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THORDON
NEWSWORKS

Nine CSL Newbuilds Eliminate Oil From Shaftline

Installed with COMPAC Seawater Lubricated Propeller Shaft Bearings

The drive for pollution free ships continues as Canadian-based ship owner, CSL Group Inc., eliminates oil from the stern tube and equip nine of their latest newbuilds with seawater lubricated propeller shaft bearings. CSL has specified non-metallic propeller shaft bearings that use seawater rather than oil to lubricate the shafts on the Trillium Class vessels built at Chengxi Shipyard and Yangfan Shipyard in China.

Following the successful retrofit and operation of Thordon water lubricated propeller shaft bearings on the *CSL Acadian* (converted in 2006), CSL will install a similar package on all of its newbuilds. These newbuilds include three Panamax (71,900 dwt) self-unloader bulk carriers, four (35,500 dwt) Great Lakes self-unloader bulk carriers and

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Installation of Thordon COMPAC seawater lubricated propeller shaft bearing on CSL bulk carrier built in China

two (36,000 dwt) Great Lakes bulk carriers. The new-builds fall under CSL's trademark Trillum Class which symbolically mirrors the three legs of CSL's sustainability philosophy as well as represents the three advantages the vessels provide, namely in the areas of Energy, Efficiency and the Environment. "The Trillium Class design includes many industry leading efficiency and pollution reduction features. Eliminating any possible source of pollution was given a high priority when designing these vessels", says Kevin Begley of CSL International.

The pollution of the world's oceans and seas has become a matter of increasing international concern for many ship owners. As stricter environmental legislation and improved pollution detection methods are becoming the norm in Canada, the United States of America, and the European Union; ship owners like CSL are looking for new ways to reduce all sources of pollution from their ships. Choosing seawater lubricated propeller shaft bearings and grease-free rudder bearings are just a few ways ship owners can ensure future compliance with any pending zero discharge legislation. NW

Eco-**IMPACT** Facts - Two Types of Leakage

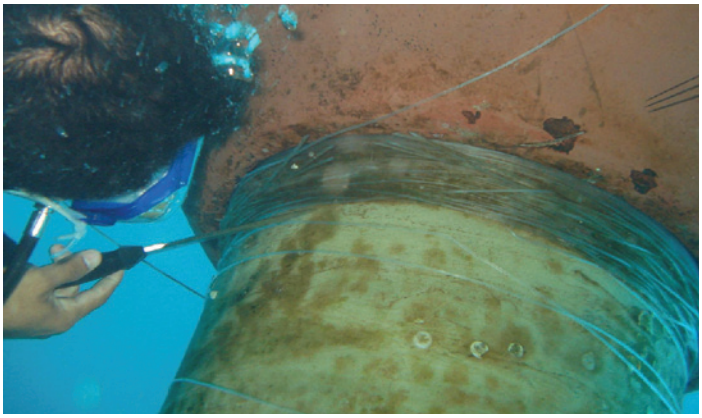
There are two sources of oil discharges from propeller shaft seals:

- Operational, where oil leaks in order for the seals to work
- Accidental, where there is damage to the sealing elements, allowing oil to escape into the sea (or allow seawater to contaminate the oil)

Historically, "operational discharges" of lubricating oil have been considered normal, and as the discharges have been below the waterline in smaller quantities, many ship owners have not been concerned. This has changed over the past decade with better oil detection methods (such as satellite and aerial surveillance) and increasingly larger oil pollution fines.

Operational discharges from stern tube leakage have only recently been quantified with the first authoritative study on stern tube oil operational discharges done by Dr. Dagmar Etkin in 2010. Her research on port oil discharges from ships estimated that if the same rates of discharge occur at sea as they do in port, the estimated worldwide annual inputs of lubricants into marine waters both in ports and at sea might amount to four times the port estimate. She estimated that total worldwide use of oil-based lubricants from operational leaks and discharges would then be about 130 million to 244 million litres (34 million to 64 million US gal.) annually. This would be equivalent to 137 individual oil spills of equal size to the Exxon Valdez disaster in 1989. NW

Etkin, Dagmar Schmidt. Environmental Research Consulting "Worldwide Analysis of In-Port Vessel Operational Lubricant," Artic and Marine Oil Spill Program Technical Seminar of Environment Canada, 8 June 2010, Halifax, Canada



Aft shaft seal damage caused by fishing net caught in the propeller

Shaftline Conversion from Oil to Water Saves Dredge Owner Money

Installed with RiverTough Propeller Shaft Bearings for Abrasive Waters

Installation of Thordon RiverTough propeller shaft bearings on the triple screw dredger, Fraser Titan

Triple screw dredger, Fraser Titan converted from oil to water lubricated propeller shaft bearings in 2011

In April 2011, the *Fraser Titan*, a triple screw 2300m^3 (8,124 ft.^{3}) dredger, was converted to Thordon RiverTough water lubricated propeller shaft bearings from an oil lubricated system. The previous oil lubricated system had many issues - frequent maintenance of aft seals, water ingress contaminating the lubricating oil, and unplanned drydockings. The vessel had its first drydocking with water lubricated shaftlines in March 2012 at Esquimalt Drydock (Canada), reporting no sealing issues (as there is no aft seal) and very little wear. At current bearing wear rates after 6,100 hours of operation, RiverTough bearings are expected to last over 10 years (+60,000 hours).

"We chose Thordon RiverTough for this vessel because these bearings are known for long wear life in abrasive waters, they eliminated the aft sealing issues we had and come with no risk of pollution," says Dmitry Kravtsov, Technical Superintendent for FRPD (Fraser River Pile and Dredge GP Inc. of Vancouver, Canada) "The Thordon solution onboard the vessel has reduced our downtime and maintenance costs."

The *Fraser Titan* has three shaftlines with diameters of 165 mm (6.6"). The Thordon RiverTough propeller shaft bearings operate in combination with hard coated Nickel-Chrome-Boron shaft sleeves which provide superior wear life in highly abrasive wear conditions experienced on the Fraser River in British Columbia. Water is used as a lubricant (instead of oil) and is taken from the river, pumped through the bearings using a Thordon Water Quality Package and returned back to the river. Since no aft seal is required, there is no risk of damage by abrasives or rope. This results in lower in-service maintenance costs and the elimination of storage, sampling and disposal of oil from the stern tube. Mill Log Marine, Thordon's authorized distributor in British Columbia, Canada, has worked with FRPD on this project and continues to advise on problem areas where Thordon solutions may further help them reduce operating costs.

At current wear rates, Thordon RiverTough bearings are expected to last over 10 years

Eco-Conscious Carisbrooke Opts For COMPAC Bearings

COMPAC bearings installed on U.K. based Carisbrooke's Vectis Eagle, one of 8 newbuilds

Seawater Lubricated Propeller Shaft Bearings for Latest Newbuilds

The *Vectis Eagle*, an 8500 dwt multi-purpose dry cargo vessel, is Carisbrooke Shipping's latest newbuild and first of their fleet to be fitted with Thordon COMPAC seawater lubricated propeller shaft bearings. The Finnish/Swedish 1A Ice-Class vessel was launched in September 2011 and carried out its maiden voyage through the Panama Canal travelling from China to Haiti and Brazil. Constructed at the Chinese shipyard, Jiangsu Yangzijiang Shipbuilding Ltd., the vessel is the first of eight to use seawater lubrication instead of oil.

"We chose Thordon COMPAC for this vessel because these bearings are environmentally friendly, water lubricated and come with no risk of pollution," says Captain Simon Merritt, Technical Manager for Carisbrooke Shipping Ltd. "All equipment on board the vessel has been chosen with energy efficiency or with its minimal environmental impact in mind."

The *Vectis Eagle* has a tapered key COMPAC bearing design with a shaft size of 470 mm (18.5"). The tapered key design allows for removal, inspection and re-insertion of the bearings without shaft withdrawal. Thordon COMPAC seawater lubricated propeller shaft bearings completely eliminate the risk of oil discharges from the stern tube. Seawater is used as a lubricant instead of oil and is taken from the sea, pumped through the bearings and returned back to the sea. There is no risk of damage to an aft seal by a fishing net or rope as there is no aft seal. This results in lower in-service maintenance costs and the elimination of storage, sampling and disposal of oil from the stern tube.

The *Vectis Eagle* is characterized by its extremely high bow and versatile single cargo hold making it currently the longest cargo space amongst its vessel class. Carisbrooke expects up to 30% reduction in fuel consumption compared to vessels of equal tonnage due to its large diameter propeller and high efficiency nozzle. The ship's design below the waterline is hydro-dynamically optimized to further reduce drag and allow better water flow to the propeller. Careful selection of all chemicals used inboard has been made to ensure the least impact to the environment as possible.

COMPAC bearings ready for installation.

Stern Tube Conversions Reduce Pollution Risk

Peter R Cresswell converted from oil lubricated propeller shaft bearings to a complete seawater lubricated COMPAC bearing system in 2010

The conversion from sealed oil lubricated bearings to open water lubricated bearings on the bulk carrier *Peter R Cresswell* demonstrates the way owners of existing ships are solving oil pollution leakage issues.

A growing number of owners of existing ships are coming to realize that the environmental and maintenance benefits offered by switching to water lubricated stern tube bearings are as important to existing ship owners as they are to these building new vessels.

In 2011, new US Environmental Protection Agency National Pollutant Discharge Elimination System (NPDES) rules specifically targeted oil lubrication discharges from stern tubes. The new requirements carry extensive civil and criminal penalties for violations, including the threat of jail. In Europe, meanwhile, the 2007 European Union Maritime Policy specifies the elimination of all vessel discharges into the marine environment by 2020.

Leakage from an oil lubricated stern tube does not necessarily mean negligence. Currently, the majority of commercial ocean-going ships operate with a propulsion system using a propeller shaft supported by oil lubricated metal bearings with oil contained in the stern tube by forward and aft shaft seals. According to seal manufacturers, the seal must leak (aft-into the sea or forward-into the ship's bilge) at the shaft/seal interface to function properly. Simple fishing nets or rope caught on a ship's rotating shaft can damage the aft seal, allowing stern tube oil to flow out into the sea. According to seal repairers, this occurs on a frequent basis.

While Deepwater Horizon may be dominating the environmental landscape, it might be worth considering that a typical ocean-going ship's stern tubes contains 1500L (396 US gal.) of oil. Even a conservative stern tube leakage rate of 6L (1.6 US gal.)/day as set by Lloyds Register Class Society Seal Type Approvals from a world fleet of around 45,000 vessels could add up to 'normal' operational stern tube oil pollution of over 80 million litres (20 million US gal.) annually.

Oil and water

One of the owners most recently persuaded of the benefits of water lubricated bearings include Algoma Central Corp. During the recent St. Lawrence Seaway freeze, Algoma took the opportunity to convert stern tube bearings on board the bulk carrier *Peter R Cresswell* to the COMPAC water lubricated system delivered by Thordon Bearings Inc. The conversion included a Water

Seawater lubricated propeller shaft COMPAC bearing replacing metal bearing lubricated with oil

Quality Package (designed to ensure that abrasives are removed from the seawater and to provide a consistent flow of water to the bearings), Thor-Coat shaft coating (to ensure the mild steel shaft stays free of corrosion), installation of bronze shaft liners (to operate in way of the bearings), and Thordon COMPAC propeller shaft bearings.

Scott Groves, Thordon Bearings Area Manager Canada/Western USA, said that the conversion process involved the removal of the shaft, existing oil lubricated bearings and oil header tank. The installation included bronze shaft liners, Thor-Coat shaft coating, fitting COMPAC bearings, Thordon Water Quality Package and a new forward shaft seal.

Using the COMPAC system, seawater is taken from the sea, pumped through elastomeric polymer shaft bearings and returned to the sea. No stern tube oil is needed. New materials and designs of non-metallic bearings now offer performance similar to metal shaft bearings with a life expectancy of 15 to 20 years, said Mr. Groves, The 30,735 dwt self-unloading ship, built in 1982, was converted at Canada's Seaway Marine & Industrial Shipyard, as part of a 12 week overhaul project involving five year survey and hull work.

Al Davies, Director of Operations, said that *Peter R Cresswell's* oil lubricated stern tube bearings had become increasingly problematic. "The whole environmental issue became a source of grief with Transport Canada. As a company we are part of a collective programme to introduce green marine policies, extending across emissions, ballast water management, grey and black water discharges. It's pretty clear that the end game will be no discharges allowed at all, and we

Peter R Cresswell dry-docking March 2010

have bought into a process that is externally audited by Lloyd's Register. The initiative with water lubricated stern tube bearings is an example of that commitment. If anyone asks what we've done for the environment; well, we can say this."

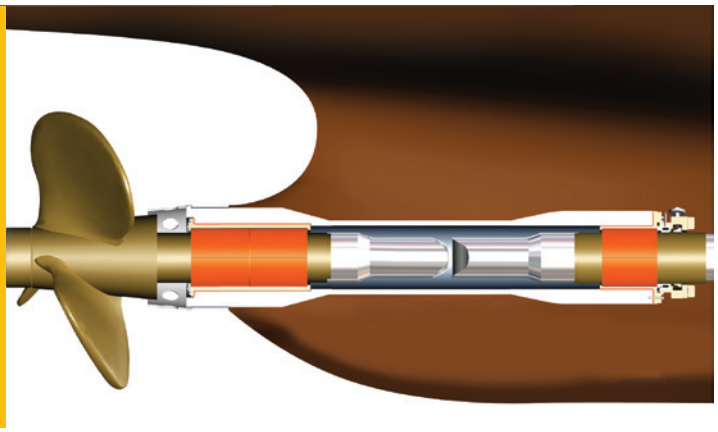
"Essentially, there came a point when the ship's stern tube bearing was getting tired and we knew that the tail shaft had to come out anyway. With Thordon half an hour away and the yard 10 minutes down the road, it seemed like a good opportunity to take another look at this solution. We already had experience of what Thordon could do on the ship *Quebecois*, where 10 years ago we replaced the bearing system because of reports that lignum vitae would not be available anymore. We knew that the COMPAC system worked, and the closed system meant that we had the lead time to order the liners."

Thordon Water Quality Package provides a controlled environment and removes abrasives from the water improving bearing wearlife and ensure a constant flow of water

Mr. Davies added that selecting bio-degradeable oils did not offer a viable solution. "Bio-degradeables are considered a discharge because of the sheen they leave. Even using those products, we would be required to notify Transport Canada if there was a discharge and they could stop the boat with no knowing of when they would let you go. The presumption is that you're guilty right off the bat." "Of course, one significant difference with using elastomer bearings is that the mild steel propeller shaft requires corrosion protection from seawater," Mr. Groves acknowledged. "This may mean a higher up-front cost for the water lubricated stern tube bearing system, but the elimination of aft seal maintenance means that the up-front costs are recouped in lower in-service costs along with no aft seal damage worries, no stern tube oil costs and no oil pollution risk (fines)."

Mr. Groves explained some of the key considerations owners should address when contemplating stern tube bearing conversion to water. Questions that needed answers straightaway included whether the new arrangement would actually fit in the space provided. This requires a review of the existing shafting and sterntube arrangement drawings, if available.

Thordon Thor-Coat shaft coating protects against corrosion



COMPAC Seawater Lubricated Stern Tube Bearing System

The planning required to convert a vessel includes a review of the existing oil system to determine what modifications are required, if any, to fit a water lubricated system.

Owners may also have to accept planning for conversion well ahead of any expected docking. "The longest lead-time items for such projects are the shaft liners," said Mr. Groves. "The number of foundries that can manufacture centrifugally cast single piece liners is limited and there is normally a 6 to 8 week lead-time to obtain these castings."

Mr. Davies said, "Thordon performed all of the measurements and clearances on *Peter R Creswell* without any issues, LR approved all of the drawings within the envisaged timeline. Since going back into operation in March, the ship's performance has been going well." Even so, Mr. Groves said that, increasingly, owners of older tonnage were seeing the switch to water lubricated bearings as a maintenance, as well as a green issue. The shallow waters of the St. Lawrence Seaway placed restrictions on navigation, with high potential for vessels to run aground, damage their blade tip and their oil lubricated shaft seals.

"The amount of manoeuvring in confined water can bring ships close to the bottom," said Mr. Davies. "Mud, debris, obstructions and ice conditions, and even rogue nets, can cause blade damage and subsequent seal failures."

"The water lubricated bearings available today from Thordon offer the same lifespan as an oil lubricated solution, but owners avoid the prospect of having to be tugged into port in the case of an oil leak," said Mr. Groves. "That means both expense and lost revenue due to downtime are avoided."

Encouraged by the results on board the *Peter R Cresswell*, Mr. Davies said Algoma was considering a new conversion project, this time involving the 1967-vintage gearless bulk carrier *Tim S Dool*. Other ships were also being considered for conversion.

"We will evaluate every ship due into drydock to see if the conversion is appropriate," he said. "Those decisions will be based on the expected longevity of the ship, and on planning well in advance. But this will surely be part of this year's winter budgetary considerations."

There are over 600 ships equipped with COMPAC water lubricated stern tube bearings, with the first ship converted from oil to water in 1998. Conversions have been on the upswing with four completed in the past six months, including two VLCC's operating out of US waters, a Canadian icebreaker and the *Peter R Cresswell*. NW

Peter R Cresswell sails on the Great Lakes, Canada

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