

# Specialty materials for specialty vessels

The age of environmental awareness and change has come and those in the various industrial sectors are doing what they can to come up with safer and more environmentally-friendly fuels and energy. With the availability of these new options comes the need for storage materials that can provide the appropriate environments to ensure safe and proper storage.

Abhi Utturkar, PE, Manager of the Specialty Vessels Business Unit at EPC company, Matrix PDM Engineering – a wholly owned subsidiary of Matrix Service Company, discovered this opportunity for growth and advancement in the storage construction industry. Now, for almost two decades, he and his team have been dedicated to the design and material selection for specialty vessels. By understanding various industries’ processes, stored products, and how they will react to the available materials of construction, Utturkar has provided his expertise to the storage construction industry and continues to discover new ways to design specialty purpose vessels using specialty materials.

By **Catarina Muia**

## An opportunity for advancement

Utturkar earned his Master of Science in Mechanical Engineering from Oklahoma State University, and his Bachelor of Engineering from Pune University in India. After exploring his options in a few different industries including automobile, manufacturing, and aerospace composite materials, Utturkar was finally drawn to the specialty vessels industry. “My thesis during graduate studies was related to cryogenics because at the time, I was working on a NASA project. After working with aerospace composites under cryogenic applications for a couple of years, I realized there was an incredible amount of advancement in the storage construction industry, specifically for cryogenic storage,” Utturkar recalls. “This included storage tanks for liquified natural gas (LNG), liquid nitrogen/liquid oxygen (LIN/LOX), hydrogen, ammonia, and so on. That growth and advancement is what attracted me to this industry, and I have now been with Matrix PDM Engineering for almost 15 years.”

As the Manager of the Specialty Vessels Business Unit at Matrix PDM Engineering, Utturkar leads an engineering project team that is specialized in ASME vessels, spheres, API 620 anaerobic digesters, Finite Elements Analysis (FEA), LNG and LIN/LOX cryogenic tanks, thermal energy storage diffusers, foundations, tank repairs, and specialty structures such as stack liners and stiffened dome roofs.

His main areas of expertise include spheres and ASME vessels, FEA, 3D stress analysis, API 620 and API 625, LNG and LIN/LOX cryogenic tanks, composite ma-

terials, reinforced dome structures, and project engineering and management. “I am deeply involved in the day-to-day engineering designs and technical project management tasks. That is what I enjoy most because it allows me to work with people across the spectrum including estimators and procurement, design engineers, vendors, customers, and field construction specialists, while making new projects happen,” Utturkar explains. “Together with my team, we focus on coming up with new and better designs and methods of construction. Creativity is one of the most important aspects of any engineering job, as we face new challenges every day. Coming up with new ways to solve these problems is what continues to keep me interested in the industry.”

## What makes vessels special?

Creativity and a thorough understanding of materials of construction and materials of containment are crucial when it comes to designing specialty vessels because these are not always the standard, flat-bottom cylindrical tanks that store crude oil. From the 1960s to the 1980s, these type of tanks were the most common type of storage for crude oil in North America. Some of these were around 400 feet in diameter, with floating and/or fixed roofs. Today, the extraction and refining of cleaner fuels from shale gas has prompted the need for more diverse storage options.

“Any vessel that is storing products other than crude oil can be considered a specialty vessel and they can come in all shapes, sizes, and arrangements. These

can be single- or double-walled, conical, spherical or combination shapes. Since each of these tanks need to be specially made per specific customer requirements, which depends on the industries they are for and the materials being stored, they also require additional evaluation in terms of design and materials used in construction,” Utturkar states.

Light hydrocarbons such as ethylene, ethane, butane, and LNG require either extremely cold temperatures or significantly high pressures to maintain their liquid form, making the material of construction for a specified specialty vessel critical. Crude oil is typically stored in carbon steel tanks. Any stored product that requires temperatures such as -270°F (such as LNG, LIN/LOX etc.) or 1,100°F (such as molten salt) in order to stay in its liquified form will require different materials of construction.

Cryogenic products can be stored in two different ways. One storage method uses a carbon-steel alloy as the material of construction, such as an ASTM A553-grade. The second method uses a 304- or 316-grade stainless steel. The material of construction is determined by which con-



Abhi Utturkar, PE, Manager of the Specialty Vessels Business Unit at Matrix PDM Engineering.

struction technique will be used, what the customer’s requirements are, and what the product’s composition is (for example, if it does or does not include hydrogen sulfide or chlorine). “Because the cryogenic products being stored can have a number of unique properties, specialty materials are required to hold them. Unlike the typical carbon steel, stainless steels and nickel alloys can sustain cold temperatures and still provide enough strength, as well as sustain high temperatures and still provide the required corrosion resistance and strength,” Utturkar explains. “For many

“Creativity is one of the most important aspects of any engineering job, as we face new challenges every day.”



A sphere specialty vessel with a diameter of 76 feet, fully completed and painted. Image courtesy of Matrix PDM Engineering

# STAINLESS

## ON OUR FINE REPUTATION

**BONNEY FORGE**

**800.345.7546 • 814.542.2545**  
**814.542.9977 fax**  
[www.bonneyforge.com](http://www.bonneyforge.com)

of these types of projects that we work on at Matrix PDM Engineering, we either use a nickel alloy or stainless steel. For tanks that need to withstand higher temperatures, we use the stainless steel materials”.

While having such a variety of specialty materials available to use for construction is highly beneficial for both productivity and safety, it can also pose some challenges for Utturkar and his team. As the metallurgical sciences have rapidly advanced and the availability of these materials (whether they are conventional metals or alloys or non-metallics) has become more accessible, it can be difficult to determine which material to use for each project and application. “We have customers in many industries including chemical and petrochemical, aerospace, mining, energy, etc., which means we have a lot of different standards and specifications to follow. Therefore, there is no such thing as a ‘one-material-fits-all’ solution, it can be

very challenging to determine which material to use,” Utturkar states. “You cannot just take one type of steel and apply it to everything. On top of that, new materials are being introduced in ASME standards. For some of our customers who have been in the business for many years, who are used to seeing conventional materials, trusting and using a new type of material can be challenging. It is not a bad thing; they are just being cautious. Either way, we implement more rigorous investigative processes on new materials before we use it on a project.”

To narrow down the materials of construction and finally choose the correct material for a specified project, Utturkar and his team must evaluate the various steps of the project from all perspectives. “The goal is to attain safer and more economical designs,” he said. “We consider ease and safety during the construction of the specialty vessel. We then evaluate which material



Anaerobic egg-shaped digesters. Two digesters are completed, and two additional are being built. Image courtesy of Matrix PDM Engineering

- Late Deliveries?
- Specification non-conformance issues?
- Material not protected for shipment?
- Inaccurate documentation?
- Backorders?

## Time for a change to P.A. Inc.

**P.A. Inc. is leading the way** with solutions for specialty alloy piping requirements.

### PIPE, FITTINGS AND FLANGES

- ▶ Alloy 20
- ▶ Alloy 200
- ▶ Alloy 400
- ▶ Alloy 600, 601, 625
- ▶ Alloy 800H/HT, 803, 825
- ▶ Alloy C-276
- ▶ Stainless 304H
- ▶ 2205 Duplex



6626 Gulf Freeway, Houston – Texas 77087 | USA  
 Phone: (800) 460-7473 | +1 713-570-4900 | Fax: +1 713-570-4950  
 Email: sales@painc.com | www.PAInc.com



## The beauty of stainless steel

Abhi Utturkar’s first interaction with use of stainless steel in structural applications came just as he began working with Matrix PDM Engineering. He and his family visited the St. Louis Arch. As he looked at it, Utturkar could not help but notice how shiny and beautiful the structure was, as the entire outer skin is constructed of stainless steel. Soon thereafter, Utturkar watched a documentary about how the St. Louis Arch was built, and later realized the construction was done by PDM, which is now part of Matrix PDM Engineering.

will be most suitable in terms of strength, corrosion, capricious sustainability, and longevity. It is important to consider materials of construction that contain specific ingredients such as chromium or molybdenum, which will add these crucial values.”

Some industries also require use of specific materials. “For example, we typically use stainless steel in the food industry, as opposed to any other type of material, to meet strict requirements and avoid contamination from the storage vessel itself.”

## Installation, maintenance, and repair

Utturkar and his team are heavily involved in the engineering, fabrication, construction, maintenance, and repair related projects for their customers’ specialty vessels. From the very first stages of a project, Matrix PDM Engineering engineers like Utturkar and his team, are with the customers every step of the way, starting with the front-end loading (FEL) – the ‘early-on’ concept stage – and working through detail design and engineering. “We then provide oversight during the construction of the tanks and vessels in the field. Although the data, information, and codes are discussed during the early stages of the project, once you are actually in the field and get into the ‘real world’ situations, whether you like it or not, things are going to change,” Utturkar states. “The company as a whole provides full spectrum services, and our specific unit assists with the company’s other subsidiaries to complete construction, inspection, maintenance, and repair work, industrial cleaning, and other important services for the customers.”

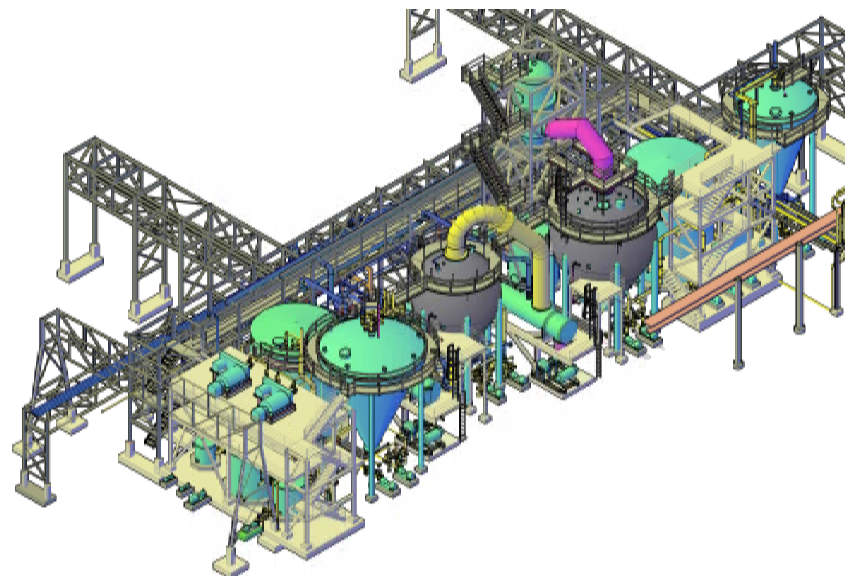
In the case of maintenance and repair, Utturkar and his team bring the same expertise used during design and construction. “For us, a typical repair project would start with an inspection. We would then complete the root cause analysis and determine what has caused the failure such as a leak in a vessel,” he said. “For example, one of our customers in sulfuric acid processing experienced a leak in a double-wall stainless steel containment, and the interstitial space was not ideal for personnel access. Inspections were required from both inside and outside of the tank to determine the root cause analysis of the leak. We ended up repairing the tank by successfully replacing and welding various portions of the vessel in a specific sequence to ensure safety of the personnel and integrity of the

structure.” It is also important to know the material properties of existing and new/replacement materials during fitness for service evaluations (FFS) and predicting the remaining life of structures. Several tests, including brittle fracture evaluation, are required to be performed and materials are always a major consideration in such evaluations. Many times, using a compatible and higher strength specialty material is opted for replacement to ensure long-term successful operation of the tanks and vessels.

## Preparing for the future

As a new generation of engineers enter the construction industry, passing on industry knowledge and mentoring has become the responsibility of veteran engineers like Utturkar. “Matrix PDM Engineering is particularly focused on enhancing safety and quality, preparing standards, creating documentation, and preserving all of the information that has been discovered and learned through all of these years,” Utturkar explains. “I think a crucial step is to pass on this knowledge and attract talented individuals to this field. Matrix has been very active in local communities to promote science, technology, engineering, and mathematics (STEM) and show that the construction industry really defines the quality of life for all of society. We can say, ‘This is what we dream of and what we design, and it all comes together in real life and materializes in the construction industry’. In order to support this, we have plenty of initiatives including volunteer projects through organizations such as Junior Achievement, multiple STEM community activities, where we encourage and facilitate students to focus on construction and engineering, and formalized programs like our Emerging Leaders Program that targets engineering and construction management students at the college level.” By supporting these programs and the new generation of engineers, Utturkar emulates the company’s core values of: commitment to safety, integrity, building and maintaining positive and professional relationships, stewardship, community involvement, and delivering the best customer service and products.

With more than 40 locations worldwide, including the U.S.A., Canada, Australia, and South Korea, Matrix Service Company and its subsidiary, Matrix PDM Engineering, has made it a priority to teach, and pass along the knowledge in order to create more engineers for the future.



A 3D engineering model of boric acid storage ASME vessels and tanks constructed of stainless steel. Image courtesy of Matrix PDM Engineering