SFSA CASTEEL REPORTER

Steel Founders' Society of America

a publication serving SFSA steel casting industry Members

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Casteel Commentary

The steel casting business is a tough business in good times. In trying times like now it can be brutal for us to survive. The Casteel Commentary discusses some of the structural reasons behind our challenges and the volatility of our markets. We have good reason to be optimistic about our future but need to manage our current circumstances to survive.

SFSA Fall Leadership Meeting

There is still time to register for the SFSA Fall Leadership Meeting being held on September 10-13 at the La Fonda on the Plaza Hotel in Santa Fe, NM. We invite you to join other industry leaders to experience a great program and networking opportunities.

This year's business sessions will include:

- Mike McDowell, Astec Industries – Perspective on Global Casting Market
- Michael Siegel, Alliant Group – Tax Incentives for Foundries: How Your Everyday Activities Can Increase Your Bottom-Line
- Larry Kavanagh, Steel Market Development Institute, Current & Emerging Steel Markets
- Rick Farrell, Tangent Knowledge – New Sales Strategies to Avoid Commoditization
- Joe Pickard, ISRI – Scrap and Commodities Markets
- Skip Guimond & Martha Guimond, Joseph Guimond & Associates - OSHA & EPA Regulatory Update and Foundry Best Practices
- Willy Oyarzabal, Fimex – 2017 SFSA Market Forecast

Saturday September 10	
Morning	Executive Committee Meeting Executive Committee Spouse Breakfast
Afternoon	Walking Tour of Historic Santa Fe & Salsa Making Competition
Evening	Welcome Reception
Sunday September 11	
Morning	Board of Directors Meeting Board of Directors Spouse Breakfast
Afternoon	Bandelier National Monument Tour
Evening	Dinner
Monday September 12	
Morning	Business Session Spouse Breakfast
Afternoon	Fly Fishing Docent Art & History Tour of La Fonda on the Plaza
Evening	Dinner
Tuesday September 13	
Morning	Business Session Spouse Breakfast
Evening	Reception

SFSA Combines Wear Castings Meeting and Future Leaders

Please save the date for the SFSA Wear Castings meeting that will be held on Thursday, October 27th and Friday, October 28th near Nashville, TN. Thursday afternoon will be for the traditional "Southern & Western T&O Division" meeting, which will feature topics on wear castings including presentations by Tom Stevens, Dick Sailors and Richard Hardin. Magotteaux-Pulaski will be hosting a tour on Friday morning. The meeting will be held in conjunction with a Future Leaders meeting, which will start in the afternoon on Wednesday, October 26th. There is no cost for the meeting - travel, hotel, meals, etc. are the attendees' responsibility. Final details for the meeting will be sent to all registered attendees. To RSVP, please contact David Poweleit at poweleit@sfsa.org. Additional details on the agenda, hotel, etc. will be available soon.

National Technical & Operating Conference

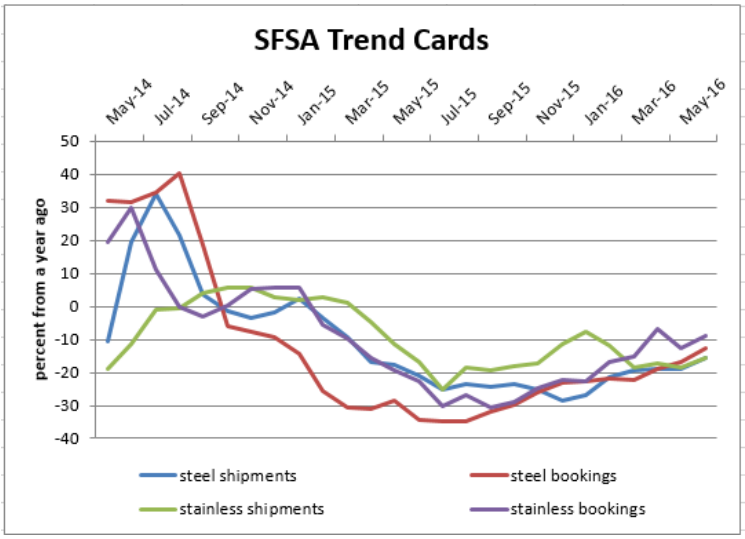
The 70th SFSA T&O Conference will be held at the Drake Hotel in Chicago, December 7-10. The T&O Committee, along with SFSA staff are working hard to assemble a program of papers and presentations that is sure to be of value in your plant. Mark your calendar. Additional information will be sent out to SFSA members when it is available.

SFSA to Offer New Safety and Environmental Compliance Service for Members

SFSA is launching a partnership with Guimond & Associates, a safety and environmental consulting firm that has worked with foundries and steel mills for more than 40 years. The principals, Skip and Martha Guimond, have assisted plants in meeting OSHA safety and health as well as state and federal EPA regulations, developed engineering control programs, and developed training and compliance programs. They have served as expert witnesses for industry and have been instrumental in determining what engineering controls are feasible in the foundry industry for both OSHA and clients.

SFSA will host a one-day meeting with the Guimonds in Milwaukee, WI on Thursday, October 20, to give members an opportunity to learn about the services that are available at no cost to SFSA members. Guimonds will also present on the current and future challenges from OSHA and EPA, how they may affect members and how you can develop strategies to meet the ever increasing regulatory requirements for safety, health, and the environment. Learn how to better protect your employees and bottom-line by attending this meeting. To RSVP, please contact Ryan Moore at rmoore@sfsa.org.

Market News

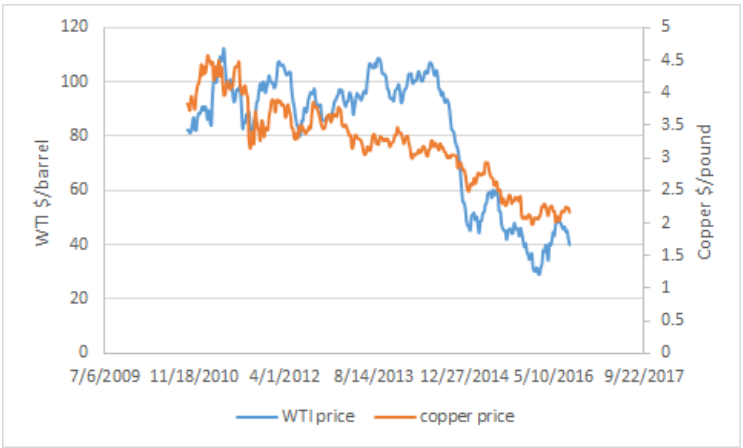


While the bookings for steel castings and stainless castings compared to a year ago continued to show shrinkage in June, the decline is smaller than in recent months. Shipments on average are off around 20%.

Backlogs have fallen to 6 weeks which likely represents the lowest level commercially possible. Business conditions remain weak in almost every market segment that consumes steel castings. The burning question is when will our market stabilize and demand improve substantially.

As mentioned in the last Casteel reporter, the production of steel and steel prices have rebounded. We are also closely correlated with the price of oil and copper. Oil prices are an indication in energy production and copper for mining activity. Rail has been also closely tied to oil prices and mining activity.

The graph shows that both copper and oil prices have seemed to bottom out recently after the lows experienced in the first half of 2016. Non-defense Capital goods orders have also fallen from their higher levels in mid-2015 but may be at the bottom in May.



Political uncertainty, financial intervention by the central banks, geopolitical tensions, terrorism and lack of economic growth has led to a low but stable economy. The ordinary projection for the near future is that the slowdown of capital investment has bottomed out and that sustaining the economy even at this slow pace will cause modest improvement in demand for the next year. It is unlikely however to cause a significant improvement in demand for steel

castings. Steady conditions with low demand and modest growth is the projection. Given the instabilities in our financial system, the distortions of ZIRP- zero interest rate policies, and threats of violence and conflict; it will be critical to prepare for volatile and abrupt changes in business conditions.

A more detailed discussion of market conditions and projections for the near term are being prepared for presentation at the Fall Leadership conference.

SFSA Training Webinars

The next SFSA training webinar will be on 'Induction Melting Operations' to be held on Tuesday, August 23rd at 10:30am central time. Registration (https://attendee.gotowebinar.com/register/2340993672804192513) is required. This 20-minute webinar is exclusively for SFSA members and will be presented by Raymond Monroe, SFSA Executive Vice President. Each training webinar is available on the Steel Wiki Website - http://wiki.sfsa.org/index.php/SFSA_Webinars. Prior topics include heat treatment, pouring and gating, steel melting practices, and introduction to steel metallurgy. If you do not yet have a Steel Wiki account, SFSA members can establish a free wiki account at http://wiki.sfsa.org/index.php/Special:RequestAccount.

Casteel Commentary

Severe swings in market demand for steel castings are unfortunately a normal part of our industry. This has been our characteristic business experience since steel casting production started in 1861. We routinely see 30-50% swings in demand in the matter of less than 2 years.

We experience this volatility because of the nature of our business. Many industries service the consumer economy which given the size of our population and the low cost of most consumer goods sees only 5-10% swings in the most volatile of times. Our industry provides products to capital equipment markets and other industrial users. These markets service the need for large equipment, consumable components and specialty items required for industrial products. Aggressive management of costs during downturns and production needs during upturns leads to volatility. In fact, our customers amplify the swings by their management of inventory. During upturns, they do not want to miss sales so they push for higher levels of production and create in process inventories to try to meet the demand. When business conditions turn down, they are stuck with unsold final product and their operations are filled with inventory. They manage their cash flow by declining to order our products and living off of their own inventory of parts and products.

We experience as we have recently a complete lack of orders as the market rapidly declines. Customers may even seek to avoid their own purchase commitments by cancelling hard orders placed to hold capacity. They may decline to accept production already made.

Quality requirements also change based on business conditions. When business demand increases and the user of steel castings cannot get all the castings he would like, the quality of the surface and other attributes may be acceptable even when they fail to meet the expectations or even the clear requirements (with a waiver). When the business conditions drop rapidly, parts that would be completely compliant in normal circumstances now fail to meet the surface quality or other subjective requirements and are rejected and not accepted.

So, how do we manage in a volatile business segment with large customers who are constantly trying to unload their business risk and volatility on us?

Well one strategy commonly sought is diversification. This has some merit, if your customers are in different market segments, sometimes the market cycle is different in those segments and allows offsetting peaks and valleys. This is however limited because most steel casting markets are based on financial and capital investment cycles and are not offsetting or different.

A more successful strategy is to limit exposure to any given customer by limiting customers to some manageable percent of the plant capacity to avoid being subject to unreasonable demands and to allow for stronger position in the market with customers.

An alternative model is to become dedicated with a large percent of the capacity to a large customer. This strategy depend on the customer recognizing the need to provide adequate demand even in slow business conditions to allow the foundry to survive the downturn and remain a supplier.

If a plant is small enough, their opportunity is market share growth. They can survive by speed of delivery and a reputation for quality and value. This can be successful but limits the potential for larger size of the business.

In any case, given the structural nature of volatility in our industry, managers need to prepare both for sudden increases and decreases in demand. They need to understand their financial and production constraints. They need to recognize the risks in customers and the opportunities. Capital investments in the plant should allow improvements in times of higher demand but not create unsustainable costs when business declines.

Our longer term outlook is exciting with additive manufacturing for casting production, new alloys and applications, computer tools for design and process control, new sensors and controls for the plant. To exploit our future opportunities, we will need to manage our way through this downturn with an eye to the capabilities and possibilities of the future. Our industry has a bright and exciting role to play and we must seize our part in realizing that future.

STEEL FOUNDERS' SOCIETY OF AMERICA
BUSINESS REPORT

SFSA Trend Cards (%-12 mos. Ago)	12 Mo Avg	3 Mo Avg	June	May	April
Carbon & Low Alloy					
Shipments	-22.4	-17.7	-21.5	-10.0	-21.5
Bookings	-23.1	-15.0	-20.0	-10.0	-15.0
Backlog (wks)	7.2	6.0	6.0	6.0	6.0
High Alloy					
Shipments	-16.9	-18.7	-25.0	-14.1	-17.0
Bookings	-19.7	-10.5	-13.5	-18.0	0.0
Backlog (wks)	7.0	6.0	6.0	6.0	6.0
Department of Commerce - Census Data					
Iron & Steel Foundries (million $)					
Shipments	1,567.8	1,499.3	1,508	1,496	1,494
New Orders	1,573.3	1,533.0	1,443	1,556	1,600
Inventories	2,036.7	2,098.0	2,089	2,101	2,104
Nondefense Capital Goods (billion $)					
Shipments	75.7	72.1	71.8	72.6	71.9
New Orders	73.7	70.6	64.8	72.9	74.2
Inventories	173.7	170.7	169.5	170.7	171.8
Nondefense Capital Goods - less Aircraft (billion $)					
Shipments	66.5	63.0	62.8	62.9	63.4
New Orders	66.2	62.4	62.4	62.2	62.5
Inventories	123.4	135.2	169.5	117.7	118.6
Inventory/Orders	1.9	2.2	2.72	1.89	1.90
Inventory/Shipments	1.3	2.1	2.70	1.87	1.87
Orders/Shipments	0.8	1.0	0.99	0.99	0.99
American Iron and Steel Institute					
Raw Steel Shipments (million net tons)	7.2	7.6	7.6	7.7	7.4

SFSA Research Review Summary

The Research Review meeting was held on July 18-20 at Rosemont, IL.

Jiten Shah from Product Development & Analysis gave an update and demonstration of the Intelligent Adaptive Machining Fixture (IAMFix) software, which is a collaboration work with Arizona State University. This tool was developed to calculate machining adjustments accounting for piece to piece variability which would minimize set-up time and rework. This software should be available to Digital Manufacturing and Design Innovation Institute (DMDII) members in August 2016. Jiten also briefly talked about the current status of his other projects (AFS-sponsored): (1) the strain life fatigue database for WCB, 8620, and 4340 should be available on Casting Alloy Data Search (CADS), which can be accessed on the AFS website, by the end of 2016. A research report will also be shared to all SFSA members; (2) there is also a current effort on developing statistically validated properties of investment cast 17-4PH and 15-5PH grades that will be added to the Metallic Materials Properties Development and Standardization (MMPDS).

Lehigh University presented recent findings for welding high strength steels (13-8+Mo, 17-4, CHA-GX3). The improved welding procedures for these alloys show almost full retention of mechanical properties during welding. For applications where post weld heat treatment (PWHT) cannot be applied such as field repairs, large components, research is currently being done to determine if these precipitation hardening alloys can be welded without conducting a PWHT. Approach is to do multiple passes and take advantage of the thermal cycles from subsequent passes to reform the strengthening precipitates. Results on the welding study of 10wt% Ni steel were also discussed. Phase transformations and mechanical properties in the heat affected zone of the welds are being examined.

UNI is currently developing simulation tools to predict casting dimensions based on the physical characteristics of the casting and sand mold. Using a cylindrical step cone wedge with a core for the experimental validation, it was found that the core is still expanding between the liquidus and solidus temperature. Additional studies will be done to further understand factors that affect the casting dimensions. UNI also presented about the developments on prediction of gas evolution in chemically bonded sands. Current work is only on aluminum castings but extension of this work to steel castings is being planned. Results for the reduction of veining defects using specialty sand blends were also shown. It was found that silica sand with as little as 10% specialty aggregates can reduce casting surface defects although this effect is highly dependent on the heat input of the metal. UNI is also working with AFS to develop test protocols in measuring and recording emissions from different binder systems.

ISU gave status updates on their ferrite prediction in duplex alloy project and using cold spray to repair surface indications on CA6NM found after machining. Both of these projects are in the initial stage of data collection and analysis.

ISU is also working on developing digital surface standard to specify cast surface requirements. Discussion with the ASTM committee on this standard has started and proposed standard is being drafted. Future work include conducting field studies to compare the standard to actual castings and to clean up the algorithms. There is also plan to work with a vendor to develop a handheld scanning tool. ISU also provided an update on the automated manufacturability analysis software that will provide early-and-often feedback to design engineers.

MS&T presented their research in optimizing hardness and toughness in high strength cast steels. The research project involved these studies (1) quench cracking and chemistry, (2) microporosity and Ni/Cr equivalence, (3) designing composition for Stage I tempering, and (4) minimizing nitrogen. It was found that silicon helps in reducing susceptibility to quench cracking. There also seemed to be a correlation with Ni/Cr ratio to microporosity. More investigation is needed to validate this. The effect of keeping nitrogen low is still being examined.

UAB is working with Montana Tech on data acquisition during pouring and filling of molds to verify solidification modeling data. UAB is also working on developing an automatic risering tool as part of ISU's automated manufacturability analysis software. An overview of the cast preform project was also given. One of the objectives of this program is to obtain forging properties using cast preforms and then forging the casting with less reduction ratios. This project aims to expand alloy availability and

widen the supply chain for low volume military components by using cast preforms from foundries. UAB is also developing a digital radiography standard.

UI presented recent findings from the distortion and dimensional prediction model they have been developing. The implementation of this tool in Magma is almost completed. The development of high performance cast steel crankshafts was also discussed. The counter-gravity with pressurization casting system has been used to produce test castings. More trials are planned to further improve the soundness of the casting. UI is also currently developing modeling tools to predict porosity in manganese steel castings. Current solidification software has limited capability so feeding zone algorithms needed to be developed. There is also a UI research effort in modeling air entrainment and inclusions although it is only being done on ductile iron.

A summary and an overview of all the current research projects with these universities can be found on the SFSA website at https://www.sfsa.org/research.php.