July 10, 2013

MV Hoegh America - Proof of Concept Experiment - Final Report

The use of a Hydropath MARINE system on a fresh water generator unit

Abbreviations

FWG = Fresh Water Generator

EJB = Electrical Junction Box

MT = Metric Tonnes

A. Client

Ray Car Carrier Ltd.

APV (FWG manufacturer) was informed of the experiment and will be provided with a full report.

B. Ship's management company

Stamco Ship Management Ltd., Piraeus, Greece

C. Installed system

Hydropath MARINE HM-100, which is powered by the patented Hydropath technology.

D. Purpose of proof of concept experiment

The purpose of this experiment was to verify the overall effect of a Hydropath MARINE system on a FWG unit. The system is designed to prevent the buildup of mineral and bio-film inside the FWG, thus reducing maintenance costs. In some cases, the system can greatly reduce or prevent the use of chemicals.

E. Date and place of installation

December 10, 2012. 0930-1500 hours.

The ship was at the Port of Tyne (UK) whilst installation of the unit took place.

F. Date and place of inspection

June 30, 2013. 0830-1000 hours. Six months from the date of installation.

The ship was at the Port of Piraeus (Greece) whilst the inspection took place.

Figure 1. MV Hoegh America.

G. Fresh water generator (FWG)

The FWG manufacturer is APV. The generator has a production capacity of 25 MT per day when in top notch condition, which rapidly drops due to lime scale accumulation on its titanium plates.

H. Installation of the Hydropath MARINE system

On the day of installation, the FWG was opened, although its indicator did not show any reduction of water production. Last opening and cleaning was conducted during May 2012.

The FWG was treated with chemicals (Liquidewt) on a regular basis by a dosing pump, as instructed by the ship managers. Despite that, on most plates of the heat exchanger it was found that there was a buildup of lime scale which was up to 3 mm thick (figure 2).

Figure 2. Lime scale precipitation on the titanium heat exchanger plates prior to the installation.

According to the chief engineer, the cleaning process typically takes 24-48 hours. This depends on the amount of lime scale accumulation.

The cleaning process is as follows:

1. Plates are dipped in a chemical (Drew Enviromate 2000) and brushed to remove soft dirt and slime (figure 4).
2. Plates are dipped in a chemical (Liquidewt) to soften the lime scale, which is later carved out with a sharp ended tool made of a copper pipe (figure 5).

Figure 3. FWG plates covered with slime.

Figure 4. Left: Drew Enviromate 2000 - multipurpose cleaning. Right: Plate is brushed to remove deposits.

Figure 5. Left: Chemical used to soften lime scale. Right: Carving out lime scale.

I. Goal of proof of concept experiment

The main goal was to significantly reduce labor and material costs, as well as potential damage to the plates during manual cleaning. The secondary goal was to reduce chemical consumption.

J. Installation location

The Hydropath MARINE system was installed on a 4" pipe, providing sea water to the FWG approximately 1 meter before the inlet to the FWG. The system was installed slightly backwards from where it should have been placed, in order to protect it from wetness whilst opening the FWG. The system is connected to an EJB connection / junction box as seen on figure 6. The EJB connection / junction box is connected to the main power cabinet of the FWG (see figure 7).

Figure 6. Left: System installation location. Right: System connected to an EJB connection.

Figure 7. FWG main power cabinet and cable connection.

K. Pre-Installation checking process

1. Prior to installation on the pipe, the Hydropath MARINE system was assembled, off the pipe, in order to pre-check the electric signal. The peak-to-peak voltage was 68-78V AC.
2. The Hydropath MARINE system was installed on the pipe. The peak-to-peak voltage remained similar to the pre-check, which meant the system was not in an electric loop. Note: An electric loop can potentially harm the system's performance.

L. Inspection at end of the proof of concept experiment

1. During the duration of the proof of concept experiment, there was no evidence of change in the water production of the FWG, which remained at 25 MT per day.
2. On June 30, 2013, the FWG was opened for inspection in the presence of the ship managers' superintendent, the fleet manager and the chief engineer of the vessel.
3. When the FWG cover was first opened, the water released was very clear with no mud or signs of murkiness.
4. Most of the plates were found clean and had no lime scale built up on them. On several plates, there were areas with very loose lime scale buildup, which was easily removed with a gentle hand touch or shake-off of the plate and without any chemicals or carving process (as seen in figure 9).
5. The FWG chamber on the sea water side was also clean and contained no lime scale, mud or slime.
6. The entire opening, cleaning and closing process took slightly less than two hours (instead of 24-48 hours).
7. It should be emphasized that during the entire period of this experiment, chemicals were not dosed into the FWG (the dosing pump was disabled).

Figure 8. FWG is opened and cover is removed. Water released is clear.

Figure 9. Some plates had limescale on them, but it was easily removed by hand.

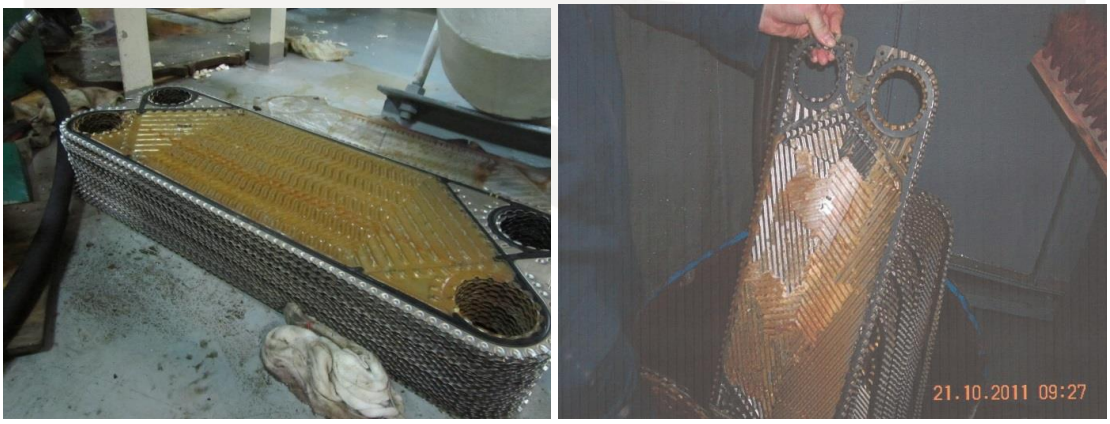

Figure 10. Left: December 2012 - before installation, plates are covered with slime. Right: FWG plates (different FWG unit) treated with chemicals but covered with lime scale and slime.

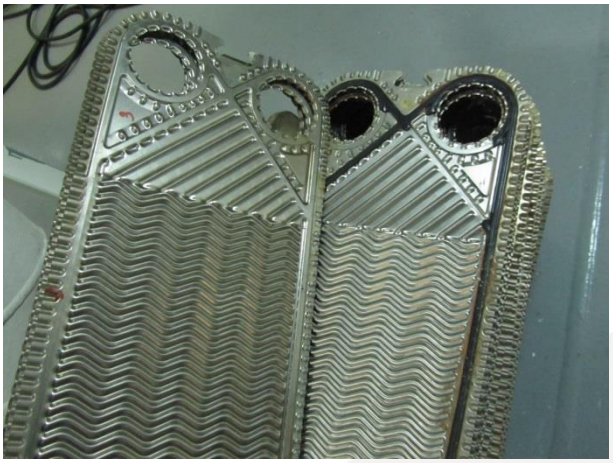

Figure 11. June 2013 - after installation of the Hydropath MARINE system, the plates are clean.

Figure 12. June 2013 - FWG chamber (where plates are mounted) treated with a Hydropath MARINE system, without any lime scale or slime.

M. Results and conclusions

After more than six months of using a Hydropath MARINE system on the FWG unit, the following improvements could be observed:

1. Throughout the experiment period there was no decrease in fresh water production of the FWG (normally production reduces over time due to clogged passages which are attributed to the accumulation of hard lime scale on the plates).
2. During the opening of the FWG, the water released was clear and did not contain any mud or slime, which clearly showed that any live organisms were effectively eradicated by the Hydropath MARINE system.

3. Most of the plates were perfectly clean. A few plates had areas of lime scale buildup on them, with a certain pattern (see explanation below). This lime scale was very loose and was easily and smoothly removed by a hand.
4. The part of the chamber where the plates were mounted was absolutely clean. The part that was not in contact with the treated water was found with a thin layer of scale.
5. The entire cleaning process took less than two hours and did not require any use of chemicals or carving tools that very often cause damage to the plates. A gentle shake of the plates was enough to release the lime scale (see explanation below).
6. The Hydropath MARINE system is a combined solution for both lime scale and bacteria, as it is proven to be effective in bacterial eradication. The sea water used in the FWG contains bacteria which create a layer of bio-mass on the plates. When heating the water to 70°C as part of the water purification process, bacteria are killed and become slime. The eradication of bacteria by the Hydropath MARINE system, prior to FWG, keeps both the FWG unit and the fresh water tank cleaner.

N. Summary

From the results described above, we can conclude that using a Hydropath MARINE system on the FWG proved itself with successful results. It clearly demonstrated that this method of water treatment greatly reduces maintenance costs, equipment damage and chemical usage.

The presence of lime scale on several of the plates is a temporary phenomenon which can be explained as follows:

1. It should be recognized that the Hydropath MARINE system emits a high frequency signal that travels back and forth within the water pipe. Bearing in mind that the experiment took place on a vessel nearing its 10^{th} year of operation, the sea water inlet pipe, leading to the FWG, had already accumulated a considerable buildup of lime scale on the pipe's inner surface. The Hydropath MARINE system, through the emitted pulses, affects the existing lime scale on the inner pipe by breaking it off over time. The broken lime scale pieces traveled with the water stream towards the plates and accumulated there. This can be seen in several photos showing a distinct water flow pattern on the lime scale pieces. This is a very common phenomenon and it can be said with much confidence that had the experiment continued for another month or two, the remaining lime scale would have been also dissolved as a result of the Hydropath MARINE system and thus would have been washed away with the water stream.

2. An additional point to consider is that this particular FWG has been in operation for over 10 years. The titanium plates which would typically have a very smooth surface were full of scratches and uneven surfaces due to years of harsh cleaning. The un-even surface of the plates renders them increasingly susceptible to lime scale accumulation.

3. Another, but not less important, issue is the difference between conditioned water (i.e. water which was exposed to the high frequency signal the Hydropath MARINE system emits) and unconditioned water. When water is treated with the Hydropath MARINE system, the mineral ions (dissolved solids) are clustered and shortly thereafter crystalized when exposed to heat and/or pressure change (i.e. the minerals precipitate out of solution and convert into suspended mineral crystals). This crystallization process prevents the minerals from attaching to the plates as hard scale, and therefore, the minuscule scale buildup can be easily removed from the surface of the plate.

4. Last but not least is the fact that the Hydropath MARINE system emits a unique frequency that eradicates most living organisms in the water. Living organisms tend to create bio-film which can act as a surface for scale to accumulate on more easily. The reduction of bio-film was a factor that most likely also helped reduce lime scale accumulation.