



August 23, 2018

## **Development of SCOPE-JET Swing Oxygen Burner for Swinging Supersonic Oxygen Jet**

The SCOPE-JET Swing developed by Taiyo Nippon Sanso Corporation (TNSC) adds a swing function to the energy-saving supersonic oxygen jet SCOPE-JET by applying the self-induced oscillation phenomenon of fluids.

### **1. Background to Product Development**

Oxygen burners rapidly entered widespread use in the electric arc furnace (“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, significantly suppressing the attenuation of the speed and concentration of oxygen gas. Using these burner lances 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.

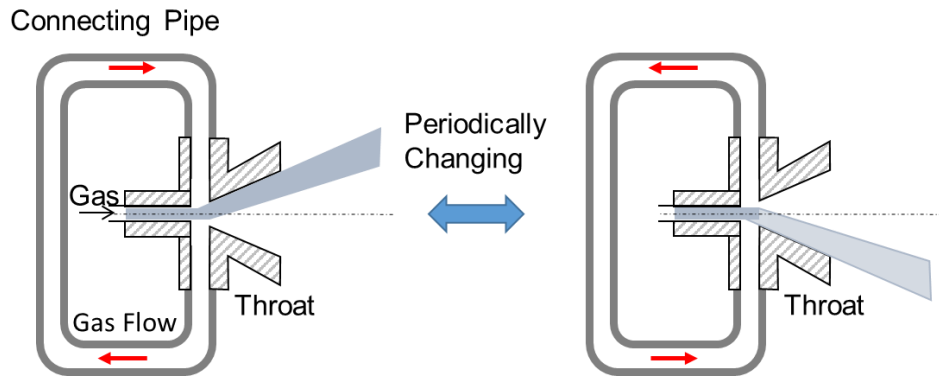
TNSC developed the SCOPE-JET high-speed oxygen lance for the EAF steelmaking process in 2001. In December 2017, the Company developed a new type of SCOPE-JET with enhanced performance that also supports low-pressure, low-calorie fuels (announced in the December 25, 2017 news release).

### **2. Technical Overview**

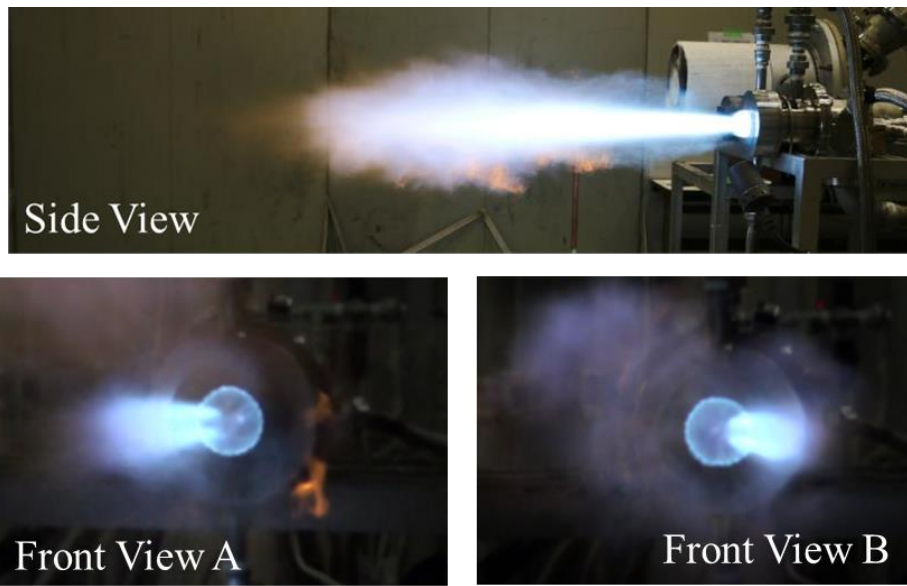
Self-induced oscillation is a technology that uses a fluid phenomenon known as the Coandă effect, in which a fluid ejected from a nozzle flows along a nearby wall surface (Fig. 1). TNSC has already commercialized oxygen combustion technologies using self-induced oscillation (Innova-Jet Swing and Innova-Jet F.H.).

SCOPE-JET Swing features a nozzle that forms a supersonic oxygen jet with a construction that generates self-induced oscillation. This has made it possible to swing the supersonic oxygen jet without a mechanical drive section. (Fig. 2)

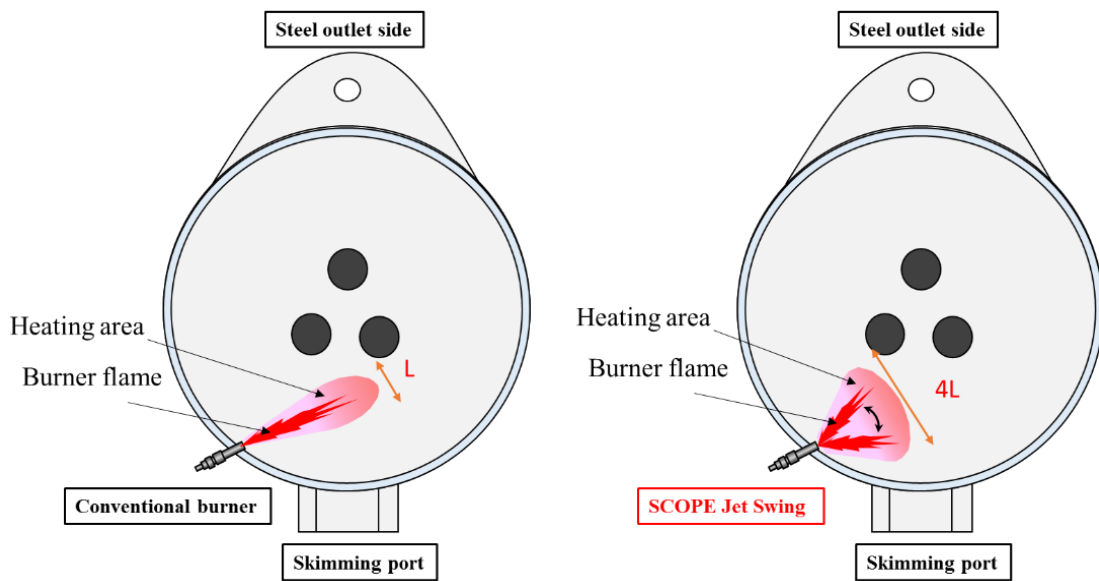
The conventional SCOPE-JET is excellent for localized melting and refining, while the SCOPE-JET Swing allows melting over a wide area, and is expected to be effective for eliminating cold spots near the working opening of an EAF (Fig. 3)



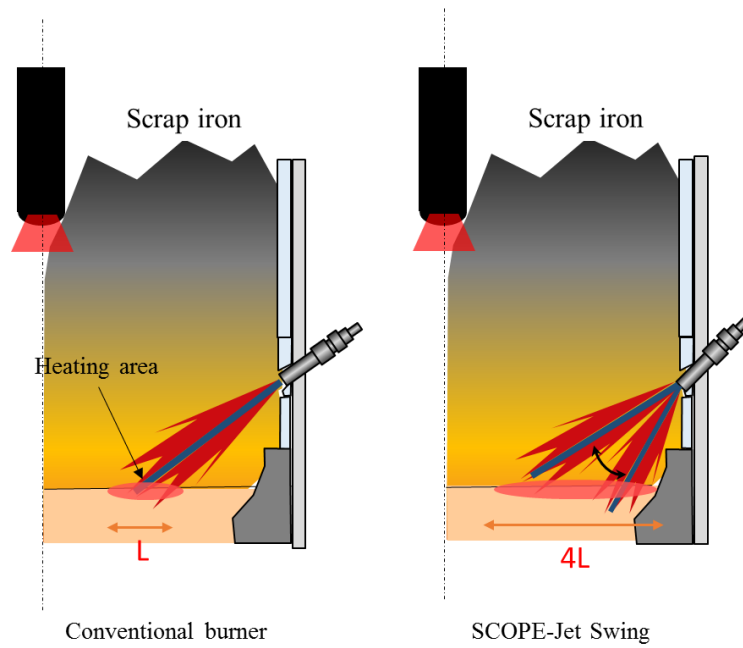
**Fig. 1 Self-induced oscillation principle**



**Fig. 2 SCOPE-JET Swing fuel combustion status**



**Fig. 3-1 SCOPE-JET Swing application in an EAF (top elevation)**



**Fig. 3-2 SCOPE-JET Swing application in an EAF (side elevation)**

### 3. Future Developments

TNSC has developed the SCOPE-JET and Innova-Jet series for the EAF steelmaking process, and these have achieved productivity increases and energy savings. With the addition of the SCOPE-JET Swing, TNSC expects to achieve further productivity improvements in the EAF steelmaking process.

Furthermore, TNSC will develop more applications for this unique fuel combustion technology capable of swinging a supersonic oxygen jet, mainly in the field of steelmaking.