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Sodium hypochlorite is a difficult chemical to handle in fiberglass reinforced plastic composite equipment. Not only are special fabrication techniques required, but the customer should also take special steps in their process to lengthen the service life of the FRP equipment.

The service life of FRP composite equipment can be seriously affected by those conditions that cause sodium hypochlorite to be "unstable". The definition of a "stable" sodium hypochlorite solution is a material which has a half life of at least 1,000 hours. Solutions manufactured and stored under the following conditions should have such an acceptable 1,000 hour half life:

Minimum pH	11.0
Maximum Temperature	75° F
Maximum Metal Content	0.1 ppm
Exposure to Sunlight	None

Sodium hypochlorite that falls outside of the above limits can cause a serious reduction in service life of FRP composite equipment. Such service life could be as short as two to three years.

The temperature of the sodium hypochlorite has a tremendous affect on its stability. The following chart shows this temperature/stability relationship in terms of half life in hours.

Half Life (Hours)

NaOCl	75° F	100° F	125° F
16.5%	2150	150	25
9.2%	6000	1600	350
5.0%	----	2700	1000

In addition, hypochlorite that is exposed to sunlight (ultraviolet rays) has a half life of just 192 hours. When exposed to sunlight, the sodium hypochlorite can quickly become unstable, with severe chemical attack occurring. This is one of the reasons that all bleach bottles are a solid opaque white. The white not only reflects the sunlight (ultraviolet ray exposure), but helps keep the contents cool.

All necessary process steps should be taken to ensure that the sodium hypochlorite is maintained at the lowest possible service temperature. In addition, no metal contact should occur with the liquid stream.

The following fabrication techniques must be employed for all FRP composite equipment used with sodium hypochlorite. These comments apply equally to pipe, as well as storage tanks.

All FRP composite equipment that is being used for sodium hypochlorite service should be pigmented a pure white throughout the entire structural portion of the laminate. This white must be such that the

equipment is entirely opaque. In addition, the white pigmentation helps minimize heat build-up from the sun.

At one time, the conventional wisdom (and our recommendation) for tanks handling sodium hypochlorite was to not use sidewall mounted manways. The earlier FRP composite recommendation was to use top mounted access top manways only, and those manways were to be fitted with Monel hardware. The recommendation was also that fittings and flanged nozzles in tank sidewalls should be kept to a minimum; and side and bottom drains should not be used.

With the advent of more stringent confined space entry regulations, and the need to inspect FRP composite sodium hypochlorite tanks on an annual basis, our current recommendation is that sodium hypochlorite tanks should always be fitted with a minimum 24" diameter sidewall mounted manway. This sidewall manway will allow easier and safe access for inspection and remedial tank repairs.

It is also now recognized that to allow "dry" access for annual inspections and repairs that sidewall bottom drains are probably necessary. All such required FRP composite sidewall fittings and manways should be made and installed with the same resin system, promoters and catalyst, that are recommended for the FRP composite tank wall.

Because of the criticality of sodium hypochlorite service, interior composite welds and layup laminates must be of the highest possible quality, finished with a non-air inhibited top resin coat.

Electro wrap heating tape should not be used as an accessory on sodium hypochlorite tanks or pipe. If necessary, to reduce summer temperatures, and to keep the product from freezing in the winter, insulation should be used as is appropriate on tanks and pipe.

For sodium hypochlorite service, we recommend that a premium grade epoxy vinylester resin (such as the Derakane 411, Kopper's 9100, etc.) be used for the resin matrix.

It has been demonstrated that the use of the higher styrene content epoxy vinylester resins (such as Derakane 411-45 and Dion 9100-05) will provide longer service life than will the lower styrene content epoxy vinylester resins. Unfortunately, many tank manufacturers have switched to the lower styrene resins in order to meet EPA emissions standards. Tanks with those lower styrene resins have shown more rapid attack by sodium hypochlorite services, especially the lower purity chemicals.

Recent testing by the resin manufacturers has also shown that the use of the brominated epoxy vinylester resins, such as Derakane 510-A and Dion 9300 will provide additional chemical corrosion resistance for sodium hypochlorite service. The larger bromine molecule in these resin systems tends to shield the methacrylate linkages of the epoxy vinylester resin from sodium hypochlorite corrosion attack.

Recent recommendations from corrosion consultants are that either de-ionized water or softened water should be used when higher concentrations of sodium hypochlorite are "let down" or diluted with water at the user's site to lower process concentrations. There is compelling evidence that hard water reacts with the sodium hypochlorite - causing it to become unstable and more aggressive.

Ashland Chemical has recently taken the position that they will no longer recommend FRP composites for storage, processing, or conveying sodium hypochlorite unless the sodium hypochlorite is "stabilized" by the supplier. We are in the process of developing recommendations on how to best achieve that stabilization. We will share that information through a future updated bulletin.

As with all FRP composite equipment, one of the keys to long life is the old adage ***"A stitch in time saves nine".*** Many end-users of FRP composite sodium hypochlorite equipment have us annually inspect their equipment to determine its condition and possible need for remedial action. Remedial action, where repairs are indicated by that inspection - are typically then done at that time.

Making small remedial action modifications and repairs on an annual basis will prevent bigger problems from occurring in the future. By waiting to make those early corrective actions the tank or equipment often becomes un-repairable and has to be replaced.

Special laminate fabrication procedures are required for all FRP composite equipment that is to be used for sodium hypochlorite service. These techniques include:

1. The use of a double Nexus or synthetic veil (with a minimum total of 30 mils thickness) in the inner corrosion barrier. Just one layer of Nexus veil is not adequate for this chemical application.

2. Behind the double Nexus interior corrosion barrier must be a full SPI 90 to 100 mil thick fiberglass chopped strand reinforced corrosion liner.

3. The resin used for the internal corrosion barrier and liner should be catalyzed or reacted with a benzoyl peroxide (BPO)-DMA cure system. Cure systems based on standard MEKP catalysts should not be used for sodium hypochlorite service.

4. After completion of the entire vessel or pipe, a separate post-cure must be used. This post-cure can be either by use of steam, or where the tank and/or pipe is put into an oven and thoroughly post-cured. This post-curing at elevated temperatures must occur for at least 16 to 20 hours at 160° F, or from four to eight hours at 180° F.

Typically, PVC pipe is used for sodium hypochlorite service. We understand that PVC pipe typically provides good service life for sodium hypochlorite. Obviously, PVC pipe is significantly less expensive than FRP composite pipe.

However, if there are other circumstances that dictate the use of FRP pipe - such as its ability to handle mechanical abuse, higher pressures, long spans, etc. - you may want to consider the option of using FRP armored or overwrapped PVC pipe and fittings. In the last two years, we have built significant quantities of such FRP armored PVC pipe for similar services. The armored PVC product has been performing extremely well. This dual laminate combines the best of both worlds; using the PVC as the internal corrosion liner/barrier and the FRP as a structural portion of the wall.

With this approach, there is no need for the Nexus corrosion barrier followed by the 100 mil liner, or for the special curing systems and post-cure. The FRP structural laminate becomes just that - an overwrap that provides the strength and mechanical protection. The PVC inner pipe is a completely integral pipeline that handles the corrosive service environment. We can provide not only the armored pipe, but all styles of pipe fittings and flanges with the FRP backing or structural laminate.

Recent case histories of FRP composite tanks for sodium hypochlorite storage have demonstrated that the end user controls the life of their vessels to a much greater extent than had been earlier imagined. Early chemical attack and degradation of FRP composite tanks have been traced back to the end user purchasing low purity sodium hypochlorite.

If the sodium hypochlorite contains high levels of metal ions; especially iron, the sodium hypochlorite half life is much shorter, the sodium hypochlorite is much less stable, and aggressive chemical attack can occur. End users of sodium hypochlorite storage vessels should be encouraged to buy only a high purity product. Dramatic increases in service life of FRP composite equipment can be obtained simply by buying the higher quality sodium hypochlorite.