Iron & Steel Institute of Japan

Oxygen Steelmaking Study Tour of North America

The Iron & Steel Institute of Japan (ISIJ), in collaboration with AIST, organized a North American Study Tour for 22 Japanese steelmakers. Included in the study tour were visits to six oxygen steelmaking facilities and four electric steelmaking facilities. The tour was reciprocal to the ISIJ for the support extended to the AIST Oxygen Steelmaking Technology Committee (OSTC) for its 2014 AIST Oxygen Steelmaking Japanese Study Tour, which was held last fall. The Japanese delegation represented 14 different steelmaking and research facilities from seven different corporations: JFE Steel, Nippon Steel & Sumitomo Metal Corp. (NSSMC), Kobe Steel Co., Nisshin Steel Co., Daido Steel Co., Aichi Steel and Sanyo Specialty Steel. North American support was provided by Tallman Bronze Co. and U. S. Steel Canada – Lake Erie Works. At the conclusion of each facility tour, the delegates were given the opportunity to ask questions of the tour hosts as well as answer questions regarding their own facilities.

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The delegation met for a networking dinner upon their arrival in Toronto, Ont., Canada, on Sunday, 6 September 2015, as many of the delegates had not met each other prior to this visit. On Monday, 7 September 2015, the delegation visited ArcelorMittal Dofasco Inc. in Hamilton, Ont. They were greeted by Neal Pyke, KOBM stream manager and OSTC membership chair. Pyke provided an overview of both the KOBM stream and the EAF stream at ArcelorMittal Dofasco, after which the group was given the opportunity to tour the two facilities. A highlight of the tour was the explanation of the automation systems used at the KOBM to minimize variation in procedure for producing each heat. The ArcelorMittal Dofasco computer system utilizes the input material data, offgas analysis, slag detection and facility production information to completely automate the KOBM converter. The system controls the production process from the start of the blow to the finish of the tap.

"What impressed me the most was safety through the study tour. Safety is expressed in the plant slogans, and the plant managers asked us where we would find some safety problems in the plant. It shows that safety is recognized as their highest priority. I would like to express my appreciation to the AIST members and others who prepared the visit."

— Mr. Mineo Niizuma, Nippon Steel & Sumitomo Metal Corp.

On the morning of 8 September 2015, the delegates crossed the border into the United States and visited U. S. Steel – Great Lakes Works. Jamie Lash, area manager — steelmaking and immediate past chair of the OSTC, provided an overview of his facility as well as the tour of the basic oxygen furnace (BOF), the RH degasser and the slab casting facility. Great Lakes Works has a unique process called "reverse tapping" at the BOF. At the conclusion of the tap, the ladle car is moved further under the vessel as the vessel is raised to avoid putting excess slag into the ladle. The RH degasser at Great Lakes

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"I was impressed by two techniques through the steelmaking process study tour. The first technique is 'auto tapping' at ArcelorMittal, which could reduce deviation of some parameters, enable us to produce steel containing ultralow phosphorus more easily and cut down slag volume. The second one is 'real-time inclusion analysis' at SDI, which I recognized as a key technique to produce high-cleanliness steel. I appreciate the AIST members and others who provided me this opportunity to visit steel plants in North America."

— Mr. Masahito Shinohara, Nippon Steel & Sumitomo Metal Corp.

utilizes the KTB lance, similar to the Japanese facilities, and the No. 1 caster has the ability to produce a "twinned" slab.

On the afternoon of 8 September, the delegates visited North Star BlueScope LLC in Delta, Ohio, USA. Rex McClanahan, meltshop manager, provided an overview of the EAF facility and the thin-slab casting and in-line hot rolling facility. The facility, originally designed to produce 1.2 million tons per year, produces 2.26 million tons per year through a variety of upgrades and process improvements. Upgrades to the EAF include offgas analysis, oxygen burners, scrap preheating and a 140-MVA transformer. North Star is unique in that its entire production is in the form of hot rolled coil. Through their efforts for customer satisfaction, they have consistently achieved the highest rating as awarded by the Jacobson Survey.

The delegation visited Steel Dynamics Inc. (SDI) – Flat Roll Group in Butler, Ind., USA, and the Structural & Rail Div. in Columbia City, Ind., USA, on 9 September 2015. Ricky Rollins, melting manager for SDI, and Conrad Fisher, plant manager for Iron Dynamics, introduced the ISIJ delegates to the production process at Butler. The Butler facility is notable in that it has a rotary hearth furnace attached to a submerged-arc furnace (SAF), which produces hot metal from mill scale that is utilized in the EAF facility. Thirty-five tons of hot metal are cast each time from the SAF and delivered to the electric arc furnace (EAF) facility. The heat of hot metal is split between the two twin-shell EAFs for each heat.

At Steel Dynamics Inc. – Structural & Rail Div., the delegates were greeted by Stephan Ferenczy, meltshop manager and AIST Electric Steelmaking Technology Committee (ESTC) chair. SDI Structural & Rail Div. produces large-frame construction beams and rails for

1. U. S. Steel – Great Lakes Works.
2. Steel Dynamics Inc. – Structural & Rail Div.

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"I really appreciate everyone at AIST and the North American steelmaking companies for organizing such a great tour. I am in charge of converter and secondary refining, and I was able to learn the differences in the idea of refining control in North America and Japan. I hope that the relationship further develops between the North American and Japanese steelmaking companies."

— Mr. Tadaichi Umae, Nisshin Steel Co.

the railroad industry via two EAFs, two ladle metallurgy furnaces (LMFs) and, depending on the end product, one of two casters. The largest section produced via their beam caster and structural mill is a 36-inch-wide beam. The rail production facility includes a vacuum tank degasser (to lower hydrogen content) and a bloom caster. Steel Dynamics is capable of producing railroad rail in 320-foot lengths that are straightened and welded into 1,200-foot lengths for delivery to the railroad companies.

On Thursday, 10 September 2015, the OSTC and ESTC members joined the ISIJ delegation for a joint tour and technical discussion at ArcelorMittal Burns Harbor, Burns Harbor, Ind., USA. Dave Sena, operations technology area manager, and other representatives from Burns Harbor greeted the group and welcomed them to Burns Harbor. The Burns Harbor facility, built in 1969, is the youngest integrated steelmaking facility in the U.S. It produces 5 million

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tons per year of plate, flat rolled and ultralow-carbon sheet. The steelmaking facility has three BOFs, two LMFs, an RH degasser and two casters. The BOFs are similar to the KOBM at ArcelorMittal Dofasco in that a high degree of automation is utilized during the process. While the KOBM process is fully automatic, the BOFs at Burns Harbor still require some "hands-on" operator interaction.

Following the tour, the group convened to the Burns Harbor conference facility for an afternoon of technical discussions. The session was chaired by Jerry Moscoe, ArcelorMittal Indiana Harbor No. 4 Steel Producing manager and OSTC vice chair. The following technical presentations were given:

- Improvement of Hot Metal Desulfurization by Mechanical Stirring
  Masaomi Senoo, JFE Steel Corp. – Chiba Works
- The Activities for Reducing Molten Steel Temperature
  Kohei Fujimoto, NSSMC Nagoya Works
- Technique for Preventing Re-Phosphorization During Tapping in BOF Steelmaking
  Takashi Sugitani, Kobe Steel Co. – Kakogawa Works

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- Furnace Automation for an EAF
  Matt Hallam, SDI – Structural & Rail Div.
- General Furnace Practices at SDI Butler
  Bob LaRoy, SDI – Flat Roll Group Butler
- General Furnace Practices at Nucor Crawfordsville
  Gerry Gillen, Nucor Steel–Indiana
- Rotary Lance Technology at the BOF Desulfurization Station
  Jaclyn Spackman, U. S. Steel Canada – Lake Erie Works

3. Technical discussion between the ISIJ and representatives from the AIST ESTC and OSTC at ArcelorMittal Burns Harbor. Masaomi Senoo, JFE Steel Corp. – Chiba Works presenting "Improvement of Hot Metal Desulfurization by Mechanical Stirring."
4. The ISIJ met with AIST OSTC members and representatives of the ESTC at ArcelorMittal Burns Harbor.
5. U. S. Steel – Gary Works.

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- Automated Tapping and Alloying Practices at ArcelorMittal Dofasco
  Neal Pyke, ArcelorMittal Dofasco Inc.
- Indiana Harbor 3 SP Ladle Metallurgy Facility
  Key Robertson, ArcelorMittal Indiana Harbor No. 3 Steel Producing
- Furnace Automation at ArcelorMittal Burns Harbor
  Diancai Guo, ArcelorMittal Burns Harbor
- Low- and Ultralow-Sulfur Practices at the USS QBOP
  Ray Kellison, U. S. Steel – Gary Works

"I would like to thank AIST and ISIJ for the great opportunity, not only to tour so many steelmaking plants in North America, but also to bring us together for discussions with peers who have similar goals. What really impressed me was the enthusiasm to update equipment and the ideas to continuously make process improvements for a more effective implementation of automation. I thank everybody who was involved and spent time with me, and hope such activities will be continued between North America and Japan."

— Mr. Shinichiro Sugimoto, Sanyo Specialty Steel Co.

Following the technical discussion, the joint group returned to the hotel for a networking reception and dinner.

The final day of the ISIJ study tour, 11 September, included visits to U. S. Steel – Gary Works, Gary, Ind., USA, and ArcelorMittal Indiana Harbor, East Chicago, Ind., USA.

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"I am grateful to AIST and ISIJ for giving us the opportunity to visit many steelmaking works in North America. I appreciated the pleasure of cooperating with wonderful engineers of the world. I hope that our steel companies can build a strong relationship and may continue to learn from one another."

— Mr. Masaomi Senoo, JFE Steel Corp.

Yun Li, senior research consultant and former OSTC chair, greeted the delegation at the U. S. Steel – Gary Works facility. Following a safety orientation, the delegation visited both the No. 1 BOP facility and the QBOP. Gary Works steelmaking facilities each have three vessels in operation. The No. 1 BOP facility has a CAS-OB for steel refining prior to the continuous casters. The QBOP converter is similar to the JFE Steel Corp. – Chiba Works converters, which also utilize the QBOP process to produce steel. While QBOPs are extremely effective in producing steel from hot metal, because of the bottom elements, they can be maintenance-intensive. The facility can operate two vessels concurrently that feed three LMFs, three RH degassers and three casters — one of which is a "twinned" caster. U. S. Steel – Gary Works produces API-grade steels, advanced high-strength steels (AHSS) and tinplate grades.

A visit to ArcelorMittal Indiana Harbor Works completed the week for the delegates. Jerry Moscoe and Shank Balajee, principal engineer — steelmaking, greeted the group and welcomed them to the No. 2 Steel Producing facility. Steve Horvath, division manager — No. 2 Steel Producing, gave the group an overview of the steelmaking facility at No. 2 Steel Producing. Jerry Moscoe provided an overview of the No. 4 Steel Producing facility. Following the presentations, a tour was given of No. 2 Steel Producing. The delegates saw the BOF vessels, the LMF station and the two continuous casters. Production at No. 2 Steel Producing focuses on AHSS; high-strength, low-alloy peritectic; and aluminum-killed steels.

AIST conducts study tours around the world to provide its members with opportunities to see similar processes and discuss technologies around those processes with individuals from other countries, cultures and backgrounds. Study tours provide ample opportunity for networking with not only the host companies, but also with colleagues and other AIST members on a deeper, more personal level. As the steel industry has grown internationally, these study tours have been a key activity of AIST in bringing steelmakers from Japan, Europe and South America closer together. ✦

6. Delegates observing the BOF operation at ArcelorMittal Indiana Harbor No. 2 Steel Producing.
7. ISIJ delegates at the continuous caster of No. 2 Steel Producing.
8. ISIJ visit to ArcelorMittal Indiana Harbor No. 2 Steel Producing.