Modern Materials in Manufacturing

Examining the Cutting Edge Materials are Emerging Throughout the State of Ohio

The state of Ohio has been heralded as the leader for manufacturing in the United States by Governor John Kasich. And rightly so. Ohio has found itself in a unique situation in that we are experiencing a revival in our steel industry, allowing businesses throughout the state the ability to experiment with new technologies and industrial processes like 3D metal printing and fracking. For individuals and businesses alike who are following the latest achievements and inventions pouring out of the technology sector, these are exciting times to be an Ohioan.

We've all heard, in some way or another, that the future of technology in this day and age is ever evolving, while present technologies are rapidly becoming obsolete. This holds true for printing technology and the emergence of 3D printing, including 3D metal printing. Armed with the revival of the steel industry, 3D printing technology is expanding to include metals, unveiling even more possibilities of technological advances already being witnessed with fracking.

The Revival of Steel Industry

These advances in 3D printing have been made possible largely due to the rebirth of steel in manufacturing, especially here in Ohio. This is great news, considering that Ohio has spent the last thirty years watching thousands of steel jobs outsourcing to plants overseas.

According to JobsOhio (2011-2013), Ohio's position as a leader in the steel industry is what has allowed the state's advanced manufacturing sector to flourish—a sector that is one of the most productive in the entire country! Accomplishments and advances in research and technological innovation have helped to foster the revival of the steel industry that Ohio is currently experiencing.

And just to prove the confidence that companies have in Ohio's steel industry, JobsOhio (2011-2013) reported that, in just the last two years, “10 leading companies have announced major investments for iron, steel and related foundry production in Ohio.” This is excellent news for Ohio steel plants and job seekers, considering the need and demand for specialty steel not only in the United States, but around the world as well.

The combination of technological innovation and advancements, coupled with the sudden surge in shale exploration and oil and gas development, steel companies like V&M, US Steel and Republic Steel are all jolting back to life. Shale exploration is especially active in Ohio. Because of this, many steel plants throughout the state have sprung back into operation to produce the steel piping needed to continue the process of shale exploration and development.

To put it into perspective, Pennsylvania, another state that has become suddenly active in shale exploration has over four hundred wells already drilled, requiring over 40 million feet of steel piping! That's not even counting the wells drilled throughout Ohio, so it's unsurprising that the steel industry is witnessing a revival of sorts.

The national demand for oil and gas development is also spurring this revival, which is also good for jobs. For instance, V&M Star recently announced the construction of a state-of-the-art mill that will cost $350 million, creating 350 new jobs. V&M Star intends to play a big role in oil and gas development.

V&M isn't the only company investing in Ohio. Numerous companies are rebuilding their inventories in response to the interest in U.S. energy production and the demand for steel and other building materials. Many companies are even going so far as to relocating full or partial operations back to Ohio, returning jobs to Ohio that had been lost to India, Mexico and Asia due to company outsourcing. With the sudden steel revival and shale development, it is becoming steadily cheaper to produce products here, in America, rather than abroad.

According to JobsOhio (2011-2013), positioned 600 miles of 70 percent of North America's manufacturers and 61 percent of the continent's population, Ohio could not be in a better position during these exciting times. That being said, Ohio is likely to lead the return of manufacturing jobs back to the United States.

Another key industry that is fueling the resurgence of American steel is the energy sector. Seeking clean alternatives to energy, the steel industry is predicted to play a monumental role in new energy infrastructure both domestically and overseas and research for clean, efficient energy continues. However, as it stands right now, fracking alone will be enough to keep the steel industry busy for awhile.

Steel's Industry's Influence Over Fracking

Fracking, otherwise known as hydraulic fracturing or hydrofracking, is a new technology being used in Ohio and other parts of the country by leaders of the energy sector. The sophisticated fracking process is able to reach the abundant domestic oil and clean natural gas underground that would otherwise be inaccessible. It's truly a revolutionary process that allows for both increased oil dependency and a cleaner alternative to coal as an energy source. Furthermore, because the steel industry and and fracking are returning a sizable number of manufacturing jobs back to the United States, the U.S. economy is also benefiting. This means that fracking and steel production could just be the answer we were looking for in regards to improving our damaged economy.

Just as Ohio is shaping up to be the leader for returning manufacturing jobs to the U.S., it too would seem that Ohio is also gearing up to lead the country in fracking. In fact, Governor Kasich signed a law in 2011 that allows companies to legally carry out the fracking process in Ohio state parks. Since then, more than 3,000 acres of land in Ohio have been set aside by the United States Forest Service, specifically for fracking.

It's estimated by the Ohio Oil and Gas Energy Education Program that there's nearly 20 trillion cubic feet of natural gas beneath Ohio's ground surface, valued at over $100 billion! In addition, the Ohio Department of Natural Resources estimates that there's an abundance of oil shale the equivalent of between 1.3 to 5.5 billion barrels, valued at close to $550 billion, in the ground that fracking could recover.

While the monetary benefits of fracking would benefit not only Ohio's economy, but also the overall national economy, there are some who skeptical and worried about the dangers and harmful effects that fracking could have on the environment and people residing in areas near fracking sites.

Fracking is a process that uses chemicals and water –hence the name 'hydraulic fracturing'-- to reach the gas and oil in the shale deep under ground. In this process, a bit of the chemical/water mixture ends

up back on the surface. Because of this, there are many individuals who fear that this contaminated liquid can seep into ground water, effectively reaching homes as drinking water. While companies taking part in and supporting fracking assure individuals that the contaminated chemical/water mixture does not infiltrate the ground water system, many skeptics remain unconvinced.

But fracking, like all other industrial processes, is not without it's risks and dangers. However, that is in no way reason enough to cease fracking. The benefits of energy independence and the overall monetary gain are to precious to pass up because of the off chance that an accident *could* happen. Other industrial processes like coal mining and off-shore drilling have their share of dangers and risks, but we allow those. Why should fracking be treated any differently? Besides, burning the natural gas recovered from fracking instead of coal works to reduce CO2 in the atmosphere. That's a huge bonus for anyone concerned about the environment.

In addition to fracking, the revival of the steel industry on the United States has also aided in the exploration and evolution of new technologies. One such technology is the 3D printer and the use of metals in 3D printing.

3D Printing Technologies Expand and Evolve Thanks to Steel Revival

So we've established that there's a lot of hype and attention surrounding the steel industry and fracking, but what about 3D printing? How does 3D printing work and when did it start? What are the challenges facing 3D printing and what does the future hold for this very unique piece of technology?

3D printing is an advanced additive technology that has actually been around for decades. With recent advancements and improvements, 3D printing is currently the fastest and most reliable manufacturing option on the market.

Originally created in 1984 by a man named Charles Hull, the fist 3D printer was rooted I the stereolithography (SLA) method that worked by concentrating a beam of ultraviolet light focused onto the surface of a vat filled with a liquid resin known as photocurable photopolymer.

Another type of 3D printing was created in the 1980s known as Fused Deposition Modeling (FDM) technology. FDM was created by a man named Scott Crump, who also went on to found Stratasys in 1988. Unlike Charles Hull's 3D printer, Mr. Crump's printer created objects by producing small beads of melted thermoplastic material to form layers until the object reached completion.

The functionality of 3D printing technology has allowed for many companies and businesses to experiment and explore new products and prototypes. What's more is that, through the use of metals, 3D printing allows for manufacturing companies to develop prototypes that are more precise and realistic at a fraction of the cost that they'd spend without the use of 3D metal printing. As an added bonus, 3D printing is also a fast method of creating complex designs and prototypes that manufacturing companies need in order to operate.

All 3D printers, including metal printers, work in a similar fashion by creating a 3D object by layering thinly sliced, horizontal layers on top of each other, one after another, until the desired object is complete.

Printers know what object to create thanks to the digital Computer Aided Design (CAD) that begins the

process. A CAD is created in a 3D modeling program, a sophisticated software program that send the design and instructions of an object to the 3D printer to be printed by reading the file and printing it according to the design specifications. To put it simply, 3D printing creates each precise bit of an object where it needs it, layer by layer, in an additive process.

3D printing appeals to companies and manufacturers because it is a cheaper, more efficient and precise alternative to the traditional design and creation methods available. It is also a more energy-efficient method of production and, in terms of raw material usage, 3D printing is a more economical method compared to traditional methods of production. All of these benefits mean that companies who utilize 3D printing will likely end up saving money that can be used in another area of their business.

As far as what people can print? The options are limitless. While manufacturers incorporate 3D printing into their business plan to reduce costs and boost production efficiency, other industries can harness the abilities of this exciting technology, whether it's to print things like jewelery, artwork or toys. The array of material types, including plastic, different metals, glass and more allow for great flexibility when deciding what to print.

Despite the perks and benefits that 3D printing has to offer the world at large, there are a fair share of hurdles that this particular additive technology has to overcome of it is to become as common as any other household item, like refrigerators and dish washers.

According to Stephen Hoover (2012) of the xerox company, PARC, 3D printing is limited by the range of materials available. For instance, 3D printing is not yet advanced enough to accommodate and replicate electronic components used in popular, mainstream electronics like cell phones and iPods. PARC is working on developing the necessary technological advances, but it might be awhile before a 3D printer can print a sophisticated iPad or laptop.

Other advances are needed to address the fact that 3D printing, as it stands now, cannot print more than one material at a time. More research is needed to develop the capabilities for 3D printers to be able to print multimaterial objects. Peter Weijmarshausen (2012) of Shapeways, a 3D printing company, has stated that, while current 3D printers work great for printing objects consisting of only one material, the technology just isn't there yet for multimaterial printing.

For now, though, current 3D printing methods appear to be working just fine for manufacturers and anyone else curious enough to experiment with designing and printing objects of their own. The riveting thing about technology in the present age is that it is constantly evolving and improving. That being said, it won't be long before businesses and individuals are able to print complex, multimaterial objects like iPods and laptops.

To say that the future of 3D printing looks bright would be an understatement. As previously mentioned, as the technology for 3D printing continues to evolve and improve, the options of objects available to print will be virtually endless. Eventually the 3D printing will be so efficient that individuals will have the ability to print replacement parts and other metal products for their cars and household appliances.

As 3D printers, including metal printers, become cheaper and realistically available to the average person, the manufacturing industry as a whole will change. The manner in which individuals go about

purchasing products for store shelves will evolve so that products, art, clothing, appliances and more can be designed and produced by the consumer.

But manufacturing will not be the only area changed with the continued advances being made with 3D printing. Medicine, architecture, art...almost every industry will undergo changes as 3D printing becomes more readily available.

For example, bio-printers in the medical industry will allow the ability to print human tissue. The architecture industry is already experimenting with printing concrete structures, and 3D printers are already able to produce complex art sculptures.

Moving Forward

Advances in 3D printing, especially now with the use of metals, will continue to have huge effects on every industry in some way, shape or form. It will completely change the manufacturing industry and how consumers obtain products.

It is clear that the revival of the steel industry and all of it's resounding benefits will not only serve to boost the U.S. economy, but it has reestablished the state of Ohio as the leader in U.S. manufacturing. Furthermore, it can be said that the steel revival has even rendered Ohio as the leaders in technological and industrial innovations. From fracking to 3D metal printing, Ohio is leading the country to a better tomorrow.

References

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