Parcel Tankers

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4/25/16

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As the seagulls fly through the air you feel the cold ocean breeze blow against your head. You hear the engine of the parcel tanker run. You see the ship's bow cut through the cold water. Now imagine a world without parcel tankers. You might say that daily life would not be different. In reality though, the chemicals that parcel tankers transport impact our everyday life to a great extent. These chemicals are used to produce items on which consumers rely. For instance, without the chemicals that parcel tankers transport, the price of gasoline would skyrocket by over 1000%. We wouldn't have plastics or soft cloths. We wouldn't even have fertilizer for our lawns. Parcel tankers or chemical tankers travel across huge oceans to transport chemicals. These chemicals can be very dangerous. Parcel tankers are known for transporting more than 50 chemicals simultaneously. Many companies depend on chemical tankers to transport liquids that they need for their products. For example, Exxon uses many chemicals transported by parcel tankers to make their gasoline. The parcel tanker industry is relatively new yet many people rely on it for their daily needs.

Origins

Cargo transport ships were used many years ago. These were not ships that were dedicated to only transporting. The cargo usually was on the side of the ships. Chemicals were kept outside so if there was an emergency they could have been easily thrown overboard. These ships only transported a small amount of goods and chemicals. They also were wooden and did not have an engine and were usually around 100-300 tons in mass. As time went on, these ships gradually became larger. By 1770 ships as big as 550 tons were used. It was difficult though to

increase the size of a ship at this time because ships were made of wood. Wood is very heavy and with too much weight, the ships will sink. Many improvements were made during that time as well . Ships had a better navigation system that was more accurate. There was a new feature added called the chronometer. This measured time accurately despite extreme temperatures. Also better maps of the oceans were created and storm tracks could be better predicted. This made sailing safer because you were never going somewhere “blindfolded”. The last major change is the addition of insurance and guidelines. There was now a working insurance system for ship-owners, captains, and crew members. The guidelines or laws were created to keep people safe and prevent injuries.

In spite all of these new changes, ships were still too small to carry many different things at once. These problems occurred because of the structural limitations of the wood. Ships were now being made of steel. Because they were made of steel, different engines and energy sources were able to be used. Coal was a popular fuel because it was so cheap. Since the 1840’s, the amount of cargo transport ships could have has increased by 400%. Today 1.2 tons of cargo are transported for each person on the globe.

The parcel tanker industry started off in the late 1950s. With the advancement of technology, ships could transport different types of chemicals simultaneously and safely. Because of these advancements, there were ships dedicated to transporting chemicals only. The first chemical tankers were modified product tankers. Vegetable oils and tallow (fat) were the first chemicals to be transported. The chemicals shipped were usually commodity based chemicals. During the 1970s the market for chemicals increased. Now there were individual

tanks with their own piping and pumps. There was also improved tank coating and stainless steel. The volume of trade across the Atlantic Ocean increased.

At the start of the 1980s, the Japanese began to transport chemicals because of a strong market. There were new laws that were created to keep the crew safe and protect the environment in case of an accident. In the 1990s there were many new chemicals that were being created. Because of this, many large companies relied on parcel tankers to provide them with the liquids they needed for their products.

Inventors/Companies

Jacob Stolt-Nielsen, the developer of the parcel tanker trade and its technology, was born in 1931 in Haugesund, Norway. Stolt-Nielsen went first to London in 1952 as an unpaid shipbroker trainee in the bulk carrier business, shipping dry cargo such as coal and ore. Stolt-Nielsen had great drive and intelligence and quickly became a successful broker, even securing a seat on the prestigious Baltic Shipping Exchange at only 22 years of age.

The Baltic Shipping Exchange is a large floor in a room where brokers representing charterers meet brokers representing ship owners. When cargo meets ship in the right size and position, a ‘fixing’ is negotiated – in other words, a transport contract. The exchange was an authentically British institution established to ease contact between owners of ships and freight before the invention of the telephone (Jacob Stolt-Nielsen An Entrepreneur, p.67). Stolt-Nielsen then worked for a tanker broker. He found it interesting as tankers were bigger ships. Bigger ships were starting to be built so bigger cargoes could be carried.

During World War II, the biggest ship was about 16,000 dead weight tons (DWT). In 1952 they grew to 30-50,000 deadweight tons. Some older shipowners said they would not work well and would break in two in a real storm. In 1954 Stolt-Nielsen sailed on his uncle's 2,800 DWT tanker from London to Houston. He wanted to go to Texas because he heard of chemical cargoes with difficult names such as xylol, toluol and solvent naphtha, which were being exported from America to Europe in little tankers. The major chemical companies, such as Dow, were all located in Texas and the chemicals they produced were all shipped from Texas ports.

The quantities involved were small, but the freight rates were very high. Known collectively as solvents, these special products were feedstock for the expanding petrochemical industry (Jacob Stolt-Nielsen An Entrepreneur, p.69-70). These were the base products for the growing petrochemical industry. Stolt-Nielsen knew that demand for products made from synthetics would grow in the future. For instance, nylon stockings had just come onto the market and were very popular. Stolt-Nielsen studied his uncle's ship to see how a tanker's cargo tanks, pumps, loading lines, cleaning system, engine, navigation worked. He understood the technology and remembered all the details. He saw the discharge and loading process and noticed everything about the process. Since solvent shipping freight was not fixed, or contracted, in London but in New York, Stolt-Nielsen wanted to go there. He thought that he could make a successful career shipping specialized products, especially those used for the production and sale of synthetics.

Because global exports were becoming easier in the 1950s, with less customs barriers and other restrictions, Stolt-Nielsen felt that with the right technology he could make money on this type of shipping. Others tried to come up with the technology. For example, in 1948 Union

Carbide converted a tanker to carry nine different chemicals in the middle of the ship with petroleum carried in side tanks. Not much is known about this venture so it may not have been successful. In 1954 Dow Chemical built a tanker to carry 11 different chemicals. Products could not be securely segregated and contamination occurred. Although there was still some way to go before segregated chemical shipments was achieved, this was the beginning of what was to become the parcel trade.

Stolt-Nielsen was the man who first succeeded in developing and operating a parcel tanker without the cargoes cross-contaminating each other (Jacob Stolt-Nielsen An Entrepreneur, p.77). In 1954-55, the demand for chemical exports from USA to Europe and Asia that Stolt-Nielsen had predicted happened. There were larger shipments and more types of products being shipped and needing to be shipped. The tankers for chemicals, or solvents, as the ship-owners called them were still too small - in the 2,550-4,250 deadweight ton range.

There was plenty of cargo but the problem was the ships could not segregate more than four different grades or product types with the common ring-line discharge pipe system that was used in oil tankers. The ring-line worked well there but it reduced the number of segregations possible. The ring line system creates centrifugal pressure and acts like a vacuum. Ship-owners installed two pump rooms with four pumps which doubled the number of grades that could be handled but it was not good enough to keep a larger ship of about 13,000 DWT sailing and making a profit.

Stolt-Nielsen understood that the problem of not contaminating the many grades of chemicals that would need to be shipped on that larger tanker was still there with the ring-line

system. He had to find a solution and thought about it a lot. Then he remembered an article he read in *Life* magazine describing the way water was pumped up from deep wells in the desert. Archimedes' Law means that liquids cannot moved by suction over more than about ten meters. But the application of force allows them to be pushed up to any required height – provided the pump is at the bottom. The article in *Life* magazine stated a company called Byron Jackson produced water pumps designed for desert use. Stolt-Nielsen got in touch to learn more about such "deep-well" units (Jacob Stolt-Nielsen An Entrepreneur, p.78). The 'deep-well' pumps would replace the ring-line system and each tank then could be a watertight unit since the ring-line holes could be welded shut. The cargo could then be loaded and discharged over the deck separately and then a ship could segregate as many grades as it has tanks both safely and securely. The world's most advanced chemical carrier – essentially the first parcel tanker – was in the process of taking shape (Jacob Stolt-Nielsen An Entrepreneur, p.79).

Stolt-Nielsen knew this concept was a great idea but did not have the money to purchase a ship on which to try it. His father, who lived back in his hometown of Haugesund could not understand the new direction Stolt-Nielsen was taking maritime history, so Stolt-Nielsen turned to his partner RJ Chianelli and another business contact Mr. Steuber. They liked Stolt-Nielsen's idea. They paid him $20,000 for his concept which was a 20% stake in the business that they named Chemical Carriers Inc. They found a new 13,000 dead weight tons product tanker that they chartered, or leased named MT *Freddy*. It was the perfect size and they were excited that this ship would write shipping history as the world's first parcel tanker.

The old ring-line system was taken out and each of the 19 tanks had a deep-well pumps installed. MT *Freddy's* first cargo went from the US Gulf of Mexico to Rotterdam, The Netherlands, in May of 1955 with 19 different parcels or grade. There was no mixing and no contamination of grades. Stolt-Nielsen's idea was a success. Now that he had the technology, Stolt-Nielsen thought about which other cargoes could go on a parcel tanker. In 1957, Stolt-Nielsen realized that there was a lot of edible fat, or lard, to be exported if it could be shipped less expensively. When the lard was shipped from Asia it was hardened into a big block wrapped in coconut matting and shipping on a cargo liner. Once the lard got to Europe it was melted into a liquid again. This took too much time and money. Shipping lard as a heated liquid would be much cheaper and easier. Stolt-Nielsen was told that he could not follow through with this idea because any edible product could not be shipped by a tanker. Stolt-Nielsen felt that if tanks could be cleaned for a solvent product then it would be possible and easy to do it for lard. Stolt-Nielsen spoke to a potential customer, Swift & Co. - the largest US meatpacker at the time who made many animal products.

Mr. Swift agreed with Stolt-Nielsen's theory and agreed to ship a trial cargo from New Orleans to Liverpool. The cargo was edible lard from pigs but was listed as inedible grease so the cargo could be carried by tanker. As Stolt-Nielsen had expected, the quality of the lard was the same between loading and discharge. The theory was confirmed. This trial shipment convinced Mr. Swift to transport lard as a liquid rather than a solid and another field of export was opened up by Stolt-Nielsen. In 1959 Stolt-Nielsen formed Parcel Tankers Inc. and his first ship was MT *Stolt Avance*. This was the first time the term "parcel tanker" was used. Ships were identified by

their cargo, like solvent tanker, lube oil tanker or vegoil tanker. “Parcel tanker” was something unheard of, and was a new shipping term that Stolt-Nielsen created to reflect the technology of his specially converted ship, the parcel tanker, to segregate many parcels of different liquids. It is now an established term and identifies this business.

By the end of 1962, Parcel Tankers Inc. had 89 parcel tankers in operation. The ships sailed regularly from the U.S. Great Lakes to Europe with lard and vegetable oils, and from the US Gulf to European destinations with chemicals, solvents, fats and lube/edible oils. The ships also sailed from the US Gulf to Japan with primarily chemicals and solvents. Petrochemical products were shipped almost totally from the US Gulf because that is where all the big chemical companies and their production facilities were. It was rare for cargos to become contaminated. The pumping and piping system developed by Stolt-Nielsen was a success. Today the company is named Stolt-Nielsen Limited and they are a leading global provider of integrated transportation solutions for bulk liquid chemicals, edible oils, acids, and other specialty liquids through its three largest business divisions, Stolt Tankers, Stolthaven Terminals and Stolt Tank Containers.

How It Works

There are many things that contribute to the functionality of the parcel tanker, also called a chemical tanker. Two of the main components are the pumps and tanks where the liquids that are being transported are stored. The pumps are large industrial pumps that move huge amounts of liquid. These pumps are usually a certain type called the centrifugal pump. These pumps have many parts including the impeller, the shaft and the casing. The impeller rotates and moves the

liquid up a pipe to the tank. This part of the centrifugal pump is usually made of steel or plastic, depending on what kind of liquid is being moved. Another part of the pump is the casing. The casing holds and surrounds the innards of the pump. This might seem like a simple part, but it is very important. The purpose of casings is to house internal parts, confine fluid and protect against erosion. The casing is made from a thick metal. The materials used to make this casing vary because some liquids that are being moved will erode or harm the casing. The casing needs to be strong enough to withstand enormous amounts of pressure that is created to move the liquids.

Next is the shaft. This is a long metal rod that is connected to the engine. Thus the impeller rotates. Steel is the most common material for shafts. Lastly, there is the coupling. This is a device that connects the pump to the driver of the pump. This piece is important because it needs to be strong enough to withstand a sudden change in movement and force. All of these pieces work together to move liquid efficiently and safely. These pumps are in each tank of a parcel tanker.

Another very important part of the parcel tanker are the tanks that hold the liquids being transported. These tanks need to be efficient to save on costs. Many of the chemicals being transported are very dangerous and need to be handled carefully. These tanks can be heated or cooled depending on the needs of the liquid. Some liquids need to be hot and some liquids need to be cold. Some are extremely delicate and need to be held at an exact temperature. The tanks are heated a number of ways that include heating coils. Because of this feature of heating and

cooling liquids, parcel tankers can transport many different types of liquids in different tanks, all at the same time safely. Some of the liquids include acids, vegetable oils, and oils.

Chemical tankers have up to 56 separate tanks. Each tank has its individual pumps and cleaning system. The pumps are located in each and every one of the tanks on parcel tankers. They are usually located at the top of the tank so that more pressure will accumulate inside the pipe. Most tanks are made out of stainless steel of other materials. This material depends on the liquid being transported. A significant factor that decides what material the tank will be made of is whether it is corrosive. Rust that is created inside the tanks can cause problems. Rust makes the cleaning process very hard for the crew members. The outside is also made by a strong material because the seawater during rough seas can rust the tanks. Mr. William H. Humphreys, a parcel tanker expert who worked on parcel tankers himself said, “Before there were cleaning systems in each cargo tank, one cleaning mechanism was used for the whole ship. This process was very laborious, that is why we put a cleaning system in each tank. It made the cleaning process much easier.”

Rust is a great problem in the chemical transport industry. It causes many problems to ships and their tanks onboard such as corrode the storage tanks. Some chemicals that erode stainless steel are heavy liquids like glycols and caustic soda. Rust can contaminate the cargo and make the cleaning process very hard. This can be prevented by putting cargo in tanks that cannot be eroded by that chemical or putting a coat or layer of other materials inside the tank. Some materials that can be coated inside the tank include epoxy, zinc silicate and polyurethane. This will protect the vulnerable metal.

Purpose

Parcel tankers are used around the world to transport liquids, chemicals, and acids. These ships are specialized to carry any type of liquid: flammable, corrosive and toxic. These ships transport the highest value cargo in the liquid cargo industry. They transport everyday liquids called edibles like olive oil, and also transport dangerous liquids like propylene oxide. This liquid is added to jet fuel and is very flammable. Many of the liquids that are transported are liquids that we use daily. For example, TDI, Toluene Dilsocyanate, is used to make mattresses soft and comfortable. This liquid reacts harshly when exposed to outside air. The tanks are filled with nitrogen to take out all of the air from the tanks.

Another example of a cargo on parcel tankers is rubber. Before the rubber is manufactured into tires, contact lenses, or wire coating, it is in a liquid form and is transported on parcel tankers. The chemicals transported on parcel tankers make products like plastics, adhesives, dyes, food and feed additives, surface coatings, and textiles.

Parcel tankers weigh an average of 40,000 DWT and can weight up to 50,000 DWT. These ships are multi-directional ships, meaning they travel to different ports and have many different trade routes. Parcel tankers are very different than other liquid transport ships like crude oil transport ships and clean products ships. Many well-known companies such as ExxonMobil, BP, Shell, DuPoint, Mitsubishi, and Vitol rely on parcel tankers to deliver vital cargoes like biodiesel and BTX, a combination of benzene, toluene, and xylene, that they need to manufacture their products. BTX is used to make house heating oil. Biodiesel used to make home heating oil. Biodiesel is a clean-burning diesel replacement that is reducing U.S.

dependence on foreign petroleum and improving the environment. It is made from a combination of feedstocks including recycled cooking oil, soybean oil, and animal fats. An average of 40 different liquids can be transported at the same time, and up to 60 can be accommodated on some parcel tankers.

The parcel tanker business is dangerous because many hazardous liquids are being transported simultaneously. One wrong move or mistake can prove disastrous to the cargo or fatal to the crew members. Some liquids can become very dangerous if they become five degrees cooler or warmer. Some liquids have a low flash point, which means that they explode easily. Any accident involving chemical tanker is usually very harmful to the environment. These liquids can pose a large threat to the wildlife of the ocean. Many of the liquids being transported have a far greater pollution threat than that of crude oil.

Impact

Many new technologies have improved the parcel tanker design over the years. For example, Framo, a widely used pump company, is making pumps that are more efficient and also slightly smaller. They are less susceptible to corrosion because of their better protective casing around the pump. The ways to manage the temperature inside the tanks are more accurate. They detect smaller changes in temperature and can effectively change the tank temperature so that the chemical is safe. Some chemicals need certain conditions to be stable. Some liquids need a bed of nitrogen and some need ultra-dry conditions. Some liquids need to be constantly moving and some need to be cut off from outside air completely. This has prevented many accidents and has made transporting these chemicals around the world over all safer.

Though most individuals may not know it, parcel tankers affect many parts of everyday life. Chemical tankers transport many chemicals and acids that are used daily. For example, many chemicals used to make gasoline are transported. Many fats that are used in cooking are transported by parcel tankers. Also oils like olive oil are transported in chemical tankers. Without parcel tankers, many products used daily would be harder to get and some would not even be available. Parcel tankers transport many different types of chemicals and acids safely and fast. Without parcel tankers, chemicals would become elusive and they would not be used as often because of how hard it would be to get them. Parcel tankers have revolutionized the chemical transport industry and made people's lives so much easier.

The environmental impact of parcel tankers has not always been minimal and regulated. Only a few decades ago, cleaning solutions that were used to clean the tanks were dumped into the oceans. Mr. Humphreys, who spent three years at sea noted, "When I traveled to a port in Brazil on my father's ship, the water was extremely dirty. It was brown. The water used to clean was just dumped in the harbour. Many laws have changed now. Parcel tankers have to travel 250 miles offshore to dispose of these solutions." Though one has to go further offshore, the liquids that parcel tankers dispose of greatly harm the environment.

Future

Engineers in the parcel tanker industry attempt to improve ship design to increase efficiencies and in turn increase profit. The next generation of chemical tankers are influenced by a need to be environmentally responsible, safe and to provide a quality service with no accidents

while carrying cargo from Point A to Point B in the fastest way possible. Mr. Humphrey says, "There are many new concepts for better hull designs and better engine efficiency." He also states that "making better parcel tanker designs is hard because you will have to deal with that change for the next 30 or so years." The average life of a parcel tanker is 30 years and any change made to the design will be around for many decades. So if the new design works it is good for the business. If the new design does not work well, it will negatively impact the business.

New parcel tanker technology is changing in the type of fuel used, and adapting the type of tank used. Parcel tankers typically use diesel oil as fuel. This type of fuel can be very expensive and not environmentally friendly. Alternative fuels are being explored for future use on parcel tankers. Biofuels are a possibility although liquified natural gas and methanol are the most likely alternative fuels. The idea of sustainable technology is causing the parcel tanker industry to adapt the design of the tank. This will provide both financial and operational advantages over the current parcel tanker design. The stainless steel cylinder tanks is less costly to build as they are less sophisticated, and can be taken out of the hull when the tanker is scrapped, or recycled, and be reused in a new tanker. The cylinder tanks are insulated with the heating/cooling coils placed on the outside. The insulation around every cargo tank, reduces the energy used for heating and cool purposes once the cargo has reached its temperature.

The cylinder tanks are all the same size and can carry the same amount of cargo. This makes cargo planning easier and faster so profits can also increase. Because of their shape, the cylinder tanks are easy to clean. They have a small diameter and need only a small jet of water

to clean it. Since there are no coils within the tanks there are no shadows that make cleaning difficult. It is possible that there would be up to a 75% reduction in washing time with the same reduction in the water needed for washing. This in turn would reduce the amount of tank wash water, or slops, produced. About 90% of slops can be legally dumped overboard, but the other 10% has to be disposed of at shore facility and it is very expensive to transport these slops to these facilities. Less slops to dispose of means less operating costs and less of an environmental impact.

Parcel tankers impact daily life by providing the raw products used to produce items that make life easier. From gasoline to olive oil, parcel tankers transport thousands of different chemicals. Without chemical tankers, many chemicals would not be able to be transported. Therefore we would not have as many goods with economical costs. Before parcel tankers, chemicals were transported on the side of ships in large wooden barrels. Later they were transported on steam ships. Many years later, a man named Jacob Stolt-Nielsen revolutionized the chemical trade by creating parcel tankers. Parcel tankers store these chemicals in large tanks that have their own cleaning system and pump inside them to prevent cross-contamination. Up to 56 different chemicals can be transported all at the same time. Many people's lives all over the world have been affected by parcel tankers. The world would not be the same without them.

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