Stern Tube
Lubricating Oil Discharges
Legalities, Consequences and Solutions

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Overview

- Stern Tube Lubricating Oil
- What is Stern Tube Oil Pollution?
  - Operational
  - Accidental
- Oil leakage legislation
- IMO disclosure
- Consequences?
- Is there a solution?
The Suezmax tanker *Vladimir Tikhonov*, owned by SCF Group (Sovcomflot), passed Cape Dezhnev thereby completing her transit along the Northern Sea Route (NSR).
The Vladimir Tikhonov was escorted by the world’s two most powerful nuclear icebreakers 50 let Pobedy and Yamal following a new deep-water route to the north of the New Siberian Islands archipelago.
Stern Tube Lubricating Oil

• Current Propeller Shafting Practices
  ▪ Over 95% of commercial ships use oil lubricated white metal stern tube bearings

Typical stern tube system has 1500 to 3000 L of oil
Oil Lubricated
Aft Stern Tube Seal
Stern Tube Lubricating Oil

• Oil systems have been used since 1950’s
  ▪ it replaced seawater lubricated wooden or phenolic bearings where shafts were required to be withdrawn ($$$) every 2.5 to 4 years for inspection (safety)

• Advantage for oil system
  ▪ bearing environment controlled
  ▪ higher load capabilities
  ▪ allow condition monitoring
    • oil sampling
    • temperature monitoring

• Oil system allows for the shaft to remain in place without being withdrawn for inspection for 10 to 15 years
What is Stern Tube Oil Pollution?

1) Operational oil leakage (*normal consumption*)
2) Accidental oil leakage
Operational Oil Leakage

• Seal Manufacturers claim drip free operation of 2500 hours or 2 years, whichever comes first for replacement of seals. A typical commercial ship will operate 6000 – 8000 hours per year

• In order for a seal to work it must leak oil, the internal pressure inside the stern tube must be greater than the outside water pressure and it must maintain oil at the mating surface, under the seal lips
Operational Oil Leakage

- Wartsila Propulsion, a leading seal manufacturer estimates...

- The amount of oil leaked from stern tubes into the marine environment under ideal operating conditions is in excess of 10 million litres (2.6 million US Gal) per year

Operational Oil Leakage

Kobelco Eagle Marine Engineering, a leading seal manufacturer states…

“In stern tube bearings, the radial movement of the shaft is considerably larger than that of bearings for general industrial application. In addition, external disturbances such as rough seas and vibration are considerable. It is impractically impossible to seal the stern tube oil perfectly. Therefore, one of the serious environmental issues in medium and large commercial vessels is stern tube oil leakage.”

Accidental Oil Leakage

• Typical causes of increased oil leakage from stern tube seal damage:
  ▪ Fishing nets or rope caught in the propeller
  ▪ Propeller shaft misalignment or bent shafts
  ▪ Aged or worn lip seals
  ▪ Propeller contact with ice or ocean floor
Shaft Seal Damage
Accidental Oil Leakage
Accidental Oil Leakage
Lloyd’s Register reports…

“Defect statistics over the last 20 years indicate that the aft stern bush represents 10% of shaft line failures, with the forward stern bush representing 4% of total failures. Interestingly, the aft stern gland (seal) and forward stern gland (seal) represent 43% and 24% of failures respectively.”

Stern Tube Oil Leakage

Environmental Research Consulting study

“Total annual inputs of lubricating oil worldwide from stern tube leakage and other operational discharges into port waters is estimated to be between 37 million to nearly 61 million litres. If the same rates of discharge occur at sea as they do in port, the estimated worldwide annual inputs of lubricants to marine waters both in ports and harbours and at sea might be estimated to be about four times the port estimate. This assumes that each vessel spends, on average, three days at sea for every day in port.

Total worldwide use of lubricants from operational leaks and discharges would then be about 130 million to 244 million litres annually.

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

• Most ship owners and operators believe stern tube oil leakage is minimal and consider the oil lost as “normal operating consumption”

• The only true numbers for stern tube oil leakage can be gained from those ship owners and operators who are also spending money on oil to keep their stern tube in working order
Oil Leakage Legislation
Stern Tube Oil Pollution

- Stern tube oil pollution (MARPOL Annex I) improved detection methods in U.S.A., EU and Canada
  - More investigators and enforcement
  - More anti-pollution tracking vessels
  - Satellite tracking using SAR imagery (EMSA)
- More stringent legislation
  - National Pollutant Discharge Elimination System – NPDES (USA)
  - Bill C-15 (Canada)
  - OSPAR Convention (Northeast Atlantic)
  - Integrated Maritime Policy (EU)
IMO MEPC 60 (Jan., 2010)

• Addressing Marine Pollution from Oil-based Lubricants during Normal Operations
• Presented by WWF (World Wildlife Fund) and FOEI (Friends of the Earth International)
  ▪ Specific concerns over discharges of lubricants below the waterline from stern tubes and thrusters, since these are almost impossible for authorities to observe.
Development of a Mandatory Code for Ships Operating in Polar Waters

- Discharges from shipping during regular operation in polar areas (submitted by Norway)
- DNV Report for Norwegian Maritime Directorate
  - Presented at IMO DE 54 (Aug. 2010)
  - Conclusion:

*As a potentially relative large source of operational oil discharge, however still not effectively regulated and of unknown exact magnitude, stern tube leakage should be addressed as a particular environmental aspect in the polar environment as well as in other areas. Of particular importance under ice operation is the potential for especially high leakage rates, and the proximity to ice with regards to deposition of oil.*
What are the Consequences?

Stern Tube Oil Discharges
Stern Tube Oil Pollution

• Stern tube oil pollution from seal damage is a growing concern for ship owners
  ▪ Costly to repair seals (US$150,000)
  ▪ Criminal fines or jail terms for ship crew, manager, and owner
  ▪ Loss of contracts or permits
  ▪ Bad public relations or insurance problems
Can ship owners and operators prevent stern tube oil pollution (STOP) from occurring?

...YES!

There is a Proven Alternative To Avoid This
History

• Seawater as a lubricant dates back to earliest days of shaft driven propellers

*lignum vitae* seawater lubricated bearings
History

• Navies used seawater lubricated rubber and *lignum vitae* propeller shaft bearings

• WHY?
  ▪ Non-catastrophic safety mode

• If ship is hit and shaft seals are damaged (oil leaks out or seawater leaks in). The ship is stranded!!!
Seawater Lubricated Propeller Shaft Bearings

• Technical equivalence
  ▪ Viable alternative to oil lubricated white metal propeller shaft bearings
  ▪ Proven operational performance
  ▪ Advances in monitoring techniques

• Eliminates stern tube oil & pollution risk
Thordon COMPAC Bearings

Thordon COMPAC bearings fitted in bronze carrier with internal tapered keys
Thordon Seawater Lubricated Propeller Shaft Bearings

Over 2,000 vessels with Thordon propeller shaft bearings installed.
**Alaskan Frontier** equipped with COMPAC since 2004

BP / Alaska Tankers (U.S.A.) 4 twin screw oil tankers (185,000 dwt) built at NASSCO (U.S.A.) from 2004-2006, equipped with COMPAC prop shaft bearings
COSCO (China) – 3 Car Carriers (56,000 GT) equipped with COMPAC seawater lubricated propeller shaft bearings (2009-2010)
UAL Texas equipped with COMPAC since 2002

Flinter Gronigen (Netherlands) - 28 ships equipped with COMPAC specified by owner. First 3 ships done in 2002
Gypsum Centennial
equipped with COMPAC since 2001

2 U.S. Gypsum Corporation (U.S.A.) 50,000dwt bulk carriers - equipped with COMPAC.
Gypsum Centennial (2001) and Gypsum Integrity (2009)
B.C. Ferries (Canada) – 5 ferries equipped with Thordon seawater lubricated COMPAC propeller shaft bearings since 2003
Seawater Lubricated Stern Tube Bearings

- Carnival Corp. – world’s largest cruise ship owner

Carnival’s Corporate policy for future vessels:

Fixed pitch propellers and water lubricated Thordon bearings on Inconel journals.
Seawater Lubricated Stern Tube Bearings

*Grand Princess* equipped with COMPAC since 1998

Carnival Corp. (U.S.A.) – 14 Cruise ships (108,000 to 115,000grt) equipped with COMPAC. Two more on order.
Existing Vessels: Converted from Oil to Seawater
Seawater Lubricated Propeller Shaft Bearings

• *Eliminate* stern tube oil pollution risk

• Provide technical equivalence
  ▪ Viable alternative to oil/metal systems
  ▪ Installed on over 2000 vessels to date
  ▪ 15-20 year bearing life
Environmental Leadership in Marine Bearing Technology

Questions?

Thank you!