

# Analytical modelling of nitrogen content prediction in pig iron and molten steel during steelmaking process

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## KEY STAGES FOR MODELING

The project focuses on creating models used to predict the amount of nitrogen dissolved in metal during four key technological phases of steel production in a BOF steelmaking route.

## MODELING APPROACHES

The following statistical approaches were used to create models with the highest predictive power.

1. **Modern regression analysis** with econometric cointegration analysis,
2. **Automated machine learning** (AutoML)

## PRESENT FINDINGS

Current prediction deviation  
**0.0005 ~ 0.0007% nitrogen in metal.**

## PROCESSING INSIGHTS

### Stage 1 – Pig iron pretreatment

The more modest performance of hot metal pretreatment model reflects the inherent

challenges of nitrogen prediction under extreme processing conditions.

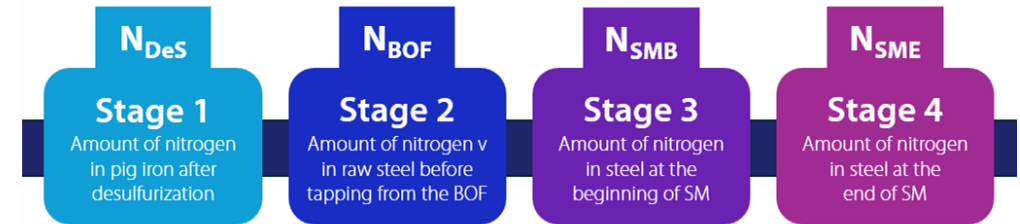
### Stage 2 – BOF steelmaking

The model's intermediate performance demonstrates that BOF processes provide more predictable absolute nitrogen values, likely due to the well-characterized thermodynamics of oxidation reactions and CO formation that strongly influence nitrogen removal.

### Stage 3 and Stage 4 – Secondary steelmaking

Secondary steelmaking processes occur under more controlled conditions with lower temperature gradients, reduced reaction rates, and more stable thermodynamic equilibria.

The ladle furnace environment provides better process control compared to the aggressive conditions in BOF or during desulfurization pretreatment of pig iron.



MODEL ACCURACY	MODERN REGRESSION ANALYSIS	MACHINE LEARNING (AutoML)
Stage 1 - N <sub>DeS</sub>	83,46%	<b>85,39%</b>
Stage 2 - N <sub>BOF</sub>	77,23%	<b>79,37%</b>
Stage 3 - N <sub>SMB</sub>	<b>79,97%</b>	78,92%
Stage 4 - N <sub>SME</sub>	<b>80,37%</b>	79,72%

For more information about this project and actual state of the solution, please log on to site:

[www.nitrogen-prediction.eu](http://www.nitrogen-prediction.eu)



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