

Ana Urquijo, general manager, Aiainox, accepted a plaque of appreciation from Ron O'Malley.





# AIST SAFTC & SFSA Specialty Alloy and Foundry Study Tour — Spain

23-29 June 2018

The AIST Specialty Alloy & Foundry Technology Committee (SAFTC) is composed of various steel and specialty alloy producers and suppliers, and key personnel from research universities. The Steel Founders' Society of America (SFSA) is an organization for the steel foundries, which focuses on steel casting technology. After a successful joint study group in the U.K. in 2016, AIST and SFSA collaborated again to bring 15 participants to Spain. It should first be noted that the Spain study group tour was made possible with the gracious support of Committee of Associations of European Foundries (CAEF), the European Foundry Association and Federación Española Asociación Fundidores (FEAF). For decades, SFSA has partnered with Bundesverband der Deutschen Gießerei-Industrie (BDG), the German foundry association. Through

BDG and CAEF, SFSA was connected with FEAF, who kindly assisted in arranging tours of their steel foundry members in Spain. Without these partnerships and long-term friendships, the tour would not have been possible. The study group participants would like to recognize the support of John Middleton and Diana David, who volunteered their time planning and organizing the tour.

A study group tour is so much more than an opportunity to visit another country. Why should companies participate in study group tours? The short answer: it is an investment in their future (both for the company and the individual). Tours provide a unique experience for benchmarking your company on a world scale. Owners and upper-level managers gain the benefit of seeing the state of the industry



By David Poweleit, vice president of technology, Steel Founders' Society of America





L'esprit industriel

## Castmetal Vitoria



Sergio Lertxundi (center), technical manager at Castmetal Vitoria, accepted a plaque of appreciation from John Middleton (left), SAFTC study tour chair, and Ron O'Malley (right), AIST vice president.

for manufacturing to make long-term planning decisions and to help evaluate CapEx proposals from staff. Operations and technical staff gain the benefit of seeing new processes and technology that may be adapted back at home. Tours allow one to benchmark how others are resolving challenges and making changes, how others have leveraged their opportunities not only to survive but to grow, and how others have addressed their needs through equipment and processes. Foundries and specialty alloy producers are each unique and have their own niche based on product, personnel and equipment. What is successful for one company may be a disaster for another, but having a means to benchmark and ideas to consider are the heart of the value for study groups. The tours also provide a unique experience to network the European way, by getting to know one another through a week's worth of visits to manufacturers while riding on a bus or dining together. Even the host company benefits by having colleagues in the industry provide constructive criticism when their operations are viewed by someone with experience similar to their own. Thus, it is possible to collaborate and share methodologies and strategies. With friendships made, reciprocal assistance and tours are the norm.

The group was able to tour seven steel foundries along with one mill in northern Spain. While newer



Inaki Barrenengoa (center), plant manager for Castinox, accepted a plaque of appreciation from John Middleton (left) and Ron O'Malley (right).



Mikel Pujana, AMPO sales director, and Iker Azpiaz, AMPO area sales manager, accepted a plaque of appreciation (center, left to right): Dave Poweleit, Steel Founders' Society of America; John Middleton, Pujana, Azpiaz and Ron O'Malley.



than many U.S. foundries, plants were in good condition, and recent investments in facilities were common.

### Castmetal-Vitoria (25 June)

Castmetal-Vitoria makes low- and medium-alloyed steel in an automatic molding green sand line with two 5.5-ton furnaces and bottom pour ladles. Primary markets include construction/mining (e.g., axle housings) and railroad. Their unique capability is the automatic molding line with box size of 2,500 x 1,300 x 900 mm and in-house machining capability. They believe steel castings offer designers weldability and higher mechanical characteristics, and that they offer good technical advantages and price.

### Castinox (25 June)

Castinox makes high-alloyed steels including stainless, duplex, super duplex and nickel-based alloys in chemically bonded silica molds with 3-ton, 1-ton and 0.7-ton induction furnaces and lip pour ladles. Primary markets include paper, offshore, chemical, petrochemical, nuclear, water treatment, heating and desalination. Their unique capability is short and flexible delivery time, quick changes of alloys, continuous process improvement, and an experienced and knowledgeable technical office. They believe steel castings offer designers a less expensive and faster opportunity to provide geometry in short runs.

### AMPO (26 June)

AMPO makes high-alloyed steels including stainless, duplex, super duplex and nickel-based alloys along with a little carbon and low-alloy steel in chemically bonded sand, Replicast, centrifugal and shaped centrifugal. Their 5-metric-ton electric arc furnace, 5-metric-ton argon oxygen decarburization (AOD), and seven induction furnaces produce castings from 50 to 5,500 kg and up to 3,000 x 3,000 mm. Primary markets include valves, marine, separation, power generation and pumps. Their unique capability is having several casting processes and an integrated in-house machining facility, and they can provide reverse engineering/patternless/rapid prototyping for low-volume parts.

### Estanda (27 June)

Estanda makes low-alloy steels, white irons, high-chrome, manganese steel and heat-resistant steels in green sand and chemically bonded sand with induction furnaces. Primary markets include railway, cement and mining. What makes Estanda unique is their knowledge and experience along with automatization.

### Aianox (28 June)

Aianox makes high-alloy steel in chemically bonded sand with induction furnaces. Primary markets include shipbuilding, oil and gas, paper, and power generation.



Mikel Garcia, Estanda production manager, and Asier Arocena, Estanda industrial director, accepted a plaque of appreciation (center, left to right): Ron O'Malley, Garcia, Arocena and John Middleton.



Bruno Dupire, David de Morentin and Miguel Rota Zapata of Magotteaux-Navarra accepted a plaque of appreciation (left to right): Dupire, John Middleton, de Morentin, Zapata, Ron O'Malley and David Poweleit.

### Magotteaux-Navarra (28 June)

Magotteaux-Navarra makes high-chrome white iron, medium-carbon and low-alloy steels in green sand and chemically bonded sand with induction furnaces. Primary markets include wear-resistant castings with a focus on aggregate. By being part of a large international group, Magotteaux-Navarra has access to corporate support such as research and development, along with the ability to benchmark and collaborate with sister foundries worldwide. They believe steel casting is the most economical solution to manufacture various shapes of parts with excellent mechanical properties such as toughness and hardness.

### Ebroacero (29 June)

Ebroacero makes carbon and low-alloy steel, manganese steel, stainless, and Ni-Hard in green sand and chemically bonded sand with electric arc furnaces up to 7.5 m. Primary markets include power generation, sugar, cement, naval, offshore, industrial plants, crushing and valves. Their unique capability is their melt capacity, which is the second-highest in Spain. Ebroacero also has 55 years of experience. Their in-house machining and heat treatment allows them to make crowns and rings up to 7.5 m, treated and machined at home. They also have the ability to do all non-destructive testing (NDT) methods. Ebroacero believes that the best attribute of steel casting is the



Ignacio Gimenez (center), commercial director, Ebroacero, accepted a plaque of appreciation from Ron O'Malley (left) and John Middleton (right).





## The History of Steel

The art or science of obtaining steel is over 3,000 years old. Around 1000 BC, steel was being produced in the Near- and Middle-East. Indian craftsmen succeeded in improving the technique by using a closed clay vessel. In the 18th century, Benjamin Huntsman used a closed earthenware crucible and a coke fire to melt the mineral, hence giving birth to the blast furnace as we know it today.

The procedures involved in refining, the chemical composition, and characteristics of steel were fairly rudimentary until the mid-19th century. The contributions of Henry Bessemer, William and Friedrich Siemens, and Pierre and Emile Martin marked a new stage in the production, quality, and quantity of this material. It was not until the mid-20th century that steel production was perfected with the substitution of blasted air for pure oxygen, thus substantially improving its characteristics.

The use of iron and its production were introduced to the Basque Country around 600 BC by Celtic or Indo-European peoples coming from central Europe. The abundance of this mineral in our mountains gave rise to the tradition of forges, the forebears of modern iron and steel mills. These forges, or *agorrolak* in Basque, installed in the hills to be near the ore and wood, lasted until the 17th century. Although references are to be found regarding forges situated on river banks, the practice only spread as from the 16th century.

The development of the iron and steel industry was essential to the economy in Biscay, generating an important trading activity with Bilbao being the most relevant spot, thus becoming the most important port on the Bay of Biscay. The installation of new factories on the left bank of the Nervión Estuary and the important industrialization of the late 19th century was developed to the full with Altos Hornos de Vizcaya. The history of steel lives on in the Basque Country in the many remains that still exist of this thriving activity.

*This text appears on a placard in the Guggenheim Museum in Bilbao.*



Xabier Arbulu, managing director, Rugui, was presented with a plaque of appreciation (left to right): J-B. Prunier, Shawn Wang, Louis Pignotti, John Middleton, Arbulu, Ron O'Malley, Trevor Shellhammer, David Poweleit and Jose Luis Rodriguez.



Oroitz Unzain, of Federación Española Asociación Fundidores' technical department, accepted a plaque of appreciation for helping with the foundry tours (left to right): David Poweleit, Ron O'Malley, Unzain, John Middleton and Trevor Shellhammer.

freedom to choose the alloy and the capability to make complex shape without welding.

### Rugui (29 June)

Rugui's meltshop employs three 14-MW, 33-metric-ton Inductotherm coreless induction furnaces (two in operation and one in maintenance), with a total production capacity of 250,000 tons per year to produce billets for structural and special bar quality (SBQ) applications. Each furnace is fitted with a vibratory scrap feeding system and employs a spinel refractory lining to allow operation with a basic slag

practice. The meltshop also houses a ladle furnace with four wire feeders and bulk alloy handling, a vacuum tank degasser that employs mechanical pumps, and a 2-strand continuous billet caster. The 8-m-radius billet caster uses both open and submerged pouring practices and strand electromagnetic stirring to produce 125 × 125, 165 × 165 and 285 × 150 billets. The billets are transported to the neighboring hot rolling facility to produce hot-rolled flats ranging from 50 to 300 mm in width and from 8 to 80 mm in thickness. Rugui supplies hot-rolled flats for use in automotive, forging, agriculture, industrial machinery, wind, bright bar and other markets.

Participants in the Spain study tour came from all over the world, including the U.S., Mexico, Canada, France and the U.K. The

following are observations shared by the attendees.

- Willy Oyarzabal from Fimex (Mexico): The foundries were clean with good air quality. Compared to the U.S., the foundries were less strict on safety, and utilized fewer personnel. Short lead times allow them to compete against Turkey, China and India.
- Emilio Álvarez Miaja and Alonso Alvarez Abouchard from Fundidora Morelia (Mexico): Most of the foundries subcontracted finishing operations along with x-rays and use PEP SET



binder. They produced good quality parts with a good surface finish.

- Jean-Baptiste Prunier from Ferry Capitain (France): The study tour facilitated seeing different quality levels and different ways of achieving the required quality levels. Some foundries use filters with high-quality risers and have subsequently less welding; mainly for high-demanding markets. Other foundries use lower-cost risers but invest in more welding to achieve required quality levels. A commonality for all the foundries was the use of PEP SET. The castings produced were quite good — no cracks or sand inclusions.
- Trevor Shellhammer from Shellhammer Consulting (U.S.): The use of automation was significant, with many shops using robots for finishing and welding, and the use of a programmed continuous mixer to automatically fill the mold with a timed fill, automatic shutoff, strike-off and bring in the next box, which changed timing depending on what was scheduled next.
- Shawn Wang from ME Global (U.S.): One benefit observed was pattern storage and management systems. The pattern storage system not only provided efficient control of patterns, but also extended pattern life.
- John Multon from Multon Process Technology (U.K.): Most impressive were the advancements in the use of Enterprise Resource Planning

systems and castings technology systems, and the application of robotics to achieve smart manufacturing at most of the foundries visited.

- Louis Pignotti from Kolene Corp. (U.S.): There were subtle differences in work culture and methods in pouring steel.

The group was also joined by Guillermo Pizzuto, Antonio Pizzuto and Roberto Aguilar from RAMSA; Adolfo Quiroga from Gamma Foundries; and Ron O'Malley from Missouri University of Science and Technology.

FEAF provided the following information on the steel foundry industry in Spain. Much like the rest of the world, all markets were very low in 2016 with the start of some recovery in recent years. The Spanish steel foundry industry has 26 companies, 2,100 employees, produces more than 58,000 metric tons with 44,000 metric tons exported, and a total turnover of €308 million. The largest markets are railway, construction and cement, machinery, and pumps and valves. FEAF provides economic, commercial and technical support to the Spanish foundry industry.

The attendees greatly enjoyed spending time in Basque Country and the northern region of Spain, including a visit to Bilbao. AIST and SFSA would like to thank the companies who supported the participants of the study group, the foundries and mill visited, Inductotherm for arranging the mill tour, and FEAF for arranging the foundry tours along with assistance in planning the trip. ♦

