
Telescopic EAF Evolution

EASES 2021

16 / 06 / 2021
Why preheat the scrap

**EAF Conventional**
- Electrical energy: 60% (390 kWh/t)
- Chemical Energy: 270 kWh/t (40%)
- Molten Steel: 385 kWh/t (58%)
- Slag: 50 kWh/t (8%)
- Off gas: 175 kWh/t (26%)
- - Cooling water
- - Radiation
- - Roof opening

**EAF with preheating**
- Electrical energy: 40% (320 kWh/t)
- Chemical Energy: 265 kWh/t
- Molten Steel: 385 kWh/t
- Slag: 50 kWh/t
- Off gas: 85 kWh/t (70 kWh/t energy recovery)
- - Cooling water
- - Radiation
Energy recovery vs scrap temperature

Scrap temperature °C vs. Energy recover KWh/t

Preheated steel on the finger system
Evolution of preheating systems

The integrated scrap preheating systems are based on a scrap batch within a preheating vessel, Shaft (vertical) concept or a transport tunnel, Consteel (horizontal) concept, crossed by the fumes.

Various brand names used: Shaft, COSS, EPC, Quantum, Consteel, EcoArc, etc.

- Rotating drum BBS Brusa;
- System Endless Charging System (ESC) Danieli;
- Twin-shell EAF;
- Bucket preheating
Intecos background

FUCHS Technologies
- One of the first EAF supplier active in inventing and utilization of scrap preheating systems
- EAF with Finger Shaft
- EPC EAF - Environmental Friendly Preheating & Charging System
- COSS EAF - Integrated Scrap Preheating Continuous Optimized Single Shaft

INTECO
- 2015 – acquisition of Fuchs Technology AG and Fuchs Engineering GmbH
- Transfer of EAF and LF technology, including patents and other intellectual property rights
- TELESCOPIC® EAF – example of highly efficient EAF with charge pre-heating during melting
- ISMELT® – intense R&D work and concept that focuses on elimination of existing shaft preheater bottle-necks with simultaneous efficiency improvement combined with continuous charge feeding
Evolution of Scrap preheating

The ISMELT (INTECO Scrap Melting Technology) solution is an innovative technological design to overcome the problems, which became evident over the years in connection to scrap preheating technologies.

**Drawbacks vertical (Shaft type) systems:**
- With vertical systems the scrap is charged discontinuously in batches leading to negative consequences in the melting process and off-gas treatment and unbalancing of electric power load.

**Drawbacks horizontal systems:**
- With horizontal systems a belt conveyor or conveying device continuously transport the scrap through a channel towards the furnace and the hot exhaust fumes of the arc furnace are guided in the counter-current on the tunnel to the dedusting system. Since the area above the scrap is relatively large in the conveyor, only the top layer of the scrap is slightly preheated, while the underlying scrap portion remains cold.
ISMELT CONCEPT
The scrap is charged into the pressure insulation chamber by means of:

- scrap bucket
- conveyor belt
CONCEPTUAL DESIGN

When the lower sliding gate opens the scrap fall into the preheating chamber
CONCEPTUAL DESIGN

The bottom of the ISMELT sliding alternatively upwards slowly and backward faster, combined with the bottom slope feed the material into the EAF shell.

Controlled scrap input speed adjustable according to feeding bed oscillation frequency.
The charging scrap column is maintained to fill the tunnel section.

The hot gas is passing through the bulk, creating an intimate contact of the gas with the charged material.

The pressure drop of the scrap mesh is recovered by a booster fan driven by a frequency converter.
The primary flow is split into 2 streams to modulate the preheating grade.

- trough ISMELT chamber
- trough 4th hole on the EAF roof

The streams are mixed in the combustion chamber.

The temperature is controlled to crack all pollutants compounds.
Aachen university simulation the ISMELT process

SIMULATIONS STUDY

Simple transmission

Transmission and radiation

5' after stop of the feeding
LAST IMPROVEMENT

Added retractable car to connect the preheating tunnel to the furnace. To allow the tilting during tapping and deslagging phase. Keep the scrap far for the bath when the feeding system is not operating.

Additional suction of the off-gas during scrap charging to minimize dust losses.

Gas bypass suction on the tunnel to reduce the roof weight and design complexity.
Controlled preheating temperature through bypass off gas regulation system

Controlled scrap input related to the transformer capacity through regulation of feeding bed speed

Flat Bath Operation: Constant high energy input, lowest flicker generation and less noise generation
ADVANTAGES

✓ Temperature of the scrap at EAF inlet window 400-500 °C with an energy recover of 60-70 KWh/t
✓ Flat bath operation:
  ➢ Flickering reduced of 60% compared to a standard EAF
  ➢ Harmonics reduced of 60% compared to a standard EAF
  ➢ Noise below 95 dB at 10 m from slag door
  ➢ Refractory consumption reduced of 40% compared to a standard EAF
ADVANTAGES

✓ Reduced electrode consumption

✓ Good access for maintenance

✓ Safe system condition at any time

✓ Independence of bucket charging from melting process: no power-off time, no reactions & explosions caused by charging

✓ Reduction of dust amount

✓ Improved temperature control of off-gas-temperature

✓ Less dust on EAF working platform → better working conditions
RESULT KEY FIGURES

✓ Electric consumption       320  Kwh/t
✓ Scrap yield               92   %
✓ Natural gas consumption   9.0  Nm3/t
✓ Electrode consumption     <0.95 kg/t
✓ Carbon consumption        10   Kg/t
✓ Oxygen consumption        30   Nm3/t
✓ Lime consumption          40   Kg/t
TELESCOPIC FURNACE
Concept

Standard EAF
2 bucket 55% / 45%

Single bucket furnace

Single bucket furnace
Telescopic
Concept

Standard EAF
2 bucket 55% / 45%

Single bucket furnace
Electrodes too long

Single bucket furnace
Telescopic

During the melting the roof follows the electrodes get down
System concept
DESIGN FEATURES

UPPER & LOWER SHELL

Set of telescope panels

Set of wall panels
Bastug furnace

Telescopic roof

Telescopic upper shell
Collected data

<table>
<thead>
<tr>
<th>Year</th>
<th>TOTAL HEATS</th>
<th>BUCKET/HEAT</th>
<th>POWER ON TIME, min</th>
<th>POWER OFF TIME, min</th>
<th>TAP TO TAP TIME, min</th>
<th>PRODUCTION GOOD BILLET, t/hour</th>
<th>CHARGE WEIGHT, ton</th>
<th>GOOD BILLET WEIGHT, ton</th>
<th>GOOD BILLET YIELD FROM CHARGE, %</th>
<th>AVG POWER, MW</th>
<th>SPECIFIC EAF ENERGY, kWh/t GOOD BILLET</th>
<th>SPECIFIC O2 INJECTORS, Nm3/t GOOD BILLET</th>
<th>SPECIFIC O2 TOTAL, Nm3/t GOOD BILLET</th>
<th>SPECIFIC GAS, Nm3/t GOOD BILLET</th>
<th>SPECIFIC CARBON, kg/t GOOD BILLET</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>10538</td>
<td>1.264</td>
<td>35.7</td>
<td>46.0</td>
<td>219.6</td>
<td>184.8</td>
<td>167.2</td>
<td>90.53</td>
<td>107.3</td>
<td>349.0</td>
<td>382.0</td>
<td>30.33</td>
<td>29.91</td>
<td>5.23</td>
<td>12.43</td>
</tr>
<tr>
<td></td>
<td>7778</td>
<td>1</td>
<td>34.6</td>
<td>9.8</td>
<td>44.4</td>
<td>226.8</td>
<td>184.3</td>
<td>90.79</td>
<td>108.0</td>
<td>337.9</td>
<td>373.4</td>
<td>31.03</td>
<td>30.60</td>
<td>5.27</td>
<td>12.36</td>
</tr>
<tr>
<td></td>
<td>2731</td>
<td>2</td>
<td>38.7</td>
<td>11.8</td>
<td>50.5</td>
<td>199.6</td>
<td>186.5</td>
<td>89.83</td>
<td>105.2</td>
<td>383.6</td>
<td>406.2</td>
<td>28.31</td>
<td>27.88</td>
<td>5.12</td>
<td>12.64</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>3</td>
<td>38.4</td>
<td>13.7</td>
<td>52.2</td>
<td>181.1</td>
<td>184.1</td>
<td>85.56</td>
<td>104.2</td>
<td>363.1</td>
<td>425.8</td>
<td>34.05</td>
<td>33.61</td>
<td>5.79</td>
<td>11.37</td>
</tr>
<tr>
<td></td>
<td>All Heats</td>
<td>10538</td>
<td>1.264</td>
<td>35.7</td>
<td>46.0</td>
<td>219.6</td>
<td>184.8</td>
<td>90.53</td>
<td>107.3</td>
<td>349.0</td>
<td>382.0</td>
<td>30.33</td>
<td>29.91</td>
<td>5.23</td>
<td>12.43</td>
</tr>
</tbody>
</table>

More than 10,500 heats processed

REAL AVERAGE Energy consumption 354 KWh/t of liquid steel
Thank You