SODIUM HYPOCHLORITE TANK TK-J540A
FIELD INSPECTION

City of Winnipeg – Drinking Water Treatment Plant
PO# 611415

Inspection Date:
16-March-2021

Prepared For:
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Support Engineer

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Report Number:
2021-006 Rev.0

Inspector:
Bon Bacani, CCT-C, C.Tech.

Introduction

Structural Composite Technologies Ltd. (SCT) was commissioned by the City of Winnipeg to conduct an inspection and assess the condition of the Sodium Hypochlorite Tank, TK-J540A. The tank is installed indoors and was cleaned a few days prior to expose the fiberglass surface of the tank.

The tank was fabricated by then Structural Glass Ltd. (now Structural Composite Technologies Ltd.) back in November 2007 and is used to store 10.8% Sodium Hypochlorite Solution (Bleach) as per the WHMIS label attached on the tank.

Original drawing obtained from SCT's drawing database shows that the tank was fabricated as follows:

- Tank Nominal Dimensions: 13'-6" in diameter x 29'-5" High.
- Tank Configuration: Cylindrical with Flat Top and Base.
- Corrosion Liner: 2 plies of Nexus Synthetic Veil followed by 2 plies of 1.5 oz. Chopped Strand Mat using AOC Vipel F010 Vinyl Ester Resin. BPO cured
- Main Structure: Alternating plies of 1.5 oz. Chopped Strand Mat and 24 oz. Woven Roving to the required thickness using AOC Vipel F010 Vinyl Ester Resin.
- Outer Finish: Alternating plies of (2) 1.5 oz. Chopped Strand Mat and (1) 24 oz. Woven Roving using AOC Vipel K022AT3 pigmented Gray.

It is noted that the tank has suffered damage to the lid joint (cracked open) after an over-pressure incident occurred during operation. The lid was repaired on site by a crew from SCT in May 2014.
In 2017, the tank was inspected and subsequently relined and has since been in service until it was shut down for inspection in March 2021.

This report is based on visual inspection findings only. No other technical/mechanical means of inspection or testing was conducted.

General Observations

TK J540A is installed inside the chemical feed building. The inspection was performed on both the inside and outside surfaces to assess the current condition of the tank. The inside was inspected by entering the tank (confined space) and check all accessible areas (eye level) same as the outside. Additionally, on the outside, inspection was possible on the top via access through the building platform. The following were the noted observations:

Tank Inside:

- Based on the original drawing, the tank corrosion liner was fabricated with 2 layers of synthetic veil followed by 2 layers of 1.5 oz. mat. It appears that the reline done in 2017 was with C-Glass Veil, it could not be determined if it was one layer or 2, nor could we determine if there was 2 layers of mat behind the surfacing veil. There was quite a bit of chemical attack and roughness in several sections on the tank wall surface. Further details and photos are shown on the next pages.

- **Corrosion Liner**:
  - ***Tank Lid****:* Appears to be in good condition – white residue from the contents can be seen along the perimeter of the lid as well as the nozzle pads – typical on tanks having the same service.

  - ***Tank Floor:*** White chemical residue can be seen on the floor knuckle. Chemical attack and surface roughness is evident on most part of the tank floor. There are scratches and gouges seen on the floor as if there were metal legs or pipes dragged along the floor.

  - ***Tank Wall:*** The bottom half of the tank wall is observed to have a lot of chemical attack and surface roughness. A significant number of small patches can be seen all over the tank wall (bottom 6 feet). Some of these small patches did not have a surfacing veil on top thus exposing the glass substrate to the chemical. Non-overlapped seams for the surfacing veil were evident – surfacing veil is part of the corrosion liner and therefore it needs to cover all the glass substrate to maximize its efficiency.

The top half of the tank wall looked like it was in good condition and it was confirmed that when the tank is in use, it is mostly only half full. It would be assumed that if the tank was consistently full that you would see the same chemical attack as you see in the bottom half.

- ***Fittings and Downpipes:*** The tank's fittings and downpipes have the same condition as the tank wall with evidence of surface roughness and chemical attack. Small patches with exposed mat can also be seen on a lot of the nozzle pad laminates.

Tank Outside:

- External surface of the tank appears to be in good condition.
- No cracks or signs of corrosion observed.
- FRP Nozzle flanges appear to be in good condition – no cracks found on the face and stub.
- No signs of leak observed from the outside tank knuckle.
- Hold down lugs appear to be intact and no sign of cracking or failing.
- Overall, no issues found on the outside surface of the tank.

Repair Recommendations

SCT recommends that the minimum repair be done for the inside tank wall up to 16' from the floor, floor, and all nozzle bonds and down pipe.

If the plan is to have the tank full more regularly, then we would recommend that the entire tank wall and floor to be relined.

➢ MATERIALS OF CONSTRUCTION

- ***RESIN AND ADDITIVES:***
  - ***Resin:*** Recommended resin to be used to satisfy the requirement for potable water applications will be **AOC VIPEL K022 ACA.** If NSF Compliant is important then we suggest using **AOC VIPEL F010 H2O**
  - ***Resin Promoter:*** To satisfy the chemical resistance against Sodium Hypochlorite and the requirement for a potable water application, the resin should be promoted using **N-Dimethylaniline (DMA).**
  - ***Catalyst:*** Required catalyst to be used during relining is **Dibenzoyl Peroxide (BPO)**.
  - ***Paraffin Wax:*** A paraffin wax additive shall be added to the final resin-rich flood coat only. Acceptable wax additive is **Air Dry 2905**.
- ***SURFACING VEIL AND GLASS REINFORCEMENTS:***
  - ***Veil:*** **2 plies of Nexus® synthetic glass veil** is required for this application.
  - ***Chopped Strand Mat:*** **2 plies of 1.5 oz/ft^2 chopped strand mat (CSM)** shall be used in conjunction with the surfacing veil.

➢ GENERAL WORKSITE REQUIREMENTS

1. Resin should not be promoted at the repair location. This should be done at the fabrication shop. Promoters and catalyst cannot be in contact with each other as this may create a fire hazard at site.
2. The resin temperature should be maintained (as much as possible) between 13°C and 35°C at the time of relining. Care should be observed in catalyzing the resin following the anticipated environmental conditions at the job site.
3. The tank and the work area's condition shall be evaluated before starting the lamination process. There cannot be any moisture on all the surfaces to be relined as this will impede a good adhesion of the new corrosion liner and will cause a lot of rework after. It is recommended that the surface is also between 13°C and 35°C to achieve a good laminate bond. If working in cold condition, it is required to have a heater to keep the environment conducive for the lamination process.
4. An internal access scaffold shall be erected on the inside of the tank to gain access of the tank internal wall – from top and all the way to the bottom floor.
5. The scaffold will be dismantled when all the wall laminate is completed c/w final flood coat.

➢ SURFACE PREPARATION REQUIREMENTS

1. All internal surfaces except for the lid shall be abrasive blasted to expose the substrate of the tank structure.
2. Blast cleaned surface finish is defined as a surface with gray-white color slightly roughened to form a suitable anchor pattern for re-lining.
3. The blasted surface shall be free of all dirt, oil, grease, or any other foreign matter.
4. After blasting, all abrasive and dust shall be removed from the surfaces to be laminated by brushing, vacuuming or some other suitable means.
5. It may be necessary to use a grinder on some other areas that are not accessible during abrasive blasting i.e. scaffold base posts etc.
6. After blasting, any remaining significant pits or crevices >1/16" deep shall be filled with catalyzed filler putty to provide a smooth laminating surface.

➢ FIELD LAMINATION PROCEDURES

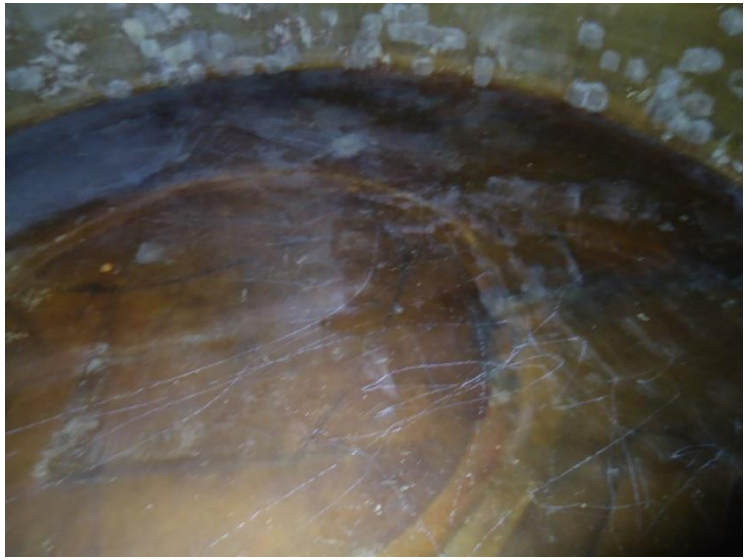
1. Laminate application shall begin from the upper wall section and work shall progress down the tank shell.
2. The floor laminates shall be the last laminates applied – after dismantling the scaffolding.
3. There shall be no contamination (dust, debris, oils, water, etc.) on the surface prior to any laminate applications.
4. Since the lamination work will occur in several sections, the entire application shall be performed in an area before moving on to the next area (below).
5. Lamination resin drips, sags, over spray, etc. shall be removed completely prior to proceeding with application – normally by wiping with acetone while it is tacky.
6. Follow the recommended laminate sequence for the new corrosion liner – 2 layers of 1.5 oz/ft^2 of CSM followed by 2 layers of synthetic glass veil (Nexus®).
7. Let laminate cure – test barcol hardness to resin manufacturer's recommendation.
8. If needed, perform some hand sanding on areas that are rough and where sharp/high points are observed.
9. Apply the final flood coat on the smooth surface to finish off the liner.

POST CURE

1. It is recommended to perform a post cure after all the laminates are completed.
2. Recommended post curing parameters are:
    a. Minimum of 4 hours at 82°C of 180°F
    b. minimum of 6 hours at 71°C or 160°F;
    c. minimum of 8 hours at 60°C or 140°F.

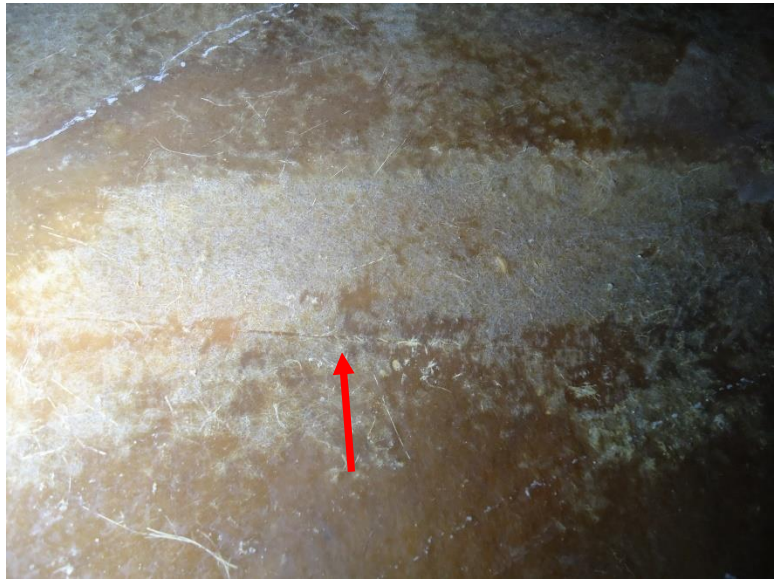
Inspection Photos – Tank Inside

Inside View of the tank lid looking from the tank floor

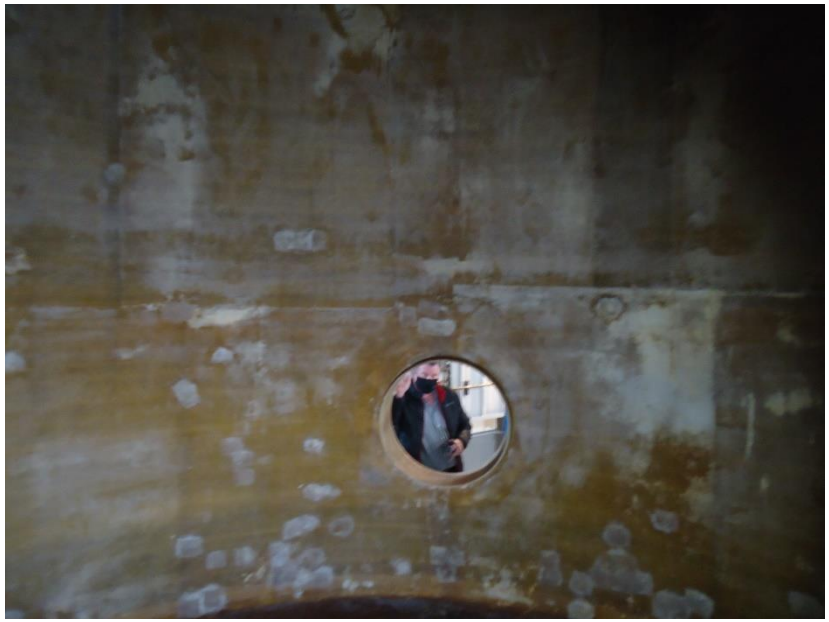


Overall View of the tank floor from the inside

Scratches and gouges on the floor. A small dry patch can also be seen on this photo.



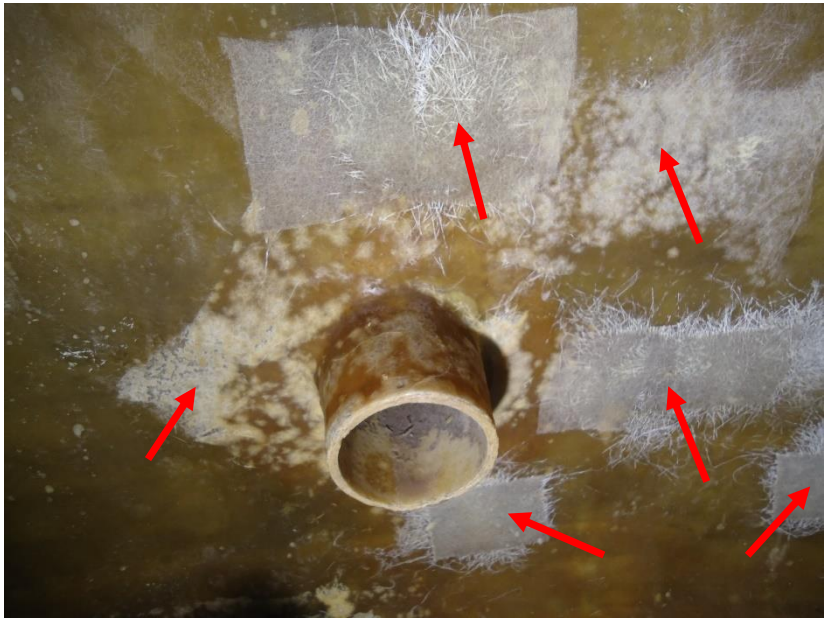
Surface roughness can be seen on most part of the tank floor

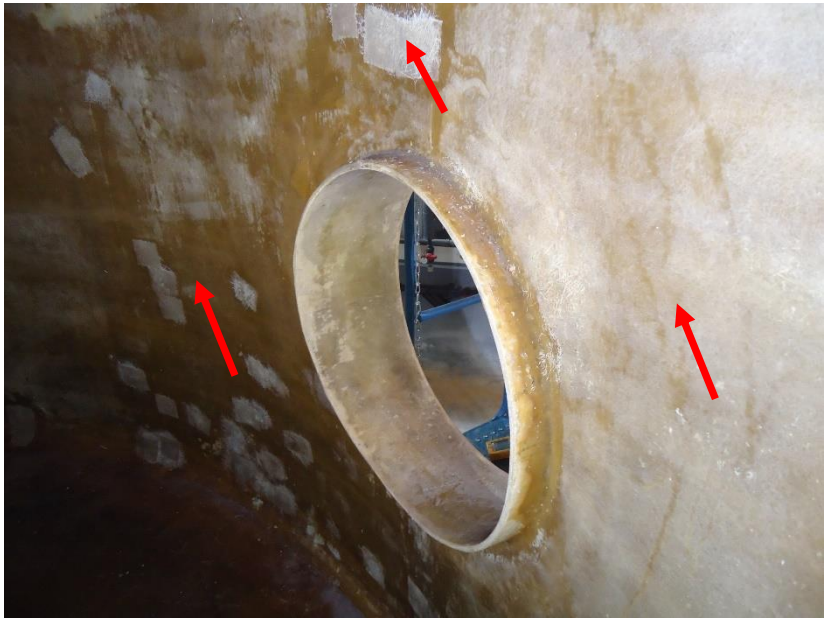


Inside view of the tank lower wall sections




Inside view of the tank upper wall sections





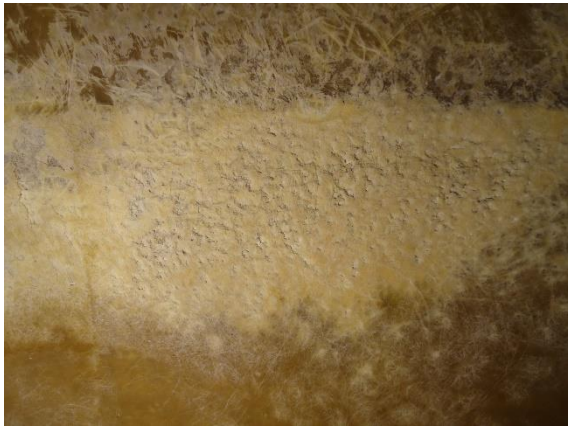
Chemical attack and surface roughness | Exposed mat on patches

View of fittings' inside laminates.

Tank Downpipes

Closer Views of Tank Wall Issues





Chemical Attacks and Surface Roughness





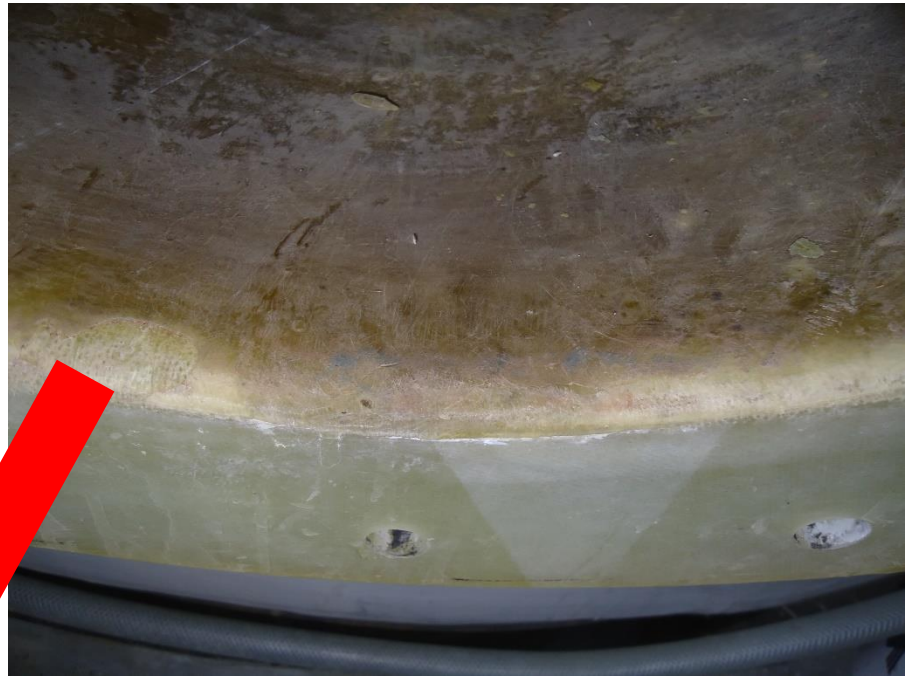


Significant Number of Small Patches | Patches without Surfacing Veil | Exposed Mat on Patches

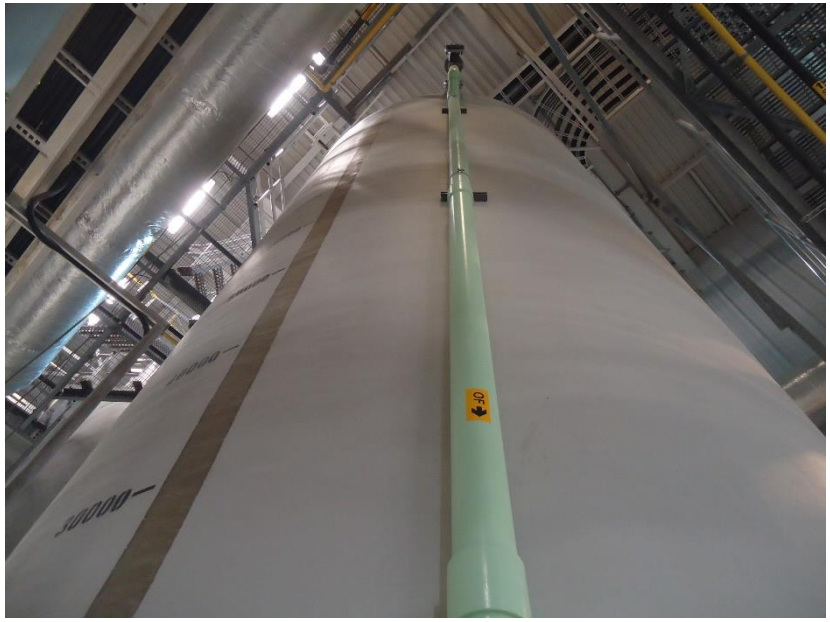


Non-Overlapping Surfacing Veil on Repair Patches

Chipped Resin-Rich Layer on Manhole Stub



Inspection Photos – Tank Outside

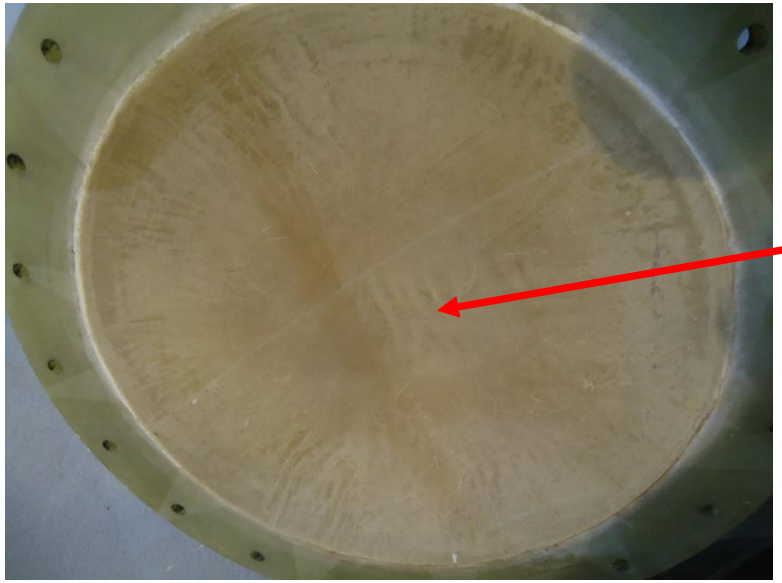


Outside Views of the Tank Wall and Manway

Integral Hold Down Lugs appear to be in good condition | No evidence of leaks seen on the tank knuckle



Flanges as seen from the outside of the tank

Manway Cover requires relining as well

Section Views of Tank Lid Nozzles

Section Views of Tank Lid
Evidence of a recent leak can be seen on the lid but there was no concern on its effect to the tank lid surface.

April 22, 2020

To: Brian Zadro
Sales Manager
Structural Composites Technologies Ltd

From: Michael Siegel
AOC Product Leader – CR/FR Resins

Re: Storage Tank for 11.0% Sodium Hypochlorite

Dear Brian,

For a properly fabricated and cured FRP tank containing 11.0% Sodium Hypochlorite, the preferred resin is Vipel K022-ACA for use in the corrosion liner. Vipel F010-CN is acceptable but Vipel K022-ACA will perform better over the life of the tank based on all available information.

The corrosion liner should consist of 2 plies synthetic veil like Nexus followed by either ECR chopped strand mat or ECR chopped glass roving. The corrosion barrier should be fabricated to a minimum thickness of 2.5 mm or 0.1 inches and cured with BPO/DMA. Studies have shown a corrosion barrier fabricated to 0.2 inches (5 mm) has improved the service life and would be preferred. The use of thixotropic additives is not recommended in the corrosion resin that is used in the corrosion liner/barrier. The structural portion of the tank should also use Vipel K022 or Vipel F010 and using an MEKP cure in the structural portion of the tank only is acceptable.

A requirement for this type of service is that the completed tank be post cured for a minimum of 4 hours at 82C or 180F. The post cure time starts once the entire tank has reached the set point temperature. Also recommended for BPO cured liners, post curing should be performed within a week of completing the tank fabrication. If Vipel K022-AC is used, post curing is a requirement for obtaining the maximum fire retardant properties. This is just another reason why post curing needs to be performed.

Some precautionary statements to help support some of the guidelines listed in the above recommendation. The suggested maximum operating temperature for sodium hypochlorite service is 40C because Sodium Hypochlorite begins to decompose at temperatures over 40C. The decomposition rate of Sodium Hypochlorite also accelerates when the pH decreases and maintaining the suggested pH minimum of 11.0 is recommended for improved service life. Sodium Hypochlorite can be very aggressive to FRP and AOC cannot state what the life expectancy of such a tank should be because of some of the factors outlined in this recommendation.

On behalf of AOC Aliancys, we appreciate your interest in our premium line of Vipel Corrosion Resistant Resin.

Best Regards,

Michael Siegel

Mike Siegel

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END OF REPORT

For all your FRP Inquiries and Needs, please contact:

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