THORDON
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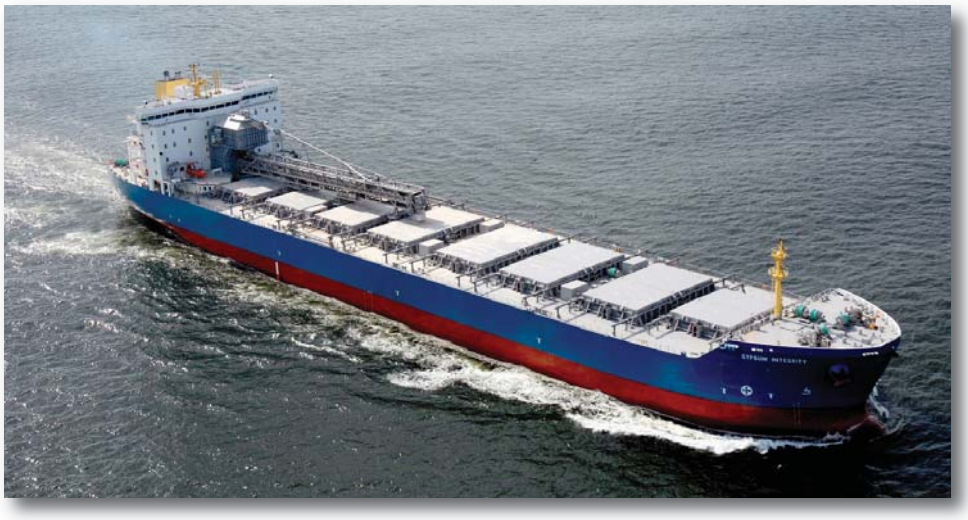
ZERO POLLUTION | HIGH PERFORMANCE | BEARING SYSTEMS

BULKER OPERATOR CHOOSES COMPAC



Gypsum Integrity equipped with COMPAC stern tube bearings

The delivery last year of the 47,761 dwt self unloading bulk carrier *Gypsum Integrity* to Gypsum Transportation marked another success for the Thordon COMPAC seawater lubricated stern tube bearing system.

COMPAC is Thordon's open, seawater lubricated bearing system that has been designed to offer long life with a 15 year guarantee against excessive wear, no pollution concerns, elimination of an outboard stern seal and low friction. To promote early formation of a hydrodynamic film between the shaft and bearing, the lower (loaded) portion of the bearing is smooth, while the upper half of the bearing incorporates grooves to encourage flow of the seawater lubricant.

The ship is now operating as part of the gypsum trade on the east coast of the US and Canada with backhauls of coal from Columbia to the US Eastern seaboard.

Managed by Beltship Management Limited (BML) this new vessel is a sister ship to *Gypsum Centennial* which, when launched in 2001, featured the first Wärtsilä RT-Flex engine and subsequently won awards for other innovative design concepts.

"In 1999 when the decision was made to place an order for a new bulk carrier the owner wanted a state-of-the-art vessel that could be supported throughout a 30 year life with a strong emphasis on safety and the environment," explained John McMillan, technical director, BML.

BML has considerable experience in the self-unloading bulk carrier market having operated most types of self-unloaders from hybrid types to bespoke vessels of ground breaking design. Therefore, on behalf of the owner BML supervised the build while US based naval architect C R Cushing & Co handled the design.

Although Cushing has designed over 150 ships it also had experience of designing large vessels with water lubricated stern tube bearings. As this type of installation suited the requirements of the owner, extensive market research was conducted and, following consultation with Wärtsilä, the propulsion system supplier, the decision was made to run the 655 mm (25.79 in) diameter tailshaft on Thordon COMPAC bearings.

"Previous vessels had traded on the east coast of America carrying gypsum one way and returning empty," said Mr. McMillan. "Clearly this was not an ideal practice, so to take advantage of economy of scale it was decided to build larger vessels that could more easily attract return loads. The choice of water lubricated bearings, although not that common for a vessel of this size, made perfect sense and was part of a conscious decision to minimise the impact the ship would have on the environment. Irrespective of how well

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trained and reliable a crew is, or how strictly the onboard procedures are adhered to, the integrity of an oil-filled stern tube can be compromised by circumstances outside of your control. Having water-lubricated stern tube bearings not only improves a company's environmental credentials but also eliminates the costs associated with maintaining an oil system and associated equipment."

As the vessel was not a standard shipyard design it was not easy to find a yard that would take on the project. However, around this time the Hyundai Mipo Dockyard (HMD) in South Korea had recently moved from shiprepair into shipbuilding and specialised in building niche vessels that required an innovative approach.

After several successful years of operating *Gypsum Centennial* it was decided to build a sister ship. However, due to the unprecedented demand for new ships HMD had adopted a mass production shipbuilding strategy and could not take on the project.

"Due to shipyards around the world having full order books we only really had a choice of three yards when the time came to sign a contract for *Gypsum Integrity*," said Mr McMillan. "Estaleiro Ilha SA in Rio de Janeiro was keen to take on the project as there had not been any major new orders from foreign owners for large vessels built in Brazil for around 10 years. Following the usual tendering procedures they were awarded the contract in 2005."

Although there were some modifications to the design of *Gypsum Integrity* incorporating the lessons learned from previous operational experience, the new vessel would also be fitted with the COMPAC bearing system. The system had performed well onboard *Gypsum Centennial* but one tailshaft defect had become apparent during the first docking.

"During a routine tailshaft inspection on *Gypsum Centennial* it was discovered that the resin coating had failed, leading to minor corrosion," said Mr. McMillan. "However, this was not Thordon supply so the coating was removed and the tailshaft dressed to remove the corrosion to the satisfaction of the classification society. Thordon provided a representative to oversee the application of its Thor-Coat product that not only prevented more corrosion but also provided a guarantee against further failure."

Thor-Coat was specifically developed to complement Thordon's COMPAC water lubricated propeller shaft bearing system and to address the risk of traditional coating failures on water-lubricated propeller shafts. Thordon says that the toughened two-part epoxy coating is up to nine times more flexible than established products approved for use as propeller shaft coatings.

According to Thordon, during a 180-degree bend test other products showed initial cracking at lower bend angles while Thor-Coat did not crack at all. If any of the coating is subject to mechanical damage it tends to fail locally, resulting in some of the coating remaining on the shaft and continuing to offer corrosion protection. If the coating is damaged to the point where corrosion does occur, says Thordon, the corrosion is limited to the damaged area only and will not migrate along the shaft under the coating. The one-coat application is by brush or blade, the coating then smoothed to a thickness of 2 mm (0.08 in).

The critical factors necessary to promote long, predictable, bearing wear life are water quality and flow rate. Since the first vessel was built Thordon has developed a self-contained water conditioning and monitoring package to provide an adequate supply of clean water to both the forward seal and the bearings. When *Gypsum Centennial* was built the bearing lubricating water was supplied from the seawater circulating system in the engine room but the new system utilises a stand-alone package. Incorporating dedicated pumps, cyclonic filters and flow monitoring equipment, the unit is designed to provide a high quality supply of water to the bearings at all times.

Thordon Water Quality Package

BML reports that it is very happy with the COMPAC product and the aftersales support it has received from Thordon. Thordon bearings can also be found on the rudders of the vessels and in a recent incident when a bronze bearing failed on a lifting boom Thordon was able to supply a replacement component.

Mr. McMillan concluded, "When the US construction industry recovers from the current recession there may be a requirement for another vessel of this type and Thordon COMPAC bearings would again be a serious contender for the stern tube installation." NW

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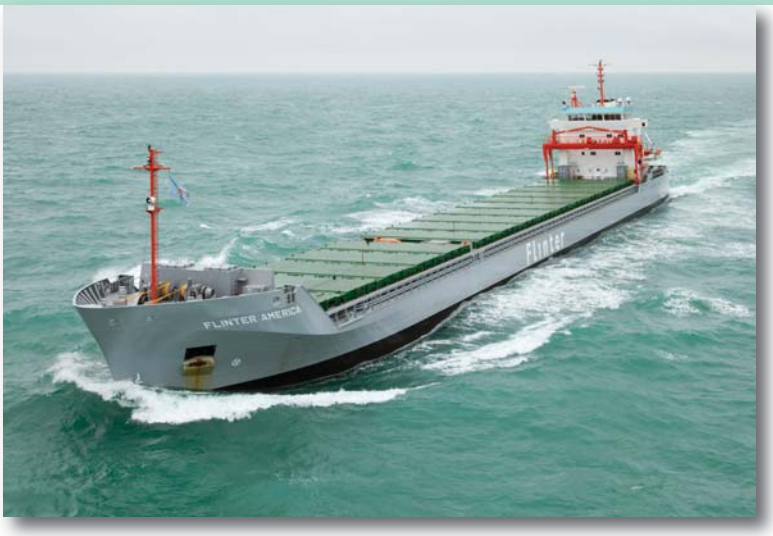
FLINTER STOP'S STERN TUBE LEAKAGE

Dutch company Flinter marks its commitment to the environment by specifying pollution free Thordon COMPAC stern tube bearings for a 20th newbuild.



Stern tube oil pollution has always been an issue for the shipping industry, but with ever increasing rules and regulations it has become law. Every day occurrences 10 years ago can now land multimillion dollar lawsuits or jail time for shipowners and managers

Several concepts are on the market to avoid such problems but one which takes the simplest path of using no oil at all is the COMPAC seawater lubricated bearings developed by Thordon Bearings. Thordon forward and aft COMPAC bearings are an elastomeric polymer alloy, but the key feature is that all lubrication is pumped seawater. To promote early formation of a hydrodynamic film between the shaft and bearing, the lower loaded portion is smooth while the upper half incorporates grooves for flow of the combined water lubricant and coolant.

This design feature has been shown to result in less friction at service speeds than oil-based technology. Research has also revealed that COMPAC bearings are 50 times more elastic than white metal and three times more compliant than other non-metallic shaft bearings; thus, edge loading is spread and local pressure is reduced, eliminating any incidents of bearing wiping.

Bearing wear data has been recorded over ten years for several ships with shaft diameters above 600 mm (23.62 in.), including Princess Cruises and Disney Cruise Lines. Results show that COMPAC bearings should be satisfactory for 15 to 25 years service life.

FLINTER CUTS POLLUTION

The enterprising and vibrant Flinter group – the Netherlands' fifth largest owner with a fleet (including tonnage on order) of more than 50 ships – is based at Barendrecht near Rotterdam and is more than just an owner of ships. This company is also involved in ship management, crewing, supervision of new ship construction, finance, brokering and onward transport of cargoes by land. Its youthful multipurpose dry cargo fleet (plus four 800 TEU cellular container ships added in 2008) ranges from 1,200 dwt to 11,000 dwt, and nearly all vessels are strengthened for ice navigation, although operations are worldwide.

A recent newbuilding programme is nearing its end, with the last ships of three classes now being delivered by Ben Kien Shipyard in Vietnam (four ships of 9,120 dwt), Chowgule & Co in India (two ships of 4,450 dwt) and five further vessels of 11,047 dwt from the Ferus Smit yard in northern Holland.

Flinter has been a regular user of Thordon COMPAC bearings since 2002 – all its newbuildings since that time have been specified with this elastomeric type stern tube bearing. The principal cataylst, reports Flinter's newbuilding manager, Martijn Berends, has been the prevention of oil leaks. "Spills always come at times when you do not need them, and they must be resolved as soon as possible," he says. Prior to the switch to these seawater lubricated bearings, Flinter, like others, had been fined for oil pollution, especially in US ports. So far, all the installations have been on new ships and there have been no retrofits.

As a user of eight years standing of the Thordon COMPAC system, Flinter is clearly convinced of its merits and Mr Berends says the ship owning group intends to continue with the same selection policy in the future.

Shaft diameters in the new Flinter-fitted fleet have varied from approximately 350 mm (13.77 in) to 500 mm (19.68 in) diameter, and all the vessels feature controllable pitch propellers of the Wärtsilä Propulsion, Rolls-Royce or Berg types.

Since 2008, Thordon has been offering a 15 year wear life guarantee that COMPAC bearings will meet class society wear standards on commercial vessels with shaft diameters of 300mm (11.8 in) or greater. Mr. Berends sees this as "good news", but adds that it is still possible that the tailshaft itself will be affected by corrosion or cavitation. As tailshafts have, in any case, to be withdrawn at a second special survey (10 years), and since the price for new bearings is relatively low compared to the total costs of a shaft withdrawal and inspection operation, he says that Flinter will probably renew the COMPAC bearings on the ships in its fleet at this interval.

GENESIS OPTS FOR OPTIONS

When one of your hydro turbines had been installed back in the 1930s, and it was time to refit, you want technologies that offer the maximum amount of options, since there really is no way of telling what you are going to find . . . like Thordon's highly engineered crystalline thermoplastic - ThorPlas.

Genesis Energy completed a refurbishment project of Generators 1, 2 and 7 at their Tuai Power Station in New Zealand during March of 2009. This station is a part of Genesis' Waikaremoana hydro generation scheme on the country's North Island.

ThorPlas was chosen as the best option for upgrading their Francis turbines.

ThorPlas wicket gate bearings

The ThorPlas bearings were prepared for the wicket gates (top, bottom and middle positions) by measuring each individual housing, then machining twenty-four tailored fits. Genesis also designed a simple retaining lip (shown in picture) that added another level of axial retention.

Link and servo motor bushes were replaced with ThorPlas bearings as well.

We asked Ian Meredith, the Genesis Hydro Engineering Team Leader why he chose ThorPlas? Ian

ThorPlas bearing installed in retaining lip

explained to us: "First of all, I researched the material and called up some peers in the New Zealand hydro industry who had already used ThorPlas. I received favorable reports about it."

"I found that ThorPlas enabled close fitting clearances. It didn't have to be thin-walled. Neither did it need an outer shell, or liner. We could order it in tube form and have our installation contractor machine it to our specifications exactly as we needed it – a definite plus when refurbishing existing machines.

Our contractor MB Century found it easy to machine, with no toxic dust. To install the bearing they simply followed Pacific Driveline's advice to freeze the bearing using dry ice. Then they either, pushed it in lightly, or tapped into the wicket gate housing . . . making it so easy to complete the job.

These weren't the only pluses. When everything was installed; we found that less force was required to move the wicket gates, so the friction component was reduced.

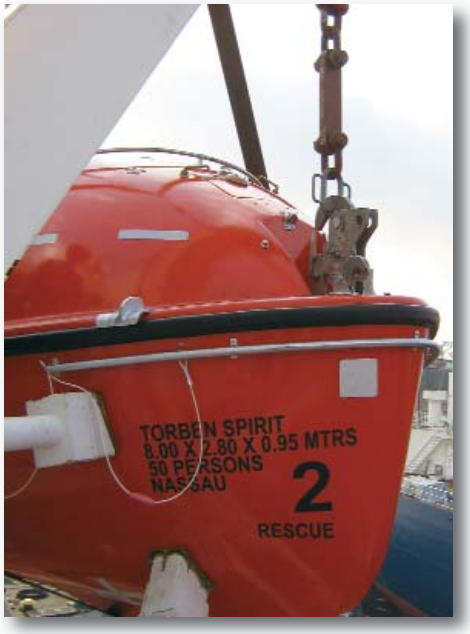
During the project we found we needed more ThorPlas than was originally planned for; and we wanted link bearings and servomotor link bearings done as well.

Pacific Driveline was terrific to work with. They had the extra material sent from Canada and out to us within the time frame we required; so the machines weren't left out of service when they could have been generating for us."

"These weren't the only pluses. When everything was installed; we found that less force was required to move the wicket gates, so the friction component was reduced."

ThorPlas bearings installed in Francis Turbine at Tuai Power Station, New Zealand

HOOK PUTS THE "LIFE" IN LIFEBOAT



Thordon bearings installed on RocLoc hook

When a cruise ship is in peril at sea, imagine the relief of the passenger who safely boards one of the little lifeboats mounted to the side of the vessel. The worst is over – that is, unless something goes wrong with the lifeboat.

Equipment used for emergencies should be failsafe. Yet hundreds of people have died in lifeboat emergencies or drills over the years, in an estimated 1,200 incidents. In the late 1990s, the Institute of Ocean Technology hired Dean Pelley and Jason Dawe to find out why.

They discovered that lifeboats weren't the problem. The problem was in the hooks that release the lifeboats from the vessel. Someone had to invent a simple, durable and reliable hook, so Dean and Jason took on the task.

Today Dean is CEO of Mad Rock Marine Solutions, Inc., a growing company based in St. John's, Newfoundland, and Jason is the company's Executive Vice President of Engineering. They launched their failsafe RocLoc hook in 2004.

Manufacturers of lifeboat hooks have faced tough challenges over the years. In the 80s, after 123 people lost their lives when three out of four lifeboats failed to release from a Norwegian oil platform, the IMO made it mandatory for lifeboat release gear to have on-load release capability. Unfortunately this resulted in hooks that, if not properly maintained or operated, could open at the wrong time – with the lifeboat still suspended above water.

"Hook systems in the past killed more people than they saved. They would open at any given time," says Lacee Abbott, Mad Rock's Business Marketing Sales Support Specialist. "When you have a lifeboat full of people and the hook fails, the fall from any height above 3 m (9.8 ft) will cause the boat to suffer significant damages, and the people inside would be seriously injured, if not killed."

Mad Rock's RocLoc hook is a pure on-load release mechanism that requires no extra equipment or complex override processes, other than required by LSA Code. The weight of the lifeboat keeps the hook closed even if there is a problem with one of the system's components. The RocLoc will not open until a crewmember opens it. It has only two moving parts, including a cam system featuring Thordon bearings in the cam's rotation.

Historically, poorly designed cam systems had caused many hooks to fail. So when Mad Rock was looking for the right bearing, the company had high expectations:

"The bearing had to have a long life span," says Abbott. "Being in salty seascapes, it had to be corrosion resistant. It had to require low maintenance. It had to work every single time. We considered the Thordon product the best on the market for meeting all those criteria."

The RocLoc is not only an ingenious, life-saving piece of hardware but a Canadian business success story. After achieving full IMO certification, Mad Rock sold its first RocLoc hook in 2006. Buoyed by the prospect of worry-free lifeboat release hooks, the cruise ship industry responded. Sales soared by three thousand percent by 2009, earning Mad Rock a place (twice, so far) on the Profit 100 fastest-growing companies list.

By eliminating injuries and fatalities due to lifeboat hook failure, RocLoc has become the release hook of choice for vessels all over the world. The cams with their durable, corrosion-free Thordon bearings are in place in Northern, Southern, Caribbean, Indian and Pacific waters, braced and ready to save the lives of unsuspecting cruise ship passengers everywhere.

GROUND CUTTING WORK, GROUND-BREAKING LONGEVITY

True to its commitment dating back to the Middle Eastern oil boom of the 1970's, the government of Abu Dhabi has spent its wealth on improving infrastructure and dramatically changed the industrial and economic landscape. The physical landscape, too has changed, as colossal earth-moving projects have dug canals, developed islands and built entire new ones.

Central to many of these developments has been the National Marine Dredging Company (NMDC), whose dredging ships dig and suck up underwater soil for large waterway construction projects. The company's largest ship is the 27,500 hp *Al Sadr*, built by IHC Holland. It measures 117.5 m (385 ft) x 20.3 m (66 ft) and is one of the most powerful dredgers in the world.

Ever since the *Al Sadr* was built in 1999, Thordon Composite bearings have functioned without fail in the cutter shaft, which has cut through millions of cubic metres (feet) of mud. When engineers finally replaced the bearing in July 2009, it showed only 2 mm (.07 in) of wear after 10 years. The Thordon distributor, Rafid Qureshi of Ocean Power International LLC, even advised that the bearing could remain in operation, but NMDC management decided that the bearings had a good run and replaced them while the vessel was already drydocked.

"It probably could have gone longer," says Qureshi. "I've seen these bearings last 12 to 15 years."

A cutterhead dredger uses a spinning head covered with an excavator piece. Throughout its life, the end shaft is repeatedly thrust into the floors of rivers and oceans. Besides performing its heavy industrial function, the bearing must withstand abrasive water that inevitably seeps through.

"This is the first bearing after the actual cutter that cuts the soil," says Jurjen Visser, Marine Superintendent at NMDC. "It is always underwater and absorbs most of the shaft's movements."

After 10 years, in contrast to the nearly-intact Composite bearing, the metal retaining ring that holds it in place is completely worn – indicating that a metal bearing would have required several replacements under such harsh conditions. During last summer's retrofit, at Qureshi's suggestion the Thordon stave bearing in the *Al Sadr* was replaced by a Thordon Composite tube bearing, an even more economical option that's easier to install.

"We have experienced within our company that exchanging the bearing when we use complete bushes is far easier and quicker," says Visser. "Furthermore, it is cheaper to buy three bush bearings than a whole bunch of stave elements."

As of 2006, NMDC vessels had dredged 890 million cubic metres (3.1 billion square feet), which the company claims is enough to build a road 20 m (65.5 ft) wide, 1 m (3.2 ft) deep and 40,650 kilometres (25,250 miles) long – that would almost go completely around the earth at the equator.

The new Thordon bearing in the *Al Sadr's* end shaft has big tasks ahead. By the end of 2010, NMDC aims to complete an AED 1.5 billion (USD 313 million) contract by the Abu Dhabi Urban Planning Council (UPC) to construct the Mussafah canal. This canal will play a key role in the development of Mussafah Industrial City by allowing ships of up to 9 m (30 ft) draft to pass. And as of November 2009, the company was awarded a three-year, AED 2.3 billion (USD 626 million) project to construct four artificial islands in the Zakum marine oil field.

As for the now-retired bearing, Thordon representatives continue to marvel over its longevity. It sustained most of its minimal damage from welding spatter when it was removed for inspection.

"Except for the first 200 mm (7.87 in) length at the mouth, the rest is perfect," says Qureshi. "In my opinion it could have run another 10 years."

Al Sadr equipped with Thordon Composite dredge bearings