

TECHNICAL ADVISORY

EAF Consumables Cost Reduction & Cost Avoidance

Technical Advisory Framework for Billet-Producing EAF Melt Shops

A practical technical framework for identifying and reducing excess consumption of graphite electrodes, carbon, oxygen, ferroalloys, lime and refractories in Electric Arc Furnace steelmaking.

Benchmarking • Deviation Analysis • Root-Cause Diagnosis • Improvement Actions • KPI Governance

Framework Overview

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Purpose of This Framework

How the methodology supports cost reduction and cost avoidance

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Indicative Technical Reference Ranges

Guidance ranges for major EAF consumables

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Understanding Excess Consumption

Where cost leakage typically occurs

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Root-Cause Diagnosis

Common process and operational drivers

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Improvement Roadmap

90-Day Assessment & Improvement + Sustain & Scale

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KPI Governance Framework

Daily, weekly and monthly tracking discipline

Why a Structured Approach Matters

Core Intent

Provide a practical, structured methodology to identify excess consumable usage in Electric Arc Furnace operations, diagnose root causes, and implement disciplined improvement actions that deliver both immediate cost reduction and longer-term cost avoidance.

Cost Reduction

- ▶ Lower specific electrode consumption
- ▶ Optimized oxygen & carbon injection
- ▶ Reduced ferroalloy over-additions
- ▶ Lower lime and refractory usage

Cost Avoidance

- ▶ Fewer electrode breakages & unplanned stops
- ▶ Longer refractory campaign life
- ▶ Reduced thermal shock & lining damage
- ▶ Lower emergency purchases at premium prices

Guidance Ranges for Major EAF Consumables

Note: These are indicative technical reference ranges only. Actual targets should be validated against furnace design, metallic charge mix, steel grade, operating practice, equipment configuration, and plant historical performance. They are intended as a starting point for assessment and discussion.

Consumable	Indicative Best-Practice Range	Typical Acceptable Range	Review Trigger
Graphite Electrodes	1.4 – 1.8 kg/t	1.9 – 2.3 kg/t	> 2.5 kg/t
Oxygen	28 – 35 Nm ³ /t	36 – 42 Nm ³ /t	> 45 Nm ³ /t
Carbon (Total)	8 – 12 kg/t	13 – 16 kg/t	> 18 kg/t
Lime (CaO)	30 – 45 kg/t	46 – 55 kg/t	> 60 kg/t
Dolomite / Magnesite	5 – 12 kg/t	13 – 18 kg/t	> 20 kg/t
Refractories (Total)	2.8 – 4.0 kg/t	4.1 – 5.5 kg/t	> 6.5 kg/t
Ferrosilicon (FeSi 75%)	1.5 – 3.5 kg/t	3.6 – 5.0 kg/t	> 5.5 kg/t
FeMn / SiMn	4 – 10 kg/t	11 – 15 kg/t	> 16 kg/t
Electrical Energy	380 – 450 kWh/t	451 – 520 kWh/t	> 550 kWh/t

Where Cost Leakage Typically Occurs

A significant share of excess consumable cost may originate from process variability, material handling, operating practice, and control discipline — rather than from inherent technology limitations alone.

Electrodes

High Impact

Reduction + Avoidance

Often the largest single opportunity

Refractories

High Impact

Cost Avoidance

Longer campaigns reduce unit cost

Oxygen & Carbon

Medium–High

Cost Reduction

Strongly process-control driven

Ferroalloys

Medium–High

Reduction + Avoidance

Precision addition is critical

Lime & Fluxes

Medium

Cost Reduction

Linked to scrap quality & slag practice

Energy

High Impact

Cost Reduction

Correlated with other consumables

Common Process & Operational Drivers

Graphite Electrodes

- Extended tap-to-tap times
- Weak or inconsistent foamy slag
- Arc instability & regulation lag
- Sidewall oxidation & mechanical breakage

Oxygen & Carbon

- Imbalanced injection timing
- Excess oxygen relative to carbon
- Limited post-combustion control
- Variable scrap density & preparation

Lime & Refractories

- High-impurity or dirty scrap
- Aggressive slag chemistry
- Insufficient slag foaming coverage
- Thermal shock events

Ferroalloys

- Inaccurate or delayed bath analysis
- Late or excessive additions
- Sub-optimal recovery rates
- Uncontrolled oxidation losses

90-Day Assessment & Improvement + Sustain & Scale

Phase 1

90-Day Assessment & Improvement Roadmap

Days 1–90

1. Map current specific consumptions
2. Compare against reference ranges
3. Identify top deviation drivers
4. Implement quick wins & stabilize

Phase 2

Sustain & Scale

Months 4–12

1. Extend refractory campaign life
2. Reduce breakage frequency
3. Lock ferroalloy addition rules
4. Embed daily performance reviews

Ongoing

Governance & Review

Continuous

1. Daily / Weekly / Monthly KPIs
2. Cost-of-deviation tracking
3. Root-cause deep-dives
4. Continuous improvement loop

Example Ranges for Assessment Discussion

Illustrative only. Plant-specific targets are established after baseline validation and technical assessment. Figures shown are example ranges intended to support discussion and are not performance guarantees.

Metric	Typical Starting Point	Illustrative Improvement Range	Primary Benefit
Electrode Consumption	2.4 – 3.0 kg/t	1.6 – 1.9 kg/t	Reduction + Avoidance
Electrode Breakages	4 – 8 / month	< 1.5 / month	Cost Avoidance
Oxygen	42 – 50 Nm ³ /t	30 – 36 Nm ³ /t	Cost Reduction
Carbon	15 – 20 kg/t	9 – 13 kg/t	Cost Reduction
Refractory Specific	5.5 – 7.5 kg/t	3.2 – 4.5 kg/t	Cost Avoidance
Ferroalloy Variance	High variability	Within ±10% of calculated	Reduction + Avoidance

Daily • Weekly • Monthly Discipline

Daily	Weekly	Monthly
▶ Electrode kg/t per heat ▶ Oxygen & carbon injection rates ▶ Tap-to-tap time ▶ Foamy slag observation	▶ Deviation vs. reference ranges ▶ Breakage incidents review ▶ Refractory gunning usage ▶ Ferroalloy recovery rate	▶ Full cost-of-deviation report ▶ Campaign life tracking ▶ Root-cause deep-dive ▶ Action plan progress review

Why Governance Matters

A clear daily–weekly–monthly rhythm turns recommendations into sustained performance. It gives plant teams visibility, creates ownership, and enables early detection of drift before cost impact becomes significant. This is the difference between a one-time improvement initiative and an embedded operating system.

KEY MESSAGE

A structured approach to consumable performance is one of the highest-ROI levers available in the melt shop.

Cost Reduction + Cost Avoidance = Sustainable Competitiveness

This Technical Advisory is intended to support assessment discussions and improvement planning. Specific targets and action plans are developed jointly with each plant based on its baseline and operating context.