BackfromBlack

True Hybrid Scrubber
Pilot Study

Langh Group Oy Ab

2017

Co-financed by the European Union
Connecting Europe Facility

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LIST OF CONTENTS

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1. Foreword

This report was made in connection with the Action **Back from Black -Study and deployment of the affordable scrubber retro fitting technology for SME shipowners** under the Connecting Europe Facility (CEF) – Transport sector and is thus co-financed by the European Union.

Purpose of the report is to summarise the true hybrid scrubber pilot installations of the Action.

2. Background

The piloting study "True Hybrid Scrubber" formed a substantial part of the CEF Action "Back from Black – Study and deployment of the affordable scrubber retro fitting technology for SME shipowners" (Agreement No INEA/CEF/TRAN/M2014/1032923).

It was based on the product development work of closed loop scrubber that had led to a full-scale prototype installation in 2013.

The background of the project was in the strict sulphur limits introduced to shipping in the sulphur emission control areas (SECAs) on January 1st, 2015. The low sulphur requirements limited to specific geographical areas tend to distort the competition within the European Union by raising the cost of short sea shipping. The competition problem has significant impact on the manufacturing industry in the SECA, as well as on shipping business. Especially small and medium size (SME) shipping companies are under pressure as the needed investments are most challenging in today's economic and financial environment.

Figure 1: The Piloting study was part of a Global Project including the project development, demonstration and deployment phases as shown in the fihure.

The Global Project included the project development, demonstration and deployment phases as shown in the figure on the right, drawn in the phase when the grant application for the Connecting Europe Facility was made.

The True Hybrid Scrubber study aimed to

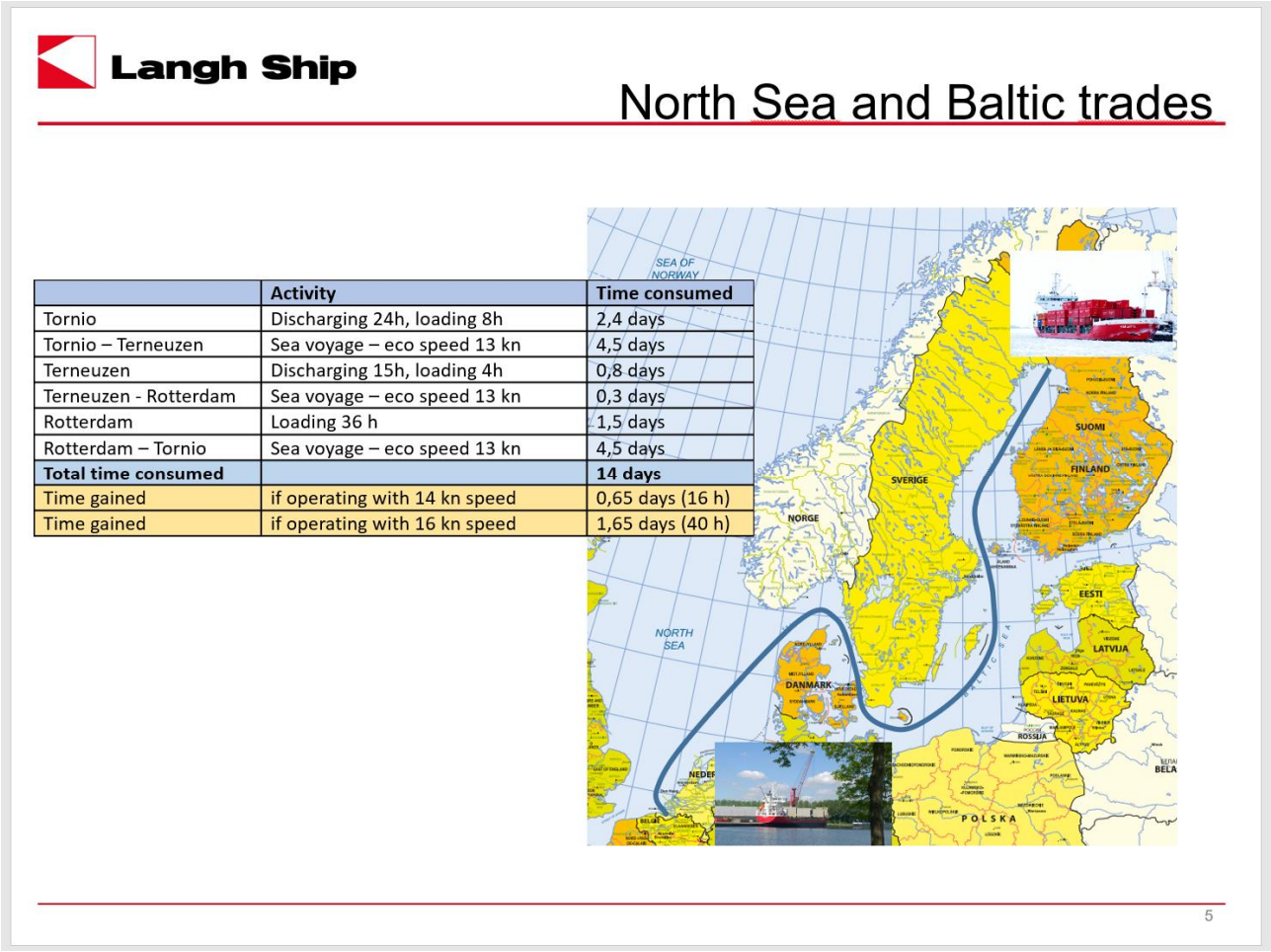
1) demonstrate the technical functioning of a hybrid scrubber that was based on known technology of open loop scrubber and the closed loop system developed by Langh Companies and to
2) turn the scrubber into a standardised industrial product.

3. Creating the true hybrid scrubber

The environment for the piloting was beneficial as the shipping company had developed the closed loop scrubber itself – there was a free access to all information and reaction speed to the information was also very fast.

The vessels were m/s Hjördis and m/s Marjatta, built in Germany in 1996, with Finnish ice class 1 A. The length of the vessels is 120m, container capacity 466 TEU, and deadweight 6526 tdw. The main engine is Wärtsilä 6L46B, 5850 kw.

The pilot vessels were in North Sea and Baltic trades as shown in the picture below. Their normal route was Tornio, Finland – Terneuzen, Netherlands – Rotterdam, Netherlands.



	Activity	Time consumed
Tornio	Discharging 24h, loading 8h	2,4 days
Tornio – Terneuzen	Sea voyage – eco speed 13 kn	4,5 days
Terneuzen	Discharging 15h, loading 4h	0,8 days
Terneuzen - Rotterdam	Sea voyage – eco speed 13 kn	0,3 days
Rotterdam	Loading 36 h	1,5 days
Rotterdam – Tornio	Sea voyage – eco speed 13 kn	4,5 days
Total time consumed		**14 days**
Time gained	if operating with 14 kn speed	0,65 days (16 h)
Time gained	if operating with 16 kn speed	1,65 days (40 h)

Figure 2: The piloting vessels route on the North Sea and Baltic was Tornio - Terneuzen - Rotterdam

4. Installation

The installations were done in connection to a two-week scheduled dry docking, which means a short stay out of service. The working principle of the system is pictured in the next figure. The open loop operation uses sea water and the closed loop operation uses technical water.

The washing water is analysed for pH, PAH and turbidity according to the regulations and the exhaust gas is analysed to find out the SO_2/CO_2-ratio.

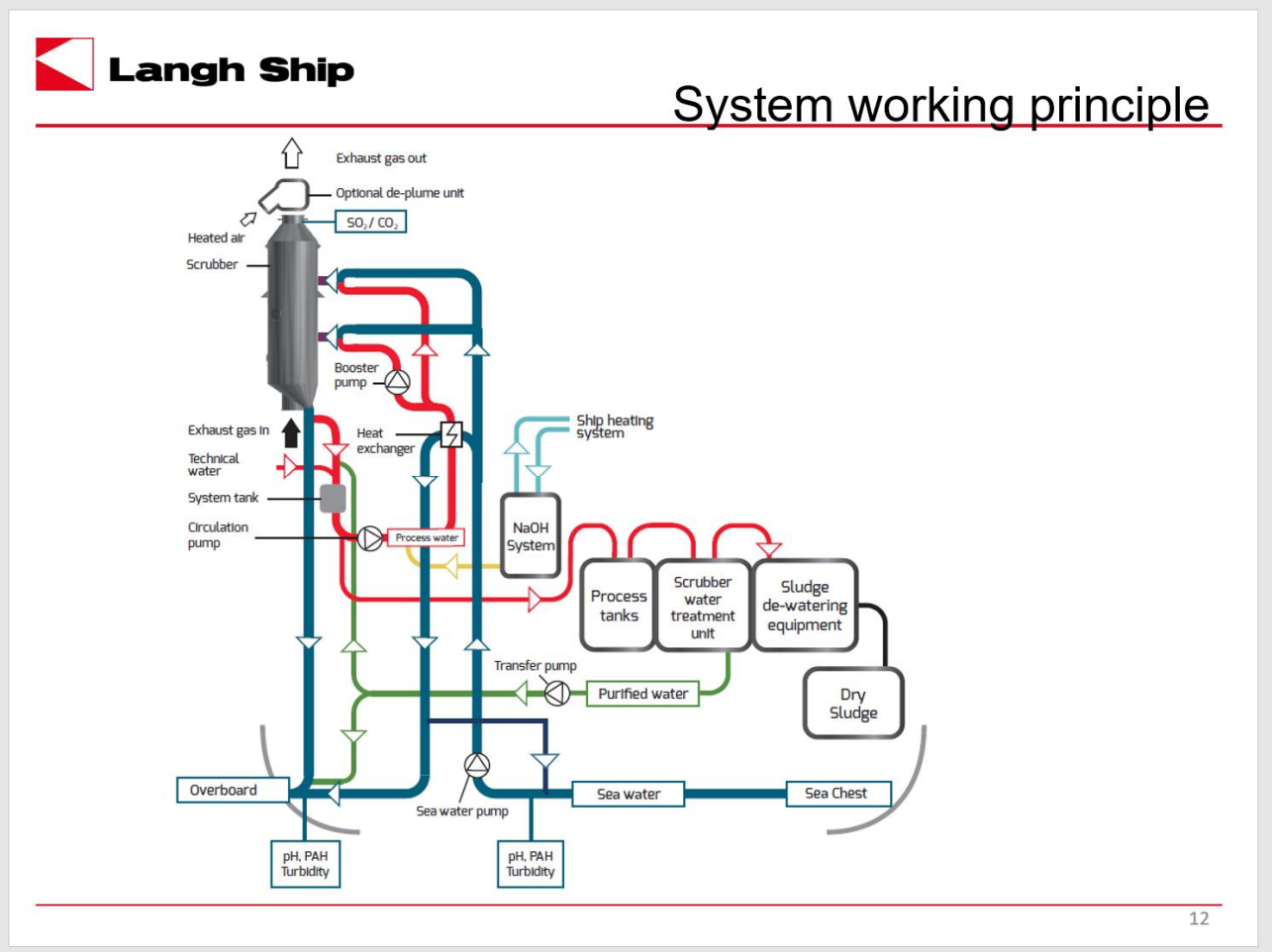


Figure 3: The sea water alkalinity in the Baltic is low and the winter conditions are icy.

5. Meeting the requirements

The new hybrid solution was successful:

- Cleaned water discharge fulfills MARPOL Annex VI
- Class approved system with required documentation
- SO_2/CO_2 -ratio, PAH, PH and turbidity monitoring
- Tamper proof data logging, values saved every 4 minutes and stored for 18 months

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6. Lessons learnt

6.1 Piping Materials

To find correct pipe materials was challenging as the piping must last extreme conditions. Circulation water pH can differ from 3 to 9; water temperature in different scrubber stages can rise from 0 to 250 degrees Celsius. Piping and scrubber towers must also last dry running conditions in case scrubbing system fails for some reason. In this case exhaust gas temperature will rise up to 300-400 degrees Celsius.

Especially in retrofit projects another challenge is to fit the piping into the vessel; pipe sizes differ from DN 15 up to DN 700. As 95% of welding must be done using TIG welding method the construction of the pipeline is extremely time-consuming.

During the Project various stainless-steel alloys were tested. Some parts of the pipeline had to be replaced after a short testing period as the carefully selected material proved to be inaccurate in reality.

One of the most difficult system part is scrubbing water discharge line. The Designer is in front of difficult choices. The main demands to this pipe section are:

- Material must last warm low pH value sea water.
- The piping must be as short and straight as possible.
- Space inside the ship is always limited and oversized pipes make construction much more expensive
- The size of the pipeline must be chosen in such a way that in all circumstances the discharge water goes freely overboard, regardless of the depth of the ship or bad weather .
- Discharge water quality monitoring must work regardless of the water amount that passes the pipeline.

In practice, it was not easy to fulfil all these demands. In the end Stainless steel alloy SMO turned out to be suitable. This alloy fulfils all demands; on the other hand, it`s expensive material and hard to get.

6.2 Sensors, gas analysers

There are many Gas analyser makers in the market. According to their working principle they are divided into two groups:

- Optical gas analysers
- Gas absorbing and measuring analysers

Both mentioned systems haves proven their reliability. Main differences between these systems are the price and maintenance range.

Based on experience, however, the crucial thing is to find the right spot for the analyser. To avoid problems with analyser and to ensure correct gas concentration readings, exhaust gas needs to be

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as dry as possible after leaving the scrubber tower. Wet gas causes problems for both types of gas analysers and can lead to inaccurate measured gas concentration results.

Since gas analyser is the main system component that indicates whether the scrubber system is working like it should, inaccurate results are dangerous. If for some reason gas analyser fails, ship has to switch over to SECA compliant fuel, which brings economical losses to the shipowner.

System sensors in general need to be carefully chosen. Again, the most challenging part is to find the ones that meet all the demands. Sensors must also have certificates approved by the Classification societies and are sometimes hard to find from the market in the same time as the delivery time may be long. All scrubber system parts are in general expensive and ship owners do not want to consider a proper spare parts stock onboard.

6.3 Level of automation

Level of automation depends on the structure of the system and on shipowner`s needs. Automation program starts and stops the scrubber system and monitors and saves the desired system parameters. Automatic data logging program is running continuously, and system values can be and presented to Port State Control and other institutions whenever needed.

Well-designed automation system drives the system and blocks activities that could compromise the operation of the components or operation of the system. However, the program does not completely replace people and the user must be familiar with the design and operation of the system with finesse.

6.4 Droplet separation (demister) to avoid extensive amounts of white smoke

Droplet separators are used in the upper part of the scrubber tower to catch from gas evaporated water as much as possible. Depending of tower design, the demister is installed vertically or horizontally inside the scrubber tower.

The demister must be designed separately to each ship depending on the gas flow speed. The better the demister works, the smaller is the chance that the gas analyser will encounter problems. A well-functioning demister saves also valuable “closed loop” system water, which would otherwise evaporate through the exhaust pipe and rain on the ship`s deck.

7. Port state controls

The port state controls have become stricter during the period. In the beginning of 2015 the authorities asked, if the captain knows the sulphur limits, in the end of the same year they already wanted to see the scrubber and took bunker samples. In 2016 the authorities presented various scrubber related questions during the port state controls and in the beginning of 2017, they asked to see the datalogger readings. It is also known that in 2017, one vessel was fined for operating in open loop in Germany.

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8. Thank you

In the end we can conclude that the piloting projects have been successful.

The projects have led to a competitive and environmentally friendly solution to sulphur emission regulations. The new product is affordable also as a retrofit improving also the SME shipping companies' possibilities in striving to survive in the harsh competition. When enabling the use of the more economical fuel, the system eases the transportation issues of the manufacturing industries especially in the island-like parts of the Baltic Sea.

And, of course, the piloting has laid a bottom to new business creating new sales for European designers and manufacturers. It has even created exports outside the European Community.

The Global Project that started from a single shipping company's necessity to answer to the new sulphur legislation has now, with the help of European Commission, led to new jobs, new business, cleaner environment, and new competitiveness of the European marine cluster.

Without the support of European Union, the project would not have been possible, and we want to thank for this. On the documentation side, there has been quite a lot of work to be done. As the project was the first one in its kind for the project coordinator, there was lot to learn, too. The guidance from INEA has been kind, informative and patient.

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