SFSA CASTEEL REPORTER

Steel Founders' Society of America

a publication serving SFSA steel casting industry Members

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Casteel Commentary

Additive manufacturing is all the buzz in manufacturing. Steel castings are likely to be the biggest beneficiaries of additive as an enabling technology to enhance the value and utility of our products. This month's Casteel Commentary reflects on how additive is our friend and not our competitor.

SFSA Fall Leadership Conference

There is still time to register for the SFSA Fall Leadership Meeting being held on September 12-15 at the Loews Hotel in Washington, D.C. We invite you to join other industry leaders to experience a great program and networking opportunities in our nation's capital.

Congressman Bill Huizenga (R-MI) will lead the business session on Tuesday, September 15 with a presentation to SFSA members. This year's business sessions will also include:

- Richard Brandt, Iacocca Institute-Lehigh University - Globalization Going Backward
- Joe Trauger, National Association of Manufacturers - Manufacturing Issues - Workforce Development, Lobbying, Healthcare
- John Anton, IHS Global - Steel Markets Update
- Ron Lorentzen, International Trade Administration - Manufacturing Trade Issues
- Max Schumacher, German Foundry Association - German Foundry Business Climate and Trends
- Raymond Monroe, Steel Founders' Society of America - 2016 SFSA Market Forecast

Meeting Schedule:

Saturday September 12

8:00am	Executive Committee Meeting
8:00am	Executive Committee Spouse Breakfast
	Arlington National Cemetery Tour
1:00pm	Welcome Reception
6:30pm	

Sunday September 13

8:00am	Board of Directors Meeting
9:00am	Board of Directors Spouse Breakfast
	Trolley Tour – Washington
1:00pm	Historical & Architecture Tour
6:30pm	Dinner

Monday September 14

8:00am	Business Session
9:00am	Spouse Breakfast
1:30pm	Mount Vernon & Distillery Tour
6:30pm	Reception & Dinner

Tuesday September 15

8:00am	Business Session
9:00am	Spouse Breakfast
6:30pm	Reception

National Technical & Operating Conference

The 69th SFSA T&O Conference will be held at the Drake Hotel in Chicago, December 10-12, with a member workshop featuring a presentation on welding nickel alloys by John DuPont on the afternoon of Wednesday December 9. The T&O Committee and SFSA staff have assembled a program of 50 papers and presentations – 39 of these are by SFSA members. This year's conference will be of great value and you will find something that you can apply in your plant. Registration and program information is available online at https://www.sfsa.org/sfsa/toconf - also please note that there is a discount for early registration.

Operating T&O Meeting (Southern Division)

Our last T&O divisional meeting of 2015 will focus on operating steel foundries. While these meetings have historically been organized under SFSA's divisions, attendance is open to all members. The Operating T&O meeting will be held on Thursday, October 8th and Friday, October 9th near Tulsa, OK. Thursday afternoon will be for the traditional "Southern Division" T&O meeting, which will feature topics on operating steel foundries including: running an induction furnace; general concepts and new technology for sand binders, testing, and additives; identifying and resolving hydrogen assisted cracking; and the basics of scanning technology and tolerance capability for steel castings. We will also tour American Foundry Group (AFG). To RSVP, please contact David Poweleit at poweleit@sfsa.org.

Future Leaders

SFSA's Future Leaders group offers a unique opportunity to position our industry for the future. With recent meetings on our research and industry roadmaps, it will all be for naught if we do not have a future generation ready to lead. Every foundry should invest in at least one individual by having him or her participate in Future Leaders. So, who is your future leader? The next meeting for the group offers a unique opportunity, as it will be held in conjunction with the Operating T&O meeting. The meeting will be held in Tulsa, OK on Wednesday 10/7 to Friday 10/9 and will feature a tour of American Foundry Group (AFG). The meeting will offer a networking and knowledge sharing roundtable along with Subject Matter Expert presentations by Paul Rudd, SFSA honorary member formerly with Hensley, and AFG. To RSVP, please contact David Poweleit at poweleit@sfsa.org.

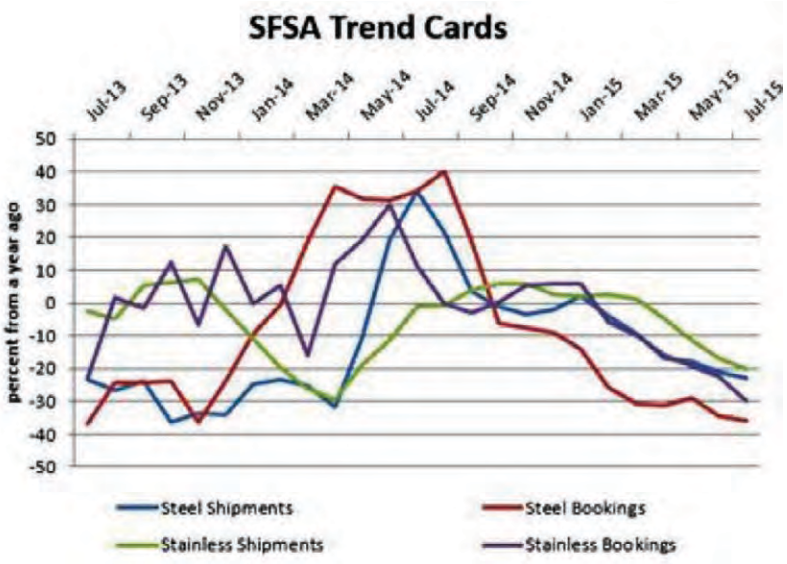
HR & Safety

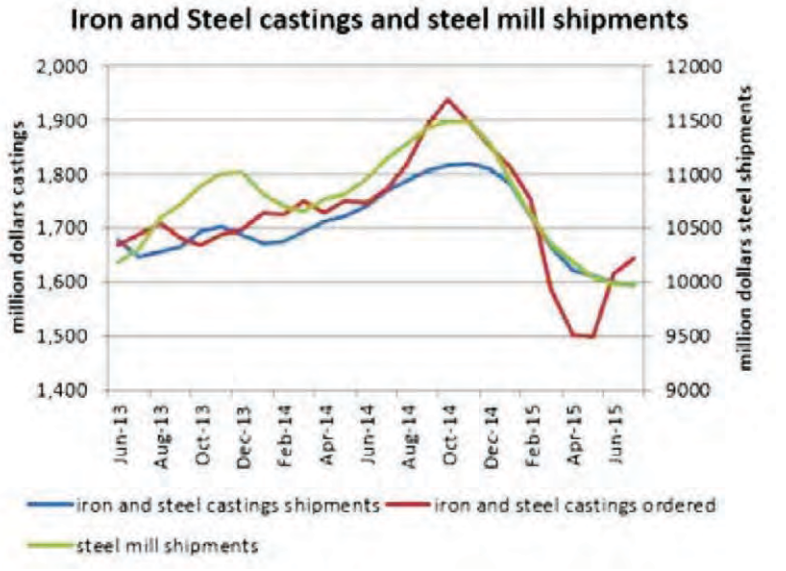
The SFSA HR & Safety Group Meeting will be held October 20-21, 2015 at the Holiday Inn KCI Airport in Kansas City, MO. This meeting is a great opportunity to learn from your peers on many safety and HR topics. In addition, a roundtable discussion is the perfect forum to network and find solutions to take back to your foundry. The meeting will include a tour of Bradken's foundry in Atchison, KS and their machine shop in St. Joseph, MO. To RSVP, please contact Ryan Moore at rmoore@sfsa.org

Market News

Orders and shipments of steel and stainless steel castings continue to decline as expected. SFSA trend cards show a decline in July for steel casting shipments of about 24% on a 3 month rolling average. The bookings are off more, over 33%. For stainless steel castings the bookings have seen a similar decline, 30%, but the shipments are off, 25%. The production index based on the trend cards shows the industry operating around 65% of capacity.

Backlogs reported by SFSA members have stabilized with an 8-week median for steel castings and a 7 week median for stainless steel castings.





In the past 15 years, the PPI for steel foundries for June is 25% over the average PPI index. For all commodities it is up 15%, iron and steel products are up 9%, capital equipment is up 12% and investment foundries are up 11%. Iron and steel products were up almost 40% in 2011 before declining in their PPI index to only be 9% over the average.

Steel mill sales show a 15% decline since October of 2014. Iron and steel castings show only an 11% decline for the same period. This decline is less likely because of the continued demand for iron castings for automotive production at a high level. Steel mill production is consistently off around 9% from the prior year with a capacity utilization around 73%.

It is not unexpected that steel casting demand is off and not likely to improve soon. Steel casting demand is closely tied in market conditions to the production of steel, the price of oil and the price of copper. Steel production as noted is down 9% on a week-to-week basis. Oil prices as tracked by WTI are down from over $100 to around $45 a barrel. This would affect the demand for energy products and the chemical and petroleum products markets. Copper prices are down from over $3.20/lb. to less than $2.40/lb. Copper is a key indicator of mining activity and the low price of copper and oil means little new investment in mining. Copper is also used in all industrial and construction activity. A low copper price is an indication of low demand in manufacturing.

The news about the economy is generally for a slow but improving growth. The outlook for steel casting demand is poor with little possibility of improvement this year.

Research Review Summary

The Research Review meeting was held on July 27-29 at Rosemont, IL. UNI presented their development of thermophysical properties of 3D printed sands. MS&T gave an update on the heat treatment that was developed for high strength steels. PSU discussed HIPing of UHSLA, which minimizes the microporosity and generally improves properties. UAB studied the validity of the ductile-brittle transition temperature (DBTT) shift as a function of specimen width (full size, ¾ size, ½ size) specified by ASME BPVC Section VIII Table UG-84.2. ISU completed their work on the effect of cooling rate on hardness for CA6N, and gave an update on automated manufacturability analysis software that will provide early-and-often feedback to design engineers. UI presented their research on the effect of core expansion on dimensional changes in steel castings. Stress simulations accurately predicted dilation of a thick walled cylinder casting. A case study on a steel bracket casting was also shown. Lehigh talked about improved heat treatment for high alloy castings. It was found that the standard heat treatments for the high alloy grades examined were insufficient in homogenizing the castings. New heat treatments were developed for complete homogenization. Under a separate program, test samples using the standard and new heat treatments are currently being used for corrosion testing.

Casteel Commentary

Additive is all the rage. The use of 3D printing type technologies is touted as a revolutionary manufacturing technology that will revitalize North American manufacturing. It is seen as a replacement for a wide range of manufacturing technologies including castings. America Makes, the first advanced manufacturing center created by the US government in Youngstown was for additive processes. At the AFS organized NIST sponsored casting industry roadmapping session, additive manufacturing was the most prominent topic of discussion.

In DC, policy makers believe that castings are an old and mature technology, not advanced manufacturing. In contrast to that prejudicial idea, steel castings have been at the forefront of advanced technologies. Attached is a paper demonstrating how our industry is a leader in all the current advanced technology areas.

How should steel foundries think about additive or 3D printing technologies? Are they competitors? Irrelevant fads? Critical tools?

I would argue the 3D printing or additive manufacturing is an enabling technology for steel castings that will multiply our value and capability. For actual part construction, additive faces fundamental challenges.

While automotive producers have been early adopters of additive techniques, it is important to see that they are not trying to use additive to make production parts. Additive is speeding up but is still way too

slow and expensive for any volume production. It is ideal for prototype or design because it is tool-less and faster than traditional methods but is not suited for production.

Additive processes also need significant development before the components made are able to meet the performance requirements reliably. For metallic printing of parts, the 3D process must have the same process development and controls as a critical weld. Then the final component must be qualified with NDT as though it were a casting. The process is not able to be translated to other parts so far but requires separate process and part qualification for each application.

None of these restrictions for metal components using 3D printing limits casting with tools or molds made by additive techniques. This makes additive the ideal enabling technology for critical casting development and in some cases production. After developing a casting design and application with printed molds, additive can play a role in producing the production tooling if required.

Additive as an enabling technology for casting manufacturing has two clear applications. It can dramatically open up the space for alternative and creative designs and provide a cost effective method for improved or replacement parts for castings where tooling no longer exists. It may also become a standard method for producing complex mold and core configurations. It is also likely to be capable of making complex investment casting shells and cores directly from the solid model.

Designers working on a new component that considers casting are severely limited by the need for tooling during the development phase of the design. Tooling takes significant time in the product design cycle and is costly. This even leads to parts well suited for casting to be fabricated or machined to avoid the long lead times and cost of tooling during product development. When castings are considered, the design is normally evolutionary and the design options are limited because of the need for tooling.

Printed molds eliminates this barrier to casting design development. With printed molds no tooling is required. This allows multiple design variants to be evaluated simultaneously. No longer is the wild idea of the most creative designer not tried because the tooling and cost are excessive. The ability to print the mold allows the casting to meet the same lead time and schedule and cost as a fabricated or machined prototype. Squeezing time and cost from the design cycle using 3D printed molds is a huge opportunity for steel castings.

Printed molds also allow complex non-producible castings to be produced by ordinary casting plants. Complex core assemblies can be made without the need for multiple tools and core assemblies. Freedom to locate risers and parting lines to optimize casting quality is possible. Printed molds reduce or eliminate to loss of tolerance and location within a mold or between mold and “core”. The ability to print ceramic shells for investment casting can be a game changer for limited production and the tolerance and fine-ness of features possible.

Printed molds allows the reverse engineering of legacy parts where tooling is no longer available. This allows cost effective production of replacement parts as castings to keep valuable systems operating. The use of solid models also allows maintenance parts to be resized or modified to gain increase production or life.

So it seems to me that we in steel castings should be early adopters and aggressive users of additive technologies. We can demonstrate our claim to be advanced manufacturing and ensure that steel castings will have a growing role in the high performance and critical requirements in the future.

Raymond

STEEL FOUNDERS' SOCIETY OF AMERICA
BUSINESS REPORT

SFSA Trend Cards (%-12 mos. Ago)	12 Mo Avg	3 Mo Avg	July	June	May
Carbon & Low Alloy					
Shipments	-10.3	-25.3	-30.0	-21.0	-24.8
Bookings	-21.6	-35.0	-33.2	-41.6	-30.2
Backlog (wks)	8.2	8.0	8.0	8.0	8.0
High Alloy					
Shipments	-5.5	-25.0	-35.0	-20.0	-20.0
Bookings	-9.9	-30.0	-30.0	-20.0	-40.0
Backlog (wks)	7.3	7.2	7.9	6.0	7.8
Department of Commerce Census Data					
Iron & Steel Foundries (million $)					
Shipments	1,712.8	1,598.3	1,607	1,603	1,585
New Orders	1,731.3	1,623.7	1,583	1,697	1,591
Inventories	2,139.5	2,013.0	2,024	2,019	1,996
Nondefense Capital Goods (billion $)					
Shipments	79.4	79.1	79.3	79.2	78.7
New Orders	79.6	79.2	82.4	81.5	73.6
Inventories	181.7	176.8	177.1	177.1	176.2
Nondefense Capital Goods less Aircraft (billion $)					
Shipments	69.7	69.5	70.0	69.6	68.9
New Orders	69.8	68.7	70.0	68.5	67.5
Inventories	122.2	121.3	121.1	121.4	121.3
Inventory/Orders		1.8	1.73	1.77	1.80
Inventory/Shipments		1.7	1.73	1.74	1.76
Orders/Shipments		1.0	1.00	0.98	0.98

Castings as Advanced Manufacturing

Advanced Manufacturing is “a family of activities that (a) depend on the use and coordination of information, automation, computation, software, sensing, and networking, and/or (b) make use of cutting edge materials and emerging capabilities enabled by the physical and biological sciences, for example nanotechnology, chemistry, and biology. This involves both new ways to manufacture existing products, and especially the manufacture of new products emerging from new advanced technologies.” This is the definition of advanced manufacturing from PCAST as shown on the manufacturing.gov website (1).

Casting metal components has generally been discounted as a possible advanced manufacturing process. This is unfounded. On the same website it is noted that, “Advanced Manufacturing is not limited to emerging technologies; rather, it is composed of efficient, productive, highly integrated, tightly controlled processes across a spectrum of globally competitive U.S. manufacturers and suppliers.”

Casting has been a leader in the development and implementation of the advanced manufacturing techniques identified by National Network for Manufacturing Innovation (NMMI). Castings were the first and dominant adopter of additive manufacturing, have been essential in light weight metals for transportation and are leaders in the creation and use of digital manufacturing and design innovation.

The first NMMI center, America Makes- National Additive Manufacturing Innovation Institute (NAMII), was founded in August 2012. “Additive manufacturing, often referred to as three-dimensional (3D) printing, is a way of making products and components from a digital model.” Metal casting helped develop the additive technologies and is the most advanced adopter of these methods. The most common software format for additive was developed by metal casting for additive production of patterns, STL files. Casting uses as a commercial technology additive both as sacrificial patterns to make investment cast components and to print molds for complex prototypes and limited production castings. Additive processes such as laser welding and laser cladding is also utilized for repair and reuse of die casting dies.

Lightweight & Modern Metals Manufacturing Innovation (LM3I) was established in February 2014. American Lightweight Materials Manufacturing Innovation Institute (ALMMII), “brings together a consortium of leading companies that include some of the world’s aluminum, titanium, and high strength steel manufacturers, leading materials providers, and critical end-users with universities on the cutting edge of technology development and research.” Arguably the most significant lightweight initiative of the last decade has been the replacement of cast iron blocks and heads with aluminum castings. This relied heavily on alloy development and process innovations in die casting, precision sand, semi-permanent mold, and lost foam processes. Emerging technology in magnesium casting, structural die cast alloys, austempered ductile and compacted graphite cast iron and high strength steel holds the promise of dramatic weight reductions and improved performance in lightweight materials.

Digital Manufacturing and Design Innovation Institute (DMDII) was also established in February 2014. DMDII, “will address the life cycle of digital data interchanged among myriad design, engineering, manufacturing and maintenance systems, and flowing across a networked supply chain.” Metal casting is the most advanced manufacturing area using digital modeling, process simulation tied to performance modeling to optimize component design. Solidification modeling for casting design is pervasive in the industry. Using process modeling to evaluate a proposed design for both the cast material properties and component quality allows an assessment using standard FEA techniques to assure reliable component performance.

Independent of the innovation institutes, casting utilizes: remote melting furnace monitoring and control; artificial intelligent robotic programming; nano-technology custom alloys; central control systems for casting processing; ultra high vacuum processing; and, automated vision inspection systems.

Success in advanced manufacturing in the US economy requires investment in casting technology. Castings are used in frontier applications like medical implants, fusion reactors, advanced aircraft engines, etc. No advanced manufacturing initiative that fails to include a fundamental involvement of metal casting technology is likely to succeed.

(1) http://manufacturing.gov/whatis_am.html