Case Study

Polymer Injection Technology

Polymer Injection Technology is an exciting new patented process, which partially substitutes the use of coke with polymers, including rubber, as an alternate carbon injectant to produce foaming slag in Electric Arc Furnace (EAF) steel making.

This innovation offers an excellent opportunity to improve steel cost efficiency while having a positive impact on the environment through energy savings and recycling polymers, including rubber.

Implementation of this technology at OneSteel's Sydney and Melbourne based EAF facilities achieved the following benefits:

- **Improved slag foaming** resulting in reduced energy consumption and therefore lower greenhouse gas emissions produced by coal fired power stations
- **Reduced** quantity of injectant required
- **Lower cost** of rubber injectant over coke
- **Increased furnace productivity** resulting from reduced power-on time
- **Reduced emission levels** for NOx, CO and SO_2

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Inventor of the technology, Professor Veena Sahajwalla of the University of New South Wales (UNSW), Australia, first developed the idea that polymers, including rubber, contain an essential source of carbon required for slag foaming in EAF steelmaking. This idea resulted in a three-year technology development and testing program conducted in partnership with OneSteel at its Sydney-based EAF facility.

The technology involves replacing a proportion of coke traditionally used as a slag-foaming agent in EAF steel making with polymers, including rubber. This results in improved slag foaming which is the driving force behind the benefits this technology can deliver.

NewSouth Innovations Pty Ltd (NSi) Australia, a commercial arm of UNSW, holds a patent in the United States of America (USA) (and other countries) for the technology. NSi has granted OneSteel the exclusive right to sub-license this technology in key EAF steel making regions around the globe.

Professor Veena Sahajwalla, FTSE, FIE Aust, CPEng, Director - Centre for Sustainable Materials Research and Technology (SMaRT) Faculty of Science, The University of New South Wales (UNSW)

NSi NewSouth Innovations

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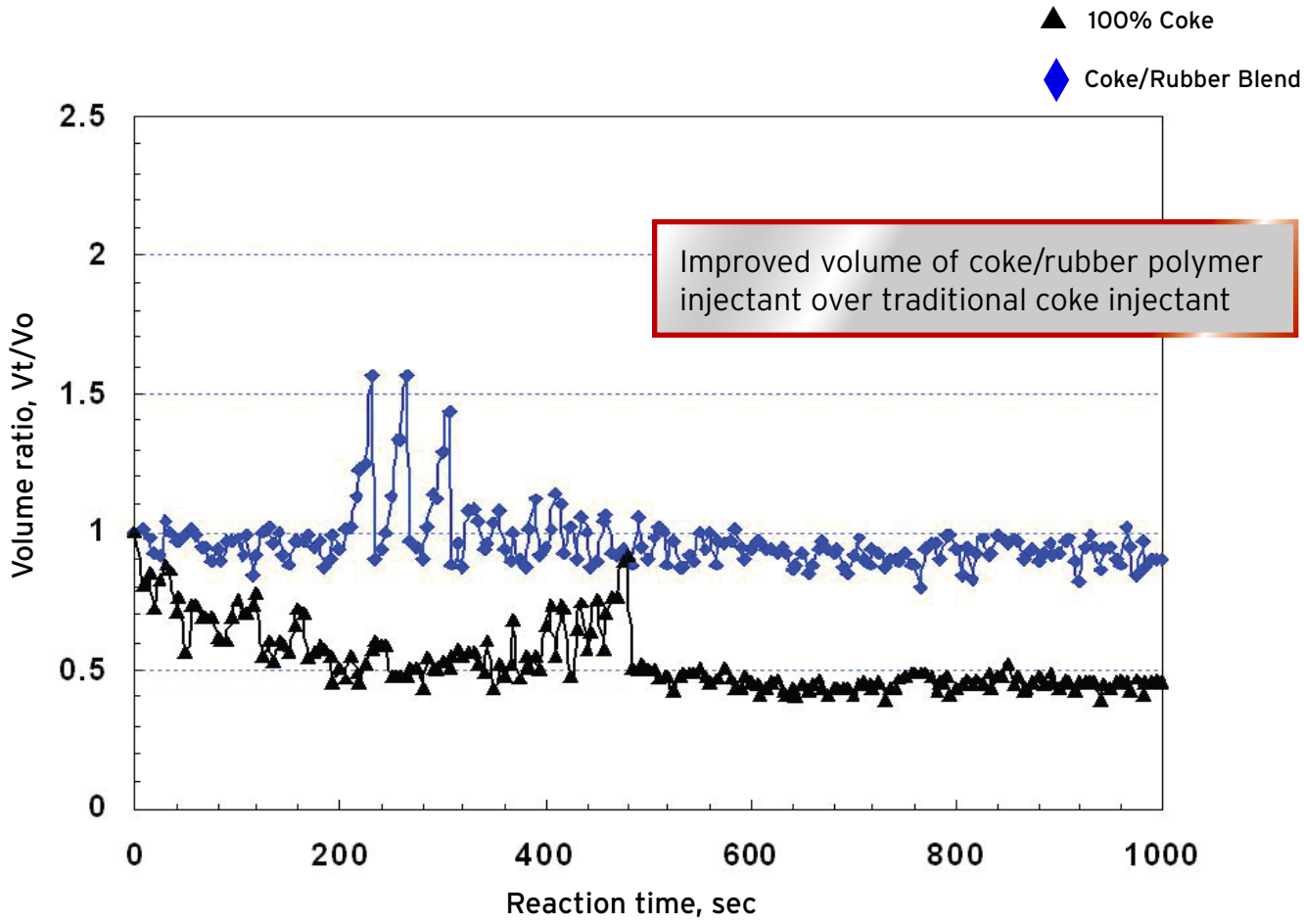
Volume Ratio Vt/VO comparison between Slag for Coke and Coke/Rubber Blend used at OneSteel's Sydney Steel Mill



OneSteel's Sydney Steel Mill is located in the outer suburbs of Sydney, Australia. The melt shop was commissioned in 1992 and it produces 570,000 tonnes of product a year using a high performance EAF to produce billets from scrap steel. Scrap makes up about 85% of the charge with the remainder made up of pig iron.

Start-up date	1992
Manufacturer	Danieli
Type	AC EBT
Transformer	66 MVA (Tamini)
Mean tapping weight	80 tonnes
Shell diameter	5.5m
Electrode diameter	22 inch (~560mm)
Chemical energy	2 BOC oxygen-natural gas burners – Fuchs combined oxygen and carbon door lance
Annualised production	570,000 tpa

Initial trials of the new technology were conducted over 14 months and concluded successfully in May 2007. The design and modification of the injection equipment was carried out in-house and injection initially occurred on the second bucket only. The Mill then proceeded to inject the new polymer blend throughout the whole heat as standard procedure. Injection occurred over 6-8 heat sequences using a Fuchs door lance. Following the completion of successful trials, Polymer Injection was then trialed over a 24-hour period. Ending July 2008, OneSteel has conducted 3,115 heats using coke/rubber injectant blend.

In the production of 3,115 heats, OneSteel diverted approximately 38,000 passenger tyres from landfill to value-added steel products. In operating this technology as standard practice at OneSteel's Sydney Steel Mill, there is potential to recycle more than 85,000 passenger tyres per annum.

The following table provides a sample of results achieved at Sydney Steel Mill during a recent trial conducted under controlled conditions:

SSM Summary	Specific Electrical Energy (kWh/t)	Carbon injectant (kg/heat)	Tonnes/ minute
Coke	424.00	462.00	2.12
Rubber blend	412.13	406.91	2.20

- Reduced specific electrical energy consumption of approximately 3%
- Reduced carbon injectant of approximately 12%
- Increased furnace productivity (tonnes per minute) of 4%
- Slag FeO levels were maintained within the required range
- Reduced emission levels for NOx, CO and SO_2

In addition, the staff at OneSteel's Sydney Steel Mill have observed a longer electrode life span.

Laverton Steel Mill, located outside Melbourne, became part of OneSteel's operations in August 2007 following a merger with Smorgon Steel Group. The EAF facility at Laverton uses a Danieli module system.

Start-up date	1988
Manufacturer	Fuchs
Type	AC OBT
Transformer	77 MVA (Tamini)
Mean tapping weight	84 tonnes
Shell diameter	5.5m, 0.95m offset
Electrode diameter	24 inch (600mm)
Chemical energy	Danieli Module System 3 oxygen-jet injectors 4 carbon-jet injectors (2 used)
Annualised production	700,000 tpa

Following the benefits OneSteel achieved from Polymer Injection Technology at the Company's Sydney facility, OneSteel proceeded to implement the technology at its Laverton, Melbourne EAF. Work to install the materials handling system was undertaken during December 2007 and January 2008. Initially, the Team ran 258 heats with one injection module during which time specific energy savings similar to those achieved in Sydney were identified using a coke/rubber injection blend.

As at July 2008, OneSteel's Laverton facility is fully operational in the use of Polymer Injection Technology. The Team now injects with 2 modules as standard practice and has undertaken 1414 heats using coke/rubber blend.

In the production of 1,414 heats, OneSteel diverted approximately 36,000 passenger tyres from landfill to value-added steel products. In operating this technology as standard practice at OneSteel's Laverton Steel Mill, there is potential to recycle more than 200,000 passenger tyres per annum.

The following table provides a sample of results achieved at Laverton Steel Mill during a recent trial under controlled conditions:

LSM Summary	Specific Electrical Energy (kWh/t)	Carbon injectant (kg/heat)	Tonnes/ minute
Coke	398.50	1,020.00	2.09
Rubber blend	387.00	856.00	2.13

- Reduced specific electrical energy consumption of approximately 3%
- Reduced carbon injectant of approximately 16%
- Increased furnace productivity (tonnes per minute) of 2%
- Slag FeO levels were maintained within the required range

Following the completion of successful trials and full implementation of this technology at OneSteel's EAF facilities in Australia, the Company is preparing to take this technology to market through its exclusive sub-licensing deal with NSi.

OneSteel's Polymer Injection Technology Team has developed a suite of products and services from which to tailor an implementation solution to meet the needs of its customers including:

- Management of a controlled trial at customer's operations in order to demonstrate technology benefits;
- Advice relating to sourcing, testing and logistics management of polymer supply in accordance with OneSteel's designed specification and Quality Assurance practices;
- Design, development and project management of the construction and commissioning of a materials handling system to facilitate injection of the coke/rubber material;
- Training and development of employees in the methodology and practical expertise required to implement and manage the technology for outcomes; and
- Coordination of environmental testing through specialised consultants.

Features and Benefits

- **Improved slag foaming** resulting in reduced energy consumption and therefore lower greenhouse gas emissions produced by coal fired power stations
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For further information, please contact:
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"We have seen an improvement in our cost efficiency whilst making a positive impact on the environment. This technology is a win for steelmakers and a win for the environment."

David Knights
General Manager EAF and Casting
OneSteel

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