December 25, 2017

Taiyo Nippon Sanso Corporation

Launch of New SCOPE-Jet® Multi-Function Oxygen Burner for Electric Arc Furnaces Supporting Various Fuels

Taiyo Nippon Sanso Corporation ("TNSC") has announced the launch of the new SCOPE-Jet®, an enhanced performance oxygen burner for electric arc furnaces ("EAF") that supports low-pressure, low-calorie fuels.

1. Background of Development

Oxygen burners rapidly entered widespread use in the EAF steelmaking processes in the 1960s and now are installed and used in many EAF. The function of oxygen burners in EAF is to promote melting by applying heat to the cold spots within the furnace and they are used mainly during the melting stage to melt solid iron scrap.

In recent years, proposals have been made to use burner lances that form flames of oxygen gas blown at supersonic speeds, making it difficult to attenuate the speed and concentration of oxygen gas. Using these burners enables omitting direct application of oxygen on molten steel as had conventionally been performed using exhaust-type lances during refining, and they have made EAF operations efficient.

TNSC has used SCOPE-Jet®, a high-speed oxygen burner lance with a compact and extremely simple nozzle structure, in EAF steelmaking processes since 2001.

TNSC has recently launched a new type of SCOPE-Jet® with enhanced performance and durability in addition to being able to support low-pressure, low-calorie fuels by using expertise it has cultivated through the EAF steelmaking process and to address market demand for cost reductions driven by rising electricity charges and secondary material costs.

2. Technical Overview

When fluid is sprayed out of a nozzle it forms jets through interaction with surrounding fluids. These jets form an area flowing immediately below the nozzle called the potential core and jets in this section are sprayed out at the same speed as the nozzle exit. Jets in the slipstream of the potential core develop while entraining the surrounding atmosphere as well as attenuating speed.

However, research until now has shown that the density ratio between the jets and surrounding atmospheric gases has an effect on the length of the potential core, which has been confirmed to stretch by the one-half power of the gas density ratio.

The original SCOPE-Jet® forms a flame surrounding the oxygen jet flow in the vicinity of the nozzle, which raises the atmospheric temperature of the jet flow and extends the jet flow's potential core.

The flame-forming nozzle was improved in the new SCOPE-Jet® extending the potential core by 15% more than the conventional model. This enhanced power in penetrating molten steel and lance functionality during refining in EAF steelmaking.

Moreover, using low-pressure, low-calorie fuels makes it possible to stabilize flame combustibility, which enables using fuels with low calorific value, such as coke oven gas (COG).

Furthermore, by leveraging expertise cultivated using the conventional SCOPE-Jet® in EAF steelmaking, TNSC has improved the structure of the nozzle to counter blockages caused by such factors as splashing in EAF, enhancing its durability.

Comparison of Performance between Conventional and New SCOPE-Jet®

	Conventional SCOPE-Jet®	New SCOPE-Jet®
Oxygen spout speed	Mach 1.5	Mach 2.0
Fuel supply pressure	40 kPa or more	20 kPa or more
Fuel calorific value	36 MJ/Nm3 or more	19 MJ/Nm3 or more
Usable fuels	LNG, LPG, A heavy oil, C heavy oil	COG, LNG, LPG, A heavy oil, C heavy oil
Potential core length	43 D*	50 D*

D: burner nozzle diameter

Potential Core Length between Conventional and New SCOPE-Jet®

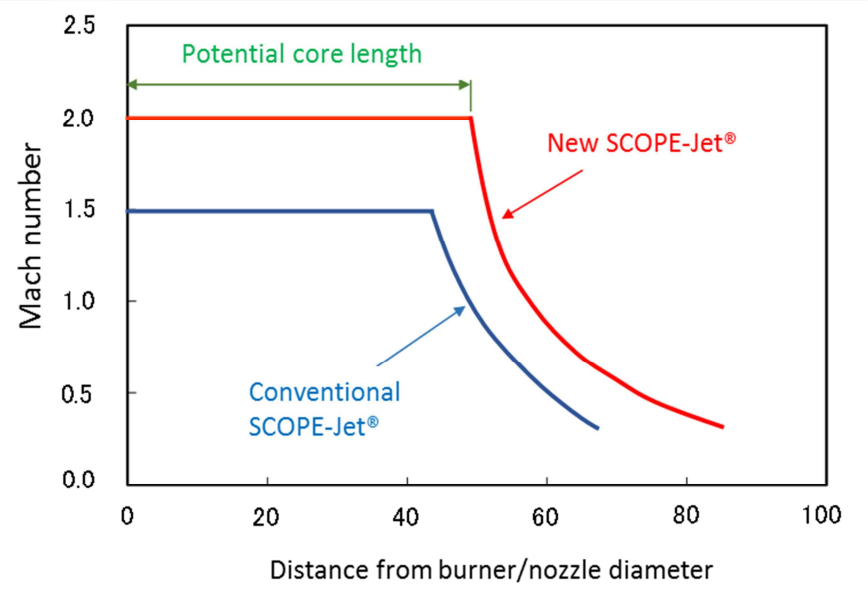
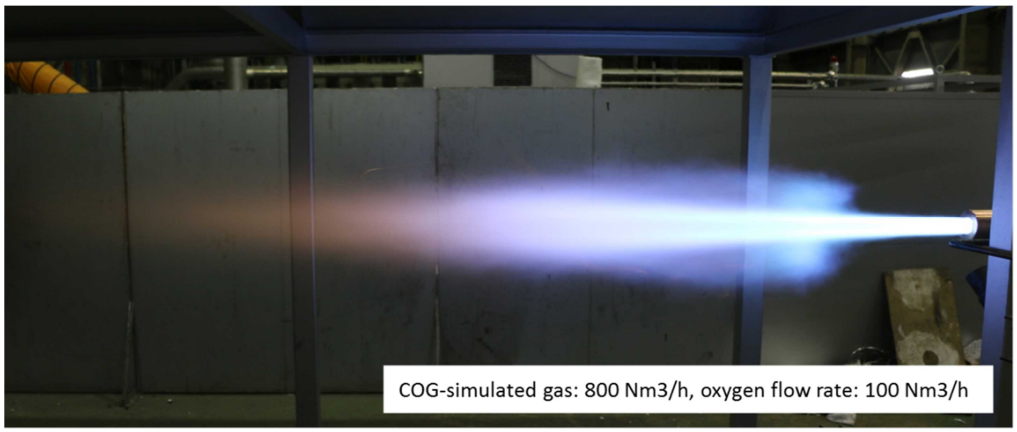


Photo of COG-simulated gas consumption



(COG-simulated gas composition: CH4: 45.7%, C2H6: 2.7%, C3H8: 2.2%, C4H10: 1.0%, N2: 48.4%
Low calorific value: 19 MJ/Nm3)

3. Developments Going Forward

Using the enhanced lance performance, TNSC will propose further cost-cutting plans for EAF steelmaking processes for use in operations during melting (burner mode) and refining (lance mode), and through package deals with carbon injection and secondary combustion technologies.

Furthermore, as SCOPE-Jet® can now support low-pressure, low-calorie fuels, TNSC will roll out uses not only for EAF steelmaking, but also for blast furnace manufacturers capable of using COG.