Grayway

THE RACE TO LIGHTWEIGHT

THE ROLE ALUMINUM, TITANIUM & CARBON FIBER ARE PLAYING IN THE MANUFACTURING RESURGENCE

Gray

THIS ISSUE / Race to Lightweight

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As the global economy continues to stabilize and the U.S. energy market grows, now's a good time to be manufacturing in the U.S.—especially for automakers and aerospace manufacturers. Both have seen impressive gains over the last few years, but the pressure to decrease gas emissions and increase fuel efficiency has created an urgency to lightweight vehicles as quickly and cost efficiently as possible. One way manufacturers are achieving this is by substituting traditional metals for lighter weight ones that are both strong and durable, like aluminum and titanium. In this GrayWay, we discuss the growth of these metals, as well as the increasing use of carbon fiber composite as an alternative to metals in manufacturing.

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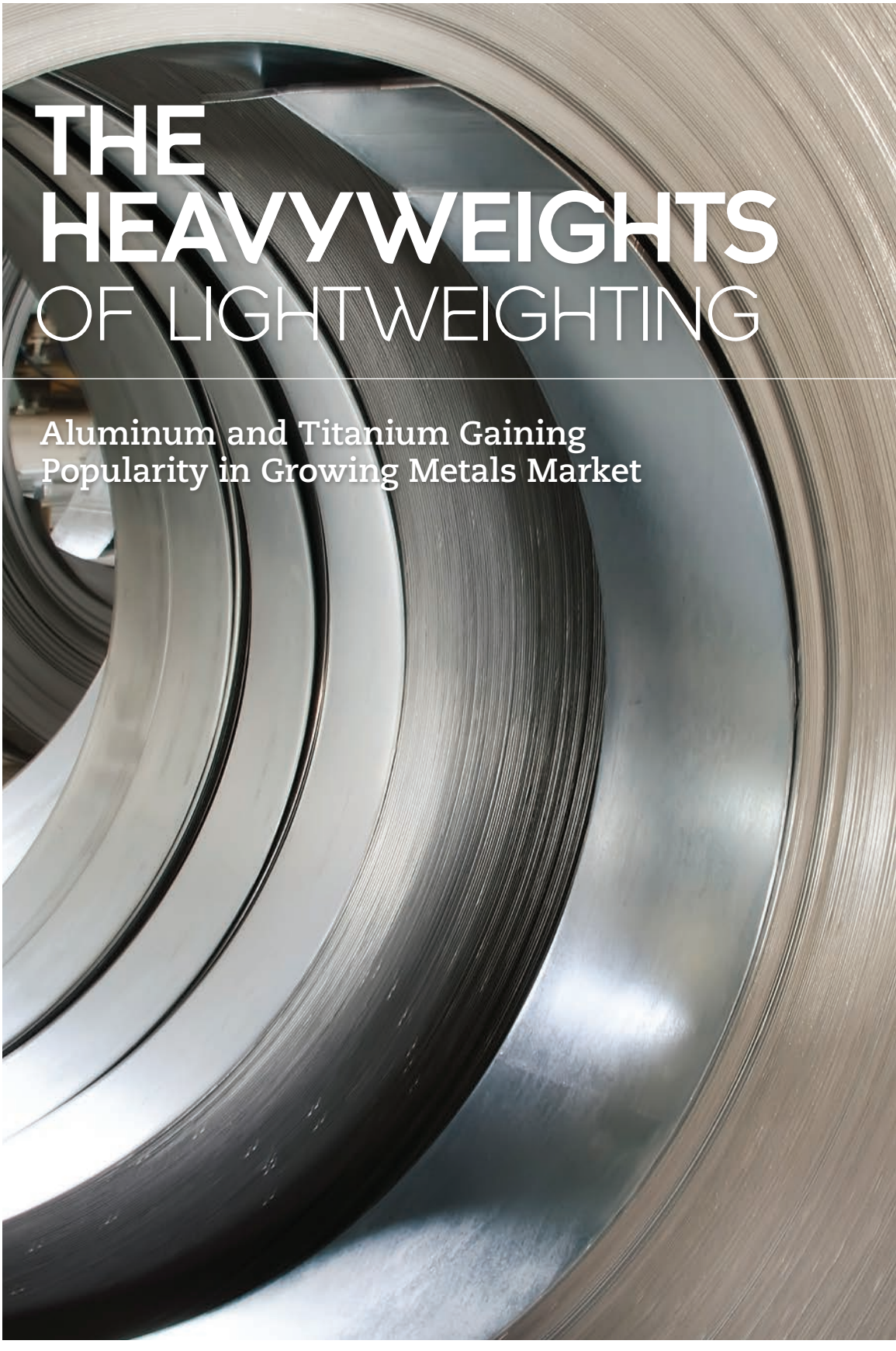


THE HEAVYWEIGHTS OF LIGHTWEIGHTING

Aluminum and Titanium Gaining Popularity in Growing Metals Market

Two years of steady growth in the U.S. manufacturing industry has many convinced the resurgence of this important market segment is here to stay. Leading the way are the world's automakers and aerospace manufacturers who have seen healthy gains over this time period.

Essential to the manufacturing of cars and planes is a robust metals market, capable of not only providing an adequate and diverse supply of metals to auto and aircraft makers, but also able to meet the ever-changing needs of these manufacturers as restrictions on fuel-efficiency and gas emissions tighten. The Corporate Average Fuel Economy bill requires automakers to increase fuel economy by 50 percent by the year 2025; this is largely being achieved by cutting the weight of cars, or "lightweighting."

Richard Schreiber

"Energy is a big cost component for the metals industry and metal manufacturing," said Rick Schreiber, assurance partner, Manufacturing & Distribution Practice of BDO USA, LLP, a leading global accounting, tax and consulting firm. "With the energy renaissance, we're seeing growth in the metals space, in addition to a lot of other spaces. We're seeing more plants, but we're also seeing more expansion projects too. That's because the economy continues to be improving and consumer confidence continues to be going in the right direction."

Compounding the demand for metals is the increasing need for lightweight metals that are not only strong, but durable and corrosion-resistant. Two standouts in this regard are aluminum and titanium, which are becoming more and more attractive as alternatives to traditional metals used by the auto and aerospace industries, like steel and iron.

ALUMINUM: A Lighter Choice

Aluminum is not a "new" metal to manufacturing. In fact, it has been used to make products since before the beginning of the Industrial Revolution. But the type of products aluminum is used to make has become more varied and diverse, with automakers and aerospace manufacturers now among its biggest users. Why? Because aluminum is lightweight, and while it's not as strong as steel—the traditional metal used to manufacture cars and planes—new alloys are continually being developed to improve its strength and durability.

According to the International Aluminum Institute (IAI), over the last 30 years, aluminum consumption growth has outpaced all other metals. The world's leading aluminum market is China, and the main industries with the highest aluminum consumption are construction and transportation.

Today, almost all automobiles feature aluminum components, from outer panels to engine parts. As evidence this trend will continue, the newest model of Ford's F-150 will feature an all-aluminum body.

According to Richard Trillwood—an electrical engineer, inventor, and entrepreneur who has worked with aluminum over his long career in precision welding—aluminum is desirable not only because it is lightweight, it's also easily recyclable, which is vitally important to manufacturers who are scurrying to meet EPA compliance standards in very short order.

Trillwood says the aerospace industry has a great need for higher-temperature and lighter-weight metals for use in the engine parts, and aluminum works well under these conditions.

Richard Trillwood

"Any sort of weight reduction is imperative to the aerospace industry because they have to get aircrafts off the ground," said Trillwood, who founded Electron Beam Engineering, Inc. (EBE), a precision electron and laser beam welding job shop based in Anaheim, Calif. "And when it comes to fuel efficiency, using aluminum with any form of transportation is going to save fuel since the vehicle is going to be lighter than if it was made of steel."

To meet the demand of the booming aerospace industry, Alcoa—a global leader in lightweight metals technology, engineering and manufacturing—recently opened the world's largest aluminum-lithium facility in Indiana, representing a $90 million investment. The plant will make aluminum-lithium alloys to be manufactured into aircraft parts for commercial jets built by Airbus, Boeing and Gulfstream.

"The future of aviation is being built with aluminum-lithium, and Alcoa is making big moves to capture that demand," said Klaus Kleinfeld, chairman and chief executive of Alcoa.

Alcoa has additionally expanded its aluminum-lithium capabilities at facilities in Pittsburgh and the United Kingdom to keep pace with demand. Already, the company has contracted $100 million in aluminum-lithium revenues for 2017.

Each year, Alcoa publishes its Aluminum Industry Outlook. For 2014, the company is projecting seven percent growth in the global consumption of primary aluminum—consistent with that of the two prior years. All regions except Europe are expected to have 3-to-8 percent increases in aluminum demand over 2013, with China (10%) expected to have the highest growth rate during the year.

With raw aluminum prices dropping dramatically since 2011, Alcoa is betting these investments increase their profit margins. With that said, aluminum remains some three times more expensive than steel on a per weight basis.

TITANIUM: A Metal for All Things, Big and Small

Another emerging contender in the metals market is titanium, also driven by the demand for lightweight metals in the automotive and aerospace industries. But titanium is being lauded as a strong alternative to traditional metals for a number of other reasons, like its superior corrosion- and abrasion-resistance that make it desirable for many more manufacturing applications, large and small.

"The future of aviation is being built with aluminum-lithium, and Alcoa is making big moves to capture that demand."

–Klaus Kleinfeld

"Titanium has been doing extremely well over the last four or so years and I expect that to continue as well," said BDO's Schreiber. "What I'm seeing is very similar to aluminum—aerospace seems to be its largest growth driver, again all from the more fuel-efficient reasons there, but also other consumer goods are helping drive titanium."

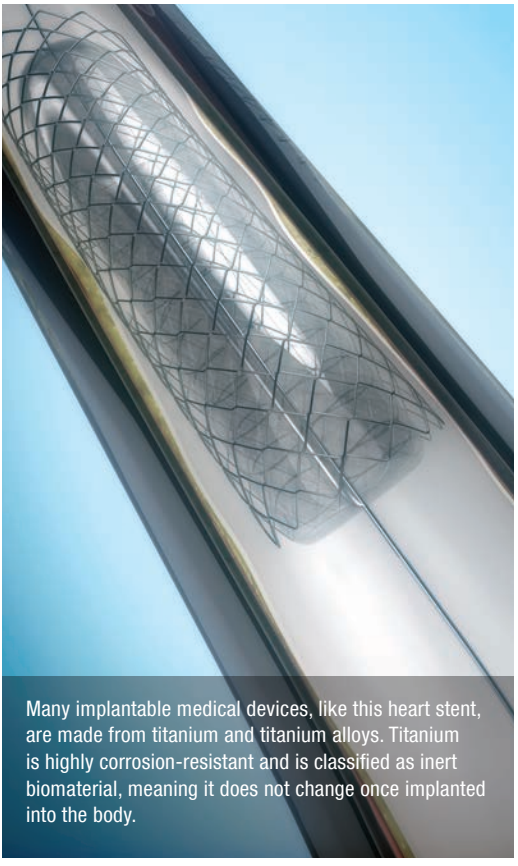
Trillwood agrees, and says while titanium costs much more than aluminum per pound, its positive attributes are sometimes worth the added cost to manufacturers.

"Titanium is a lot more expensive than aluminum, and yet, in some aerospace applications, strength and weight can be a requirement, whereas with aluminum alloys, you have less strength, but you don't always meet the strength requirements," he said. "That isn't to say aluminum is not strong, but I'm comparing one with the other."

For instance, Lockheed Martin's latest F-35 fighter jet has been getting a lot of media attention due its heavy price tag—the U.S. government is spending an estimated $400 billion to produce over 2,400 of these jets through 2037.

"Great chunks of these jets are made out of titanium—something you would never think of making a commercial product because of the cost of these very large pieces of titanium," said Trillwood. "But their principal requirement was to make a jet that was as strong as possible because of its performance, so cost wasn't the principal barrier to using titanium."

In the smaller component business, Trillwood says titanium is ideal for products that require strength, weight reduction and corrosion resistance, like implantable medical devices.



Many implantable medical devices, like this heart stent, are made from titanium and titanium alloys. Titanium is highly corrosion-resistant and is classified as inert biomaterial, meaning it does not change once implanted into the body.

"For instance, pacemakers, artificial heart pumps and prostheses are devices that need to be biocompatible," said Trillwood. "In the early days, some of these parts were made out of stainless steel and they didn't have the long-term stability and corrosion-resistance that titanium does. I would say, currently, most of the implantable devices in the human body are titanium."

According to Iluka, a global mineral sands exploration and mining company, industrial applications are the highest-growing end use for titanium metal, including the chemical, shipping, desalination, oil and gas, power generation, metallurgy and auto industries.

A FORMIDABLE PLAYER

Carbon Fiber Composite Becoming Attractive Alternative to Metals for Manufacturers

Known for its strength and durability, the bodies of Formula One racecars are made primarily of carbon fiber composite.

What's five times as strong as steel and two times as stiff, yet weighs about 70 percent less? It's carbon fiber, and it's becoming an increasingly popular alternative material in the manufacturing of a wide variety of products. With properties like this, carbon fiber has automakers and aerospace manufacturers eager to incorporate it into their products and, despite its high price tag, some have already started. The first-known successful commercial application of carbon fiber was when Boeing made some 50 percent of its 787 Dreamliner from this composite in 2009.

According to the Carbon Fiber Report—an in-depth market study on the carbon fiber industry—global sales of carbon fiber-reinforced plastics is estimated to reach $28.2 billion by 2015 and $48.7 billion by 2020. The global demand for carbon fiber is predicted to grow to 154,000 tons in 2020, up 33 percent since 2011.

Father/daughter team Max and Catherine Crawford know a thing or two about the benefits of carbon fiber. Max is a racecar driver-turned-engineer who began experimenting in the 1980s with carbon fiber as a means to lightweight racecars. As the benefits of carbon fiber became more and more clear, he left the world of track engineering to start a business in the design, engineering and production of products featuring this material, and hasn't slowed down since. His daughter, Catherine—a trained aerodynamicist—has joined her father in running the family business, Crawford Composites.

Catherine Crawford

"Carbon fiber is used in aerospace, motorsports and other industrial applications quite a lot," said Catherine Crawford. "And everything that we use it in is to make things lighter, stronger and more corrosion-resistant. You can form it into really complicated shapes, keep the weight down, and keep the strength up."

She says the automotive industry has been using carbon fiber for "quite some time," particularly makers of high-end vehicles, like Volkswagen and BMW.

According to Plastics News, both General Motors Co. and BMW AG introduced cars at the North American International Auto Show in Detroit in January that use more carbon fiber composites than their previous models. And, the bodies and cockpits of the BMW i3 electric car and the BMW i8 hybrid sports car are made almost entirely of carbon fiber composite.

"It is light and strong, which makes the car more fuel-efficient, also improving the power-to-weight ratio," said Catherine Crawford. "It also looks sexy, so it's being used in sports cars, but the productionized versions haven't really been incorporating carbon fiber due to the expense."

While the price of carbon fiber had been coming down, Catherine Crawford says increased demand by the aerospace industry has made it more difficult to get, and the expense remains high. But according to her father, the price has dropped drastically since he began using it in the '80s.

Max Crawford

"Right now, most of the higher-end cars have carbon fiber components," Max Crawford said. "The ever-present development of advanced composite materials, resin systems, and processing methods has allowed the incorporation of more carbon in automotive products, however, the cost remains high. Companies are experimenting all the time trying to find ways to productionize it, make it more readily available, and less expensive to produce."

In 2012, The Rocky Mountain Institute (RMI) studied the issue of the high cost of carbon fiber and released recommendations for kick-starting the adoption of carbon fiber composites in automobiles. Its report stated that, despite its high cost, the value added by using carbon fiber in auto parts is so great, it offsets this cost. According to RMI estimates, it would cost between $2.78 to $4.76 per pound to replace auto-body parts with carbon fiber. While this could decrease a car's weight by some 50 percent, the exorbitant increase in total cost per car could not be passed on to consumers.

The global demand for carbon fiber is predicted to grow to 154,000 tons in 2020, up 33 percent since 2011.

Recognizing this, RMI proposed the slow and gradual introduction of carbon fiber parts into vehicles—beginning with the high-value parts—to establish a healthy carbon fiber composite supply chain. The increase in demand for carbon fiber composites would eventually result in the lowering of carbon fiber prices, and automakers would then be able to incorporate more and more parts made of this composite into their vehicles.

One criticism of carbon fiber is that it is not easily recycled, but the Crawfords say this is a myth.

"Personally, I feel the recent development of recycled carbon fiber material is incredibly important," said Max Crawford. "Not only is recycled material a vital move toward significant cost savings, it also has the potential for a staggering impact on our environment—for example, the reduction of aircraft components consigned to landfills. That alone is staggering."

Crawford has been experimenting for some time with recycled carbon and is now incorporating it very successfully into select products.

THE NEW FACE OF MANUFACTURING

RECORD NUMBER OF PEOPLE SEEKING CREDENTIALS IN METALWORKING

One of the biggest challenges facing today's manufacturers is finding workers who possess the necessary skills to be successful in advanced manufacturing jobs. The lack of skilled labor is such an issue, it has prompted a movement by manufacturers, industry associations, vocational and technical schools, colleges and universities, and even governments to come together for solutions to this burgeoning problem. Consequently, a number of new workforce development programs have sprung up across the country, but it's too soon to tell what impact these programs will have on the labor pool.

But there is some evidence that efforts to improve the manufacturing workforce are paying off. This year, the National Institute of Metalworking Skills (NIMS)—the metalworking industry's primary standards and workforce certification body—announced that it awarded a record number of credentials last year to individuals seeking to enter into or advance in jobs in metalworking. In 2013, NIMS issued 13,888 industry-recognized credentials, representing an impressive 58.8 percent increase from 2012.

"These numbers show that manufacturing employers are increasingly in need of skilled talent, and individuals are seeking to validate their skills and differentiate themselves in the hiring pool through industry-recognized and standards-based credentials," said Jim Wall, executive director of NIMS. "As manufacturing becomes more complex, technology-driven and innovative, companies, workers, and students need to keep up with evolving industry standards and job requirements."

According to a release, more than 6,000 metalworking companies and major industry trade associations have invested over $7.5 million in private funds to develop NIMS standards and credentials that prepare and advance the industry's workforce, and continue to upgrade and maintain the standards as the industry changes.

Skills standards developed by NIMS range from entry- to master-level in operations such as metalforming and machining. NIMS certifies an individual's skill level according to these standards and provides credentials that companies can use to recruit, hire, place, and promote employees. Community and technical colleges use these credentials as performance or completion measures of academic coursework in metalforming and machining programs.

NIMS has also partnered with the U.S. Department of Labor to create the Competency-Based Apprenticeship System, the result of over two years of work with input from more than 300 companies in the program's design. This system integrates NIMS' national standards and skill certifications in defining and measuring required competencies in metalworking.

GRAY...
WE'RE BUILDING

GULFSTREAM AEROSPACE CORPORATION

Savannah, GA

Gulfstream Aerospace Corporation has selected Gray Construction to design and build its 72,562 s.f. paint manufacturing facility at the Savannah/Hilton Head International Airport. The facility will be located near its 680,000 s.f. maintenance building, the largest business aviation maintenance facility in the world.

The state-of-the-art paint facility is expected to be one of the most advanced high-tech paint hangars ever built. The facility will employ some 100 people and is scheduled to be complete by the summer of 2015.

Gulfstream Aerospace Corporation designs, develops, manufactures, markets, services and supports the world's most technologically advanced business-jet aircraft. Gulfstream offers a comprehensive fleet of aircraft, including the Gulfstream G150™, G280™, G450™, G550™, G650™ and G650ER.™ Gulfstream also offers aircraft ownership services via Gulfstream Pre-Owned Aircraft Sales.™ The company employs more than 15,000 people at 12 major locations.

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