Date: August 26th 2013
Vessel: Superhib -07, operated by Dutch Caribbean Coast Guard, Aruba substation.
Project: Reduction wear on Volvo- Penta Engines and stern drives
Started September 2012
Ended June 2012

The Dutch Caribbean Coast Guard uses Volvo- Penta's counter rotating double propeller stern drives to propel their twin inboard engines. The 900 horsepower, 12,2 meter (40ft) patrol/ interceptor vessels operate in harsh tropical waters. More than 65% of their patrols are done in turbulent and rough sea conditions. Functioning optimally in their vast patrolling area means, frequently going from point A to B at full or near full throttle speeds. Being airborne and forcefully entering the waves again is devastating for the propellers life span. The so called "search and rescue" missions are also a common task for the multifunctional coast guard crews.

Low speed towing is much of the included in their daily workload. This nearly daily routine of slow engine and slow shaft speeds coupled with much torque, takes a very heavy toll on the engine- and gear oils, creating very extreme operating conditions.

Coast Guard Superrhib

Even though premium synthetic blend 80W- 90 gear oil was being used, they were suffering from premature wear which eventually would lead to severely damaged outdrives. The stresses and shock loads made on the two double counter rotating stern drives were so extreme from a lubrication perspective that it would overpower the lubricant system in the outdrives. Furthermore the lubrication passages of the current model used are not designed to accurately handle the extra heat generated by the (load) stresses and speeds the Dutch Caribbean Coast Guard vessels regularly operate with. (continued speeds above 30 nautical miles an hour in rough sea conditions require a more robust and much more costly type of stern drive model, specially in the hot

AR GREEN SUPPLIES LLC,
SABANILLA ABOU 8J, SANTA CRUZ, ARUBA.
297-594-1404 INFO@ARGREENSUPPLIES.COM
WWW.ARGREENSUPPLIES.COM

tropical waters) Consequently the high quality lubricants used could not maintain an effective formation of film oil to lubricate the crucial surface areas involved.

To better deal with this situation, the service intervals were being held at a maximum of 125 to 150 engine hours, instead of the factory recommended 300 hours. During the 150 hour service interval levels, the average stern drive would last around 6 to 10 months. (depending on the amount and type of usage) Upgrading a whole fleet of double engine coast guard superrhibs to a nearly twice as costly Volvo DPR (racing) stern drive system accompanied with the all necessary parts, etc is out of the question, especially during the budget reductions the Dutch government is momentarily facing.

Innovative and resilient as the Aruba substation are known to be, they started looking for alternative solutions on the market. So they searched for a suitable and affordable result to the latter challenges faced.

The primary objective of the hereafter mentioned test was to lower the wear and tear and thus the premature break down of the stern drives and to lower the level of engine alarms that trigger reduced power output. Secondarily to extend the life of the gear and engine oils.

The two-fold test started the 12th of September 2012, first the stern drives were thoroughly flushed and prepared for the introduction of Archoil's AR9100 (10-1 ratio). Archoil's AR9100 was chosen for its excellent shock absorbing and friction limiting capabilities. For the duration of the tests that lasted nearly 9 months, the Aruba substation consistently maintained +225 engine hours as their benchmark before servicing the stern drives.

Volvo- Penta DPH-C Stern Drives

Although for this assessment much more working hours would be able to be obtained out of the treated gear oil, for this testing period around 225 hours was chosen to start

AR GREEN SUPPLIES LLC,
SABANILLA ABOU 8J, SANTA CRUZ, ARUBA.
297-594-1404 INFO@ARGREENSUPPLIES.COM
WWW.ARGREENSUPPLIES.COM

off with. After each service interval, careful assessment would be made of the quality of the gear oil. What would immediately stand out at first glance, is that no metal shavings would be present, something that before undergoing this test would normally be visually present.

The Dutch Caribbean Coast Guard uses Volvo's D-6 370 engines, that are super-charged (for low end torque) and turbo diesel (for high end power) depending on the load and engine speed. This coupled with the strenuous operations they are made to undergo, takes a toll on the quality of the engine oil. Just as the stern drives the factory recommended 300 engine hours are far from being met. Contamination and temperatures in the engine oil make that costly filter changes and downtime are more often than is operationally comfortable.

The viscosity of the heavy duty 15-40 engine oil would drop early on in the oils lifecycle to alarming levels. At or around 100- 120 engine hours the fully computerized operating system would trigger alarms related to viscosity problems, sometimes even for rising temperatures. (causing higher levels of soot) The ECM pre- programmed to save the engine from catastrophic failure, would reduce the throttle in the most inopportune moments. All this and the extra soot being produced made the engine oil would have to be replenished soon afterwards.

Volvo- Penta D6- 370 Engines

Just as the AR9100 remedied and extended the life of the gear oil in the stern drives, the AR9100 introduced at a 1- 20 ratio with the 15-40W engine oil, would extend the oil to +225 engine hours. Using Archoil's AR9100 would make sure that all the way up the new service interval no engine oil related alarms would be triggered anymore.
Again more life would be able to be safely squeezed out of the engine oil, but for the purpose and practicality of this test, a conservative +225 engine hours had been maintained.

AR GREEN SUPPLIES LLC,
SABANILLA ABOU 8J, SANTA CRUZ, ARUBA.
297-594-1404 INFO@ARGREENSUPPLIES.COM
WWW.ARGREENSUPPLIES.COM

Archoil's patented potassium nanoborate lubrication technology was developed as a solid boundary lubricant to replace outdated and toxic anti-wear additives common in today's lubricants

Boron lubrication technology was initially developed at the Argonne National Laboratory for the US Dept. of Energy. From this research AR9100 was developed, a combination of nanoborate and complex fatty acid esters which liquefy all deposits in the fluid system – carbon, varnish and sludge allowing for the Nanoborate solid boundary layer to chelate to the deposit free host alloy, filling in all asperities, and creating a high load surface as an extreme pressure agent. Boron is known for its hardness and commonly compared to diamond.

AR9100's base is composed of 4 complex organic esters which is formulated to clean all deposits and facilitate the migration of the protective boron nanoparticles to surface metal.

AR9100's surface friction coefficient tests at 0.037. It is far more lubricious than traditional lubrication oils, and it is capable of bearing loads many times that of other solid boundary lubricants.

AR9100 is highly concentrated. Dilute in standard lubrication oil as directed for the specific application.

The strong bonding between the layers prevents direct contact between metal sliding parts, minimizing wear. Nanoborate does not separate, nor needs longer bonding times to the metal as the former boric acid did. The surface created also prevents oxidation.

These bonds are so strong that pre-existing dirt, rust and carbon varnishes are displaced. These virtually indestructible bonds literally change the metal surface's characteristics and create a self healing friction barrier. This translates to extremely low-friction coefficient (under 0.038 percent) between the platelets and the metal surfaces they separate.

To handle the premature wear with the counter rotating double propellers on the sterndrives AR Green Supplies has chosen to use nano-borate lubricants. Archoil AR9100 nano-borate friction modifier forms a molecular bond with the metal surface, developing a lattice structure with strong anti-corrosive properties and reducing the friction between metal surfaces significantly compared to conventional lubricants and fluids. Once in place, the lattice structure no longer depends on the carrier (fluid) and remains in the metal, despite the possible contamination and water that can pollute the fluid. The metal now is protected for a long time from scuffing (welding), seizure (shearing), threadwelding (galling) or corrosion (pitting). Wear of the parts is prevented

AR GREEN SUPPLIES LLC,
SABANILLA ABOU 8J, SANTA CRUZ, ARUBA.
297-594-1404 INFO@ARGREENSUPPLIES.COM
WWW.ARGREENSUPPLIES.COM

by the lattice structure that provides a coefficient of friction of <0.038 and withstands pressure up to 4000 kg per cm2. (ASTM D3233 test)

The carrier of the chemical process is an Archoil patented ester. Because of its high detergency, parts cleaning can be reduced. The ester can be used in water-reducible formulations and is particularly effective in invert emulsions. AR9100 has a very good reputation when it comes to wear-protection properties and is completely stable. There is no loss of viscosity. This provides a much longer lubrication intervals, especially advantageous in bearings or where no change or addition is possible. This perfectly seems to fit the situation as is the case with the engines and stern drives of the Dutch Caribbean Coast Guard vessels.

Archoil AR9100 does not hold solids and in combination with the nano-borate formulation keeps the dirt and heat away. Lastly, the AR9100 ester matrix is biodegradable, non toxic or acidic. This also is an advantage as today we see many EP-packages greases and oils, such as PTFE, molybdenum, sulfur, graphite, phosphorus, lead, antimony and phenols that are heavily contaminating the environment they work in.

The final conclusion after having tested the stern drives that already were approximately 3/5 into their lifecycles is a very positive one. The use of Archoil's AR9100 has more than doubled the usable operational life of the stern drives, whilst easily extending the service intervals with rates nearing 75%. The use of Archoil's AR9100 friction modifier has upheld the viscosity of the engine oil and even lowered the emissions of the engines. A pleasant side effect of the introduction of Archoil AR9100 is that it makes the engines and stern drives more efficient, thus reducing operating energy requirements and also increasing fuel efficiency. The oil filters that normally are prematurely changed, now work out their intended life span and thus reducing costs. The decibel range of the engines has dropped with 5 to 6 decibels, which makes conversations onboard much more pleasant.

Using AR9100 has provided a generous ROI for the Dutch Caribbean Coast Guard substation in Aruba. Each Volvo- Penta DPH-C stern drive costs a little bit more than 11.000,- Euro's, excluding all the other necessary parts. Using the AR9100 comes at a fraction of the stern drives price. Because the service intervals are extended, the Dutch Caribbean coast guard has also become environmentally more responsible concerning the disposal of engine- and gear oils.

Top speed on these vessels are a guarded secret, but during these tests the coast guard crews managed to raise their top speed in rough seas with nearly 2 nautical miles (3.7km) an hour. All without any modifications etc. only by limiting friction thru Archoil's AR9100.

AR GREEN SUPPLIES LLC,
SABANILLA ABOU 8J, SANTA CRUZ, ARUBA.
297-594-1404 INFO@ARGREENSUPPLIES.COM
WWW.ARGREENSUPPLIES.COM

The deputy head mechanic mr. Hoek, and his right hand, Leonardo both acknowledge to be very satisfied with a smile on their faces. They are very pleased with the accomplished results. “It has saved us a lot of maintenance and downtime, but more than that it has prolonged the operational lifecycle of these engines and stern drives in such a way that it far outweighs anything we first imagined would be accomplishable.

AR GREEN SUPPLIES LLC,
SABANILLA ABOU 8J, SANTA CRUZ, ARUBA.
297-594-1404 INFO@ARGREENSUPPLIES.COM
WWW.ARGREENSUPPLIES.COM