English Translation

Final report AA Project Nova Cura

Date: May 2010
Company: Nova Sea Transport
Senter Novem project number: SMIK09001

Within the framework of Transport and Public Works Subsidy Legislation and the Temporary Maritime Innovations Subsidy Programme, a subsidy, financed by the Ministry of Transport and Public Works, has been granted by the Maritime Innovations Subsidy Programme. Senter Novem is responsible for managing this scheme.

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Brief summary

The AA project proved to be quite extraordinary. In close cooperation with the KVNR and Luykx Ultrasound BV, a unique project – aimed at preventing fouling on the hull of the Nova Cura ocean-going vessel – was completed. Much time was spent doing preliminary investigations into the development of an ultrasonic device strong enough to combat fouling. The pods were hung overboard and hauled back on-board by the crew every time the vessel docked or departed. These pods were hung overboard using long lengths of piping and were linked to the vessel's electricity grid. Over a period of 9 months, we explored various options for the permanent fixture the pods to the vessel's hull. Two visual inspections were performed by the crew of the Nova Cura by means of ballasting in order to raise the bow and the stern. Both times, the hull was found to be free of fouling. The hull was again raised and specialist snorkelling equipment was used for the final visual inspection in the clear waters of Croatia and, after 9 months at sea in the Mediterranean and northwest Europe, the hull was found to still be completely clean and free of fouling. We're now able to look back on an extremely successful project that will benefit the environment and reduce operational costs.

Introduction

Project definition and reasoning

This project was launched 1,5 years after the purchase of the Nova Cura. In May 2008, the Nova Cura took to the water with a clean, touched-up hull. The underwater paint layer was not antifouling, but paint designed especially for icebreaking and thus had no antifouling properties. After sailing for 1,5 years with speed and fuel consumption affected by fouling, the Nova Cura was dry-docked before the special survey. During the last months before the survey, various methods by which to combat the fouling were investigated. Antifouling paint would not be able to withstand icebreaking activities and the icebreaker paint would have to undergo special treatment in order to bond with the antifouling. The antifouling option would also have been extremely expensive and environmentally taxing. We came upon the idea of trying out ultrasound after noting its use in the horticultural industry.

Objective of the project

The objective of the project was thus to prevent fouling on the vessel's hull without the use of environmentally taxing substances, thereby reducing operational costs by enabling greater speed, less fuel consumption and reduced maintenance costs.

Collaboration with third parties

Collaboration took place with Luykx Ultrasound BV, a company that has been applying ultrasound products within the horticultural industry for some time. In addition, experiences were exchanged with Wagenborg, and we came to the decision to initiate this project with the KVNR (Royal Association of Dutch Ship-owners). In conjunction with Luykx, we considered further steps and adaptations of the product for application in the future. As is visible in the photograph below, upon arrival at the shipyard, the entire length of the vessel was fouled by barnacles and other organisms up to a number of metres up the hull. The following voyages were undertaken in the summer of 2009 up to the start of the study:

1. IJmuiden - Porto Nogaro
2. Bourgas - UK
3. Dunkirk - Bordeaux
4. Antwerp - Oulu
5. Kokkola - Fredericia
6. Heroya - Bordeaux
7. La Pallice -Tanger
8. La Coruna - Varna
9. Kherson - Rotterdam
10. Dunkirk - Rouen
11. Dunkirk - Bordeaux
12. Bayonne - Praia da Vitoria
13. Santander - Gdansk
14. Kaliningrad - Ghent
15. Rotterdam - Runskarr
16. Tahkoluoto - Mersin
17. Reni - Bandirma
18. Hereke - Alexandria
19. Damietta-Tarragona
20. Bilbao-Oran

Situation prior to commencement of project

In the photograph above, you'll see the situation after the trips mentioned. Cruising speed and fuel consumption were severely affected. The cruising speed was 11 knots at 90 % pitch power ratio, and fuel consumption was measured at 11 tons per day. The entire hull was fouled with barnacles, seaweed and other organisms. The box coolers were full of barnacles and the cooler ribs were covered in growth. This drastically reduced cooling ability and, as a result, the vessel could not sail at full steam. Even auxiliary motors were affected by the excessive temperatures. The entire hull was high-pressure cleaned metre by metre and was then touched-up using paint without any antifouling properties.

Nova Cura stern prior to the Special Survey 200

Box cooler area prior to the Special Survey 200

Project setup

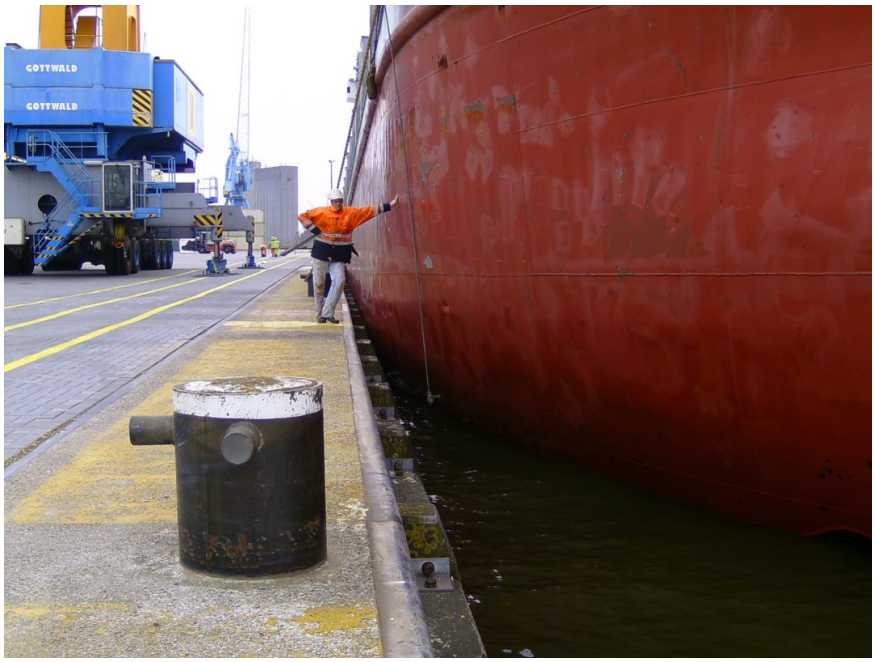
The decision was made to go ahead with the AA project. Special ultrasound pods that emit a specific frequency were supplied by Luykx Ultrasound BV. These pods were hung from simple galvanised tubing on both sides of the Nova Cura, one at the front of the starboard side facing backwards and one at the back of the port side facing forward. Ultrasound pods were also placed inside the box coolers. These pods did not form part of the AA project and were obtained at the expense of Nova Sea Transport. Before these pods were fitted, the box coolers were removed and treated in an ultrasound bath that removed all the fouling, while the cooling tubes were provided with a layer of special paint. The box cooler housings were sprayed clean and painted, and the coolers were refitted.

At the end of the vessel's stint in the shipyard, the hull was cleaned and touched up with normal paint. You'll notice that the ultrasound transmitters (USAF) are placed exactly in the centre of the area most affected by fouling.

Box coolers after cleaning

Subsequently, the following voyages were undertaken:

1. Karlsborg/Rauma-Pasages
2. Marin - Stettin
3. Police - Antwerp
4. Ghent - Marin
5. Dunkirk - Bordeaux
6.Tonnay Charente - New Holland
7. Halsvik - Stettin
8. Klaipeda - Barcelona
9. Castellon - Gijön
10. Vlissingen - Rauma
11. Kotka - Antwerp/Rouen
12. Rekefjord - Kotka
13. Kotka - Savona/Napoli
14. Marseille - Dordrecht
15. Moerdijk - Aalborg
16. Varberg - Terneuzen
17. Vlissingen - Montrose
18. Rotterdam - Mantyluoto
19. Kaskinen - Casablanca + Sfax
20. Ploce – Vlissingen



The above photograph was taken during trip 16 in the Terneuzen harbour. Draught: 1 metre

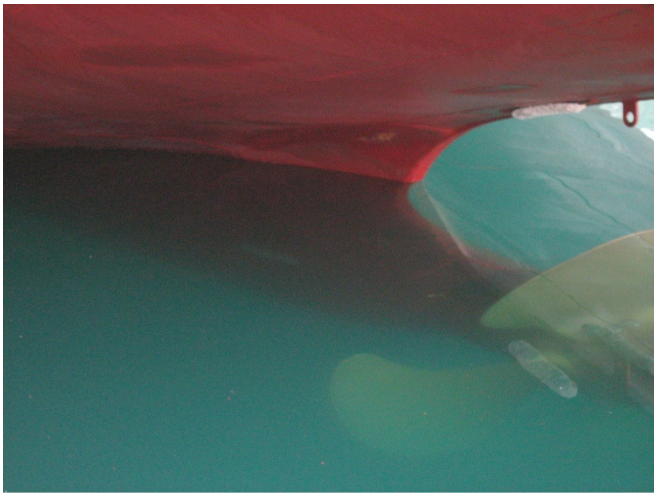
The USAF transmitters were only hung overboard when the vessel was not in motion. While underway, they were not in use, although they were activated when the vessel lay at anchor, provided currents were not too strong. Fouling is generally a problem in the northern Spanish harbours, the Mediterranean harbours, as well as in North Sea harbours.

Project results

At the start of May 2010, a thorough inspection of the current situation was performed in Ploce harbour, Croatia. Due to the particularly clear water, the entire hull was visible. All ballast was pumped out and the bow and stern were raised as high as possible. The areas that weren't fully visible were inspected using specially obtained snorkelling gear.

On these photographs, you'll see the hull around where the ultrasound head was placed. The paint is 9 months old and, within that period, the hull was not cleaned or touched up, but still looks new.

This photograph illustrates the entire bow of the vessel up to the ultrasound pod. This area has thus probably been indirectly – and not directly – affected by ultrasonic waves due to reflection off the quayside or mooring posts, and is completely free of fouling.



The stern, raised to a very shallow draught. The clear Croatian seawater ensured that the hull was well-visible, and it is clearly free of fouling. These photographs illustrate the area around the propeller. The ultrasonic pod was also not directly aimed at this area. It's possible that the ultrasound pods in the box cooler had an effect here due to reflection off the quayside or mooring posts.

Project goals achieved

The above results therefore represent an extremely positive result. After 9 months of sailing - from the vessel's launch on 5 September 2009 to present, including a late summer, a winter and a spring - the entire sub-surface area of the vessel is still free of fouling. The goals have thus been largely achieved. The cruising speed of the vessel was increased and its fuel consumption was decreased, all resulting in more favourable operational costs. These effects were achieved using a system that does not place a burden on the environment. In addition, maintenance costs have been reduce, as have cleaning costs and paint costs. An extremely notable improvement concerned vibration in the vessel. Thanks to its clean hull, vibration was considerably reduced.

Economic efficiency

Calm water cruising speed is currently 12 knots at an 80 % pitch power ratio. This has greatly reduced fuel consumption to approximately 9,5 to 10 tons per day, as opposed to 11. Due to better consumption and higher speed, it has become much more viable to set sail and operational costs have been reduced. Cost-savings can be subdivided into 3 categories. The first 2 naturally depend on one another.

A. Fuel Consumption	B. Speed	C. Maintenance
Fouled hull: 11 tons/day	Fouled hull: 11 knots/90% trottle	Fouled hull: Cleaning costs
Clean hull: 9,5 tons/day	Clean hull: 12,5 knots/90%	Clean hull: Nil
Saving €100 000/annum*	Saving 10 days or €40 000/annum*	Saving: €2000/annum*

*IFO 380 bunker prices May 2010 based on 200 days at sea
*based on a charter rate of €4000 per day
*combined cleaning/painting price estimate

A. Fuel consumption

When compared to the situation prior to the special survey, the saving on fuel is significant. With a clean subsurface area, around 10 % less power is necessary, thereby reducing consumption by approximately 1,3 tons per day. With bunker oil prices at € 400 per ton, this is a saving of € 520 per day. Taking 200 days at sea per annum into account, this is a considerable saving.

B. Speed

The increase in speed with a clean hull compared to a fouled hull at equal power amounted to 1,5 knots. On longer voyages, this will mean that the vessel will definitely be able to load or unload earlier and that, as a result, more voyages will be possible on an annual basis. It is difficult to determine the actual savings possible, though this will clearly make the vessel more operationally efficient. If the vessel can enjoy 10 extra days at sea on an annual basis, this could yield savings of approximately € 40 000 per annum depending on charter rates.

C. Maintenance and the environment

Use of this system considerably reduces the need for maintenance. Much more efficient use can be made of costly icebreaker paint because no more fouling takes place on it. The hull does not require a costly environmentally taxing antifouling layer that loses its effectiveness after a few years and must be replaced. Shipyard cleaning activities can be scrapped or postponed. These costs could amount to approximately € 20 000 on an annual basis. We can also consider the prevention of wear to the engines due to high temperatures. This has not been taken into account in making these calculations.

Applicability

Given these results, this system is ideal for use on all vessels that may be affected by any form of fouling. The entire maritime industry can use various forms of ultrasound to keep box coolers, drinking water tanks, ballast tanks, fuel tanks, etc. clean.

Non-technical points of interest

This concerns ergonomic improvements with respect to the placement of the pods. These would have to be built into the hull. In addition, further research would have to be performed into the reactions of fish and other creatures or the effect on swimmers or divers within the ultrasonic area, although a report by the Hoogheemraadschap Rijnland (Water Board) – which can be viewed via the following link - states that fish are not affected by ultrasound: http://www.visadvies.nl/cms/publish/content/downloaddocument.asp?document_id=58. Another issue at hand concerns possible amendments to maritime legislation and regulations with respect to the use of these systems. Vessels with clean hulls should benefit from lower docking fees.

Information distribution within the maritime industry

These results and information about the product will be made public via maritime magazines, freight offices, websites, the KVNR, shipping digests and word-of-mouth communication.

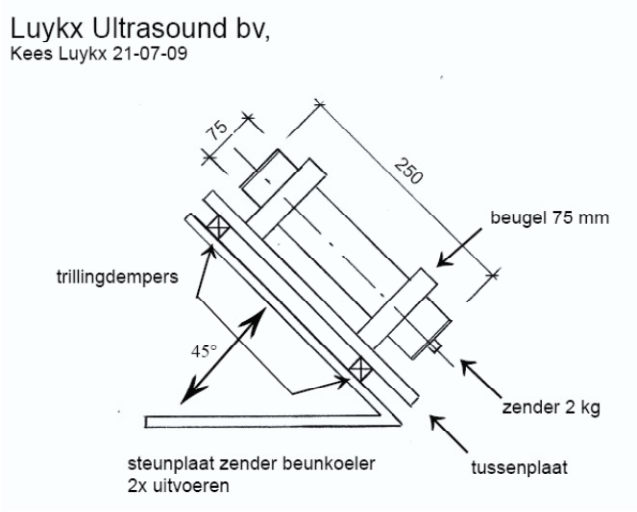
Social interest of project results

This positive result is of great social interest. Vessels will be able to sail without the need for toxic antifouling, meaning that less of a burden will placed on the environment. Less consumption at customary cruising speeds will result in less CO2 emission. There are great ecological advantages to be gained by preventing the spread of organisms via shipping. This largely concerns ballast water and the hulls of vessels. Box coolers can also become clogged with seaweed, algae, barnacles and even (live) crustaceans over time. The continued use of ultrasound can prevent the worldwide carriage of foreign organisms.

Future activities

In the future, the ultrasonic pods could be fitted to various parts of the hull and inside box coolers as part of the shipbuilding process. During this project, the pods were hauled up and down using lengths of piping. It could, therefore, be done much more ergonomically, or the pods could even be built into the hull. Another possible option could be the use of hydraulic arms to lower the pods below the water surface. A vibration-resistant bracket for use in box coolers has already been designed, positioned in such a way that the ultrasound is radiated into the box cooler at an oblique angle and the signals are thus reflected to all sides.

Ultrasound transmitter USAF®



Ultrasonic emitter bracket system for box coolers

Translation drawing:
trillingdempers – shock absorbers
steunplaat zender beunkoeler – box cooler transmitter support bracket
tussenplaat – mounting plate
zender – transmitter
beugel – clamp

Unfortunately, it is possible that this report is subject to a certain amount of bias. During the initial period before the Special survey, the Nova Cura spent most of her time in the Mediterranean and did not encounter ice at all. In the time during which the ultrasound pods were use, fewer voyages were undertaken in the Mediterranean and the vessel encountered ice a few times. For definite and irrefutable results that prove the effectiveness of the pods, the vessel will have to undertake multiple voyages in the Mediterranean through the course of a summer. If the hull remains clean throughout such a summer, definitive future steps will be taken, including the development of a CUS (Continuous Ultrasound System) that will constantly protect the hull, box coolers and possibly the ballast tanks by means of ultrasound.

Extensive summary

After a few weeks in Harlingen, the Nova Cura already had a layer of fouling on her hull. Subsequently, a number of voyages were undertaken, including some within the Mediterranean. Since the hull was covered in icebreaker paint without any antifouling properties, the layer grew even thicker. Fuel consumption and speed were noted to be poor. In conjunction with Luykx Ultrasound, it was considered to test an ultrasound system in order to avoid having to cover the layer of icebreaker paint with antifouling. Along with the KVNR, a subsidy from Senter Novem was requested. This was granted. As part of the summer 2009 special survey, the hull was cleaned and touched up with regular paint. Two ultrasound pods were brought on board and attached to long lengths of piping that were used to hang them overboard. Two ultrasound pods were also fitted to the box coolers after they had been thoroughly cleaned. After 9 months' worth of voyages, the results were inspected. In the crystal-clear waters of Croatia, all ballast was pumped out, and the bow and stern were raised as far as possible. The entire subsurface area of the vessel proved to still be clean and completely free of fouling.

The project has thus proved to be a success. There are major benefits to be gained from this technology. With respect to the environment, it results in less pollution of seawater due to toxic antifouling. Engine emissions are cut and there are economic benefits to be gained thanks to greater speed and better fuel efficiency.

Other benefits include less cleaning work necessary, less dry-dock time, lower engine temperatures and a reduction in vibration.

Maritime industry application opportunities include use for the protection of ships' hulls, ballast tanks, bunker tanks, box coolers and drinking water tanks.

The most significant conclusion reached is that, after 9 months, there was no fouling of the vessel's hull. It therefore appears that the system works effectively. We would, however, recommend that a summer is spent at sea in order to obtain an objective view, since a number of voyages into ice were undertaken.

Future steps include the permanent fitting of the pods, adjustments to the ergonomics, the placing of advertisements in maritime magazines and presentations at maritime exhibitions with the aim of marketing the product.