

## FGD Flake Glass Linings a Proven Success Story

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### Abstract

One thing has become increasingly clear it is a great time to be in the flue gas desulphurization (FGD) business. Federal emission standards are continuing to be ratcheted down coupled with the emergence of the Clean Air Interstate Regulations (CAIR) which has many power producers in North America scrambling to install the infamous scrubber. One can remember the days when these scrubbers were identified as a "Necessary Evil" sucking out profit margins like a huge vacuum. The word scrubber was almost a "dirty word" sighting high maintenance costs, un-reliable on-stream reliability and basically a maintenance headache to anyone who ran one. Well as one might imagine, times are a changing and they simply don't make scrubbers like they used to. These new scrubbers boast increased removal capabilities, use less power and if operated and maintained properly can even add to the revenue stream of the power producer given the current market of SO<sub>2</sub> allowances valued at over 1,600.00 per ton as of March of 2006. While the value of SO<sub>2</sub> credits fluctuate, just like any other commodity one thing is for sure, the SO<sub>2</sub> credit banks are rapidly shrinking.

Like any other commodity purchased in the open market however, it is all about supply and demand. Power producers are under tremendous pressure to evaluate scrubber technology offerings between the major competitors, evaluate technologies, and get the most for their buck as they scramble to meet the next tier for compliance fast approaching in year 2010. These requirements are necessary to meet not only Federal but State emissions limits as well.

### Introduction

On June 1, 1992, all eyes were upon the Pure Air Bailly Station FGD unit. The Pure Air AFGD unit was certainly a one of a kind at that time. The ability to scrub two boilers (550MW) with one absorption vessel and no spare modules for back-up was almost unheard of. Its true all eyes watched as the 1,100,000 gallon vessel that touted a 90% removal rate and was coupled with performance guarantees back to their customer, with a carbon steel flake glass resin liner was destined for pre-mature failure in the eyes of the majority of those related to the power utility industry.

Well, that was about fourteen years ago now and one thing did change. The performance for the MHI grid packed tower not only was able to achieve the 90% removal rate, but since 1996 it has achieved in excess of 95% removal and has remained on-line and available to scrub flue gas with an on-stream availability in excess of 99.85% over the life of the plant. Yes, this was accomplished with a carbon steel flake glass lined absorber vessel, outlet duct and mist eliminator framework that has required less than 2% of the surface area repairs since start up and most of those repairs were outage-related self-inflicted pain caused by mechanical damage. Can you imagine buying an automobile capable of reaching speeds of up to 160 mph and then driving at 160 mph for 10 years with little to no adverse affects on the performance of the vehicle? This feat is exactly what has been achieved at the Pure Air Bailly Facility.

### **Supplier Partnering**

Only after thirteen years of operational experience can one tell you what we know to be the keys to success. First off, if an owner considers vinyl ester flake glass lining as an option for their scrubber they need to align themselves with a proven leader in the industry. This does not necessarily mean those that sell the most vinyl esters, but with those who have a proven track record of operational success. They need to find out if their supplier is committed to the power utility industry. How do they set themselves apart from the competition? What is your supplier's role after the lining is installed? Do they offer inspections of their linings and what is the cost to you? Do they offer real-life experience in the design and specification stages? Anyone will tell you in this business that first-hand experience is invaluable during the system design stages and for months and years of operational experiences to come. One needs to look for business partners not suppliers when considering flake glass resin linings. World-class flake glass resin lining suppliers understand that their customers are in it for the long haul and they need to align themselves with companies who have demonstrated this type of partnering relationship.

### **Specification Stages**

Once you have aligned yourself with your potential vinyl ester lining supplier the next critical element is in the specification stages. The word specification is used in several ways in the coating industry. The term "job specifications" should refer to a written, legal document, usually part of a contract that precisely describes an item of work that is to be accomplished. Many technical organizations prepare documents called specifications that describe products, procedures, or conditions. Process conditions in both a wet and a dry scrubber are unique to each application. Each tank, vessel and/ or ductwork section needs to be treated independently and analyzed for process operating parameters, potential operating excursions, outage-related exposure and owner service life expectations. Only when all these variables are considered will you afford your supplier with the information needed to adequately design your vessels to achieve the same success as was realized at the Pure Air Bailly facility. A typical FGD process vessel should have up to four different corrosion control systems installed. Things such as; process conditions, slurry density, agitation, agitation height and speed, leading edges, impingement, nozzle penetrations and yes geographical location is all taken into account when designing a

world-class vinyl ester flake glass lining system. Each operating component needs to be evaluated independently. This evaluation needs to begin with the end in mind. One needs to consider the affects on the overall operation if they lose service of these tanks due to lining failure during operations. Historically, I have seen much design and engineering effort put into the Absorber vessels, leaving the reminder of the lining decisions being left to the tank fabricators and this can be a recipe for failure. FGD operating components for the most part are inner-linked and dependent upon each other for an overall successful operation.

### **Applicator Evaluation**

Not unlike any skilled tradesman all men are not created equal when it comes to flake glass lining applicators. Some may refer to this as a niche market, but it is imperative that you select suppliers that have a proven track record of success, especially if they are serving as a turn-key contractor that is offering extended warranties. The math here is quite simple, if you are paying the bottom end of the scale for a corrosion control system and are allowing yourself to be given a 1-2 year warranty, what did really expect to get if that system fails a couple of years into operation. Simply put, you got what you paid for. Even worse yet is that you're paying on the high end of the scale for your corrosion control system and you're only getting a 1-2 year warranty, well there is something severely wrong with that scenario. Today's world-class flake glass vinyl ester suppliers can offer warranties that in many cases outmatch their competitors in the super alloy, tiles and rubber-lining markets. Based on the operational data indicated at the Pure Air Bailly Station this type of performance is benchmark across all competing materials of construction. A wise-man once told me that he hated warranties because it was a bad experience for everyone involved. I never forgot that comment and have learned a great deal from it. As an owner make sure your warranty is backed by financial stability, coupled with a company that has longevity in the marketplace. Stick to what you do best, making power and allow those to stick to what they do best and in this case that's turn-key vinyl ester flake glass lining installations. The proof lies in the operational results.

### **Surface Preparation**

The next important part of the recipe for success is in surface preparation. Successful installations exhibit proper construction carbon steel welding requirements. In this case the NACE RP-0178 Comparator "C" or better is required. This is a foundational requirement to ensure proper penetrations of the filler material coupled with a smooth 1/16" radius is maintained on all steel substrate connecting surfaces. Back to back angles during the construction stages should be avoided in all instances. Improper installation of such angles set the stage for pre-mature creation of corrosion cells which will have a direct impact on the performance of your flake glass vinyl ester system. Today's performance metrics for the new technology offerings in the market leave no room for error in this area. This same construction requirement should be enforced for both internal and external steel substrate surfaces. All exposed steel surfaces shall be prepared in accordance with SSPC Surface Preparation Specification SP-5, White Metal Blast Cleaning. All steel surfaces shall have a surface profile in the range of 3 to 4 mils. The

surfaces of heavily corroded steel, containing grooving or pinholes shall be opened up and sharp edges removed through the use of an appropriate mixture of non-metallic, abrasive blast media. The anchor pattern shall be verified through the use of replica tape in accordance with ASTM Method 4417, Field Measurement of Surface Profile on Blast Cleaned Steel. Prior to coating application, the prepared surfaces shall be vacuumed or blown down with clean, dry compressed air to remove residual dust, grit, or abrasives. Surfaces to be coated shall be spot tested for soluble chloride contamination. Chloride contamination levels in excess of 40 micrograms per square centimeter shall be rejected, and require additional cleaning with steam or fresh water to flush away soluble contaminants. Simultaneous coating application and abrasive blasting operations shall not be conducted within the application area. If surface preparation is conducted in sections, no coating may be applied within six inches of the temporary boundary of the cleaned area. All steel surfaces that have been grit blasted shall be coated within the same day. No metal shall be coated that develops visible rust bloom.

The intent here is to remove all mill scale which is a heavy bluish layer formed during hot fabrication or heat treatment of the carbon steel. This profile is a critical step as it is the foundation that serves as the binding surface for the remaining corrosion control system that is about to be installed. In essence your goal is to maximize the surface area required to achieve maximize binding strength. This critical step is further supported by the outstanding world-class performance at the Pure Air Bailly facility. Since commercial start-up on June 2, 1992 they have never experienced a vinyl ester system failure in the 1,100,000 gallon absorber vessel that has caused a forced outage. As a matter of fact the only unscheduled outages have been related to carbon steel rubber-lined process piping failure making up the .15 of 1% of downtime experienced by the Bailly FGD facility. There was one instance in 2003 where there was a mechanical shift of the grid packing tower against the wall where through harmonic vibration a vertical etched hole wore through the wall approximately 1/16" wide by 4" long. A wear-back mechanical patch was installed while on-line and remained intact for 9 months with no other adverse affect on the internal lining integrity.

Successful vinyl ester manufacturers understand the ongoing importance of quality control during the construction stages. World-class vinyl ester suppliers recognize that third party quality control is essential for all parties which includes; the manufacturer, the applicator, and the facility owner. Quality control insures that all required specifications are met on a daily basis. These performance metrics include, proper surface preparations are met, proper mixing ratios, moisture control, re-coat windows to ensure proper cross-linking at the molecular level to eliminate potential inner-coat adhesion failure, and proper DFT readings are maintained. Those who have visited the Pure Air Bailly facility have seen first-hand the many surfaces that still exhibit the original DFT readings that were indicated on the lining surfaces at the time of original installation dating back to December 1991.

### **Maintenance and Inspections**

The final key to success is ongoing maintenance and inspection of any vinyl ester lining system. The Operations Group (Air Products and Chemicals, Inc.) at the Pure Air on The Lake facility have demonstrated the ability to achieve such reliability with the Fuji Resins Flake Glass lined vessel. Each scheduled outage they team with their supplier to perform a detailed inspection of the vessel and associated outlet ductwork. World-class suppliers traditionally offer long-term inspection services for the life of the lining system. World-class vinyl ester suppliers pride themselves in offering this service at no additional costs to their customers. The only requirement for the owner is to get the linings inspector to the work surface. At the conclusion of each scheduled outage Pure Air on the Lake is supplied with a detailed inspection report of all lined areas coupled with a lining assessment and any additional recommendations to the owner to improve and/or extend the life of the lining. The Pure Air Bailly Station FGD vinyl ester supplier has been proven in more than 40 installations in Japan and elsewhere, many in service for more than 15 years.

### Conclusion

The question has been asked of me many times. How long do you expect this lining system to last? My answer remains to be what I know to be fact; it has provided world-class corrosion control protection on the shores of Lake Michigan for in excess of fourteen years and has no indication of lining softening or inner-coat de-lamination. With the proactive approach by the operations personnel at the Pure Air on The Lake facility I see no immediate major lining replacements necessary in the foreseeable future.

In conclusion, properly resin-lined carbon steel vessels and ductwork can be an excellent choice with a proven track record of success. They normally offer the lowest capital cost on an installed basis. The erection is much easier than an alloy or tile vessel. The pricing historically has been less volatile to date. Long-term extended warranties are available. They offer superior performance regarding scheduling impacts during construction. A typical schedule of 5-6 months can be achieved with both the steel shell and lining. Resin lining has a world-wide experience level, while most of the experience is in Japan, ITW Devcon U.S. installations have demonstrated outstanding performance. Resin lining systems offer both excellent corrosion and erosion resistance and are basically unaffected by chloride concentrations affording the power utility industry the fuel blend diversity they require in today's markets. And finally from an engineering perspective they can offer the least cost because they have the most experience with low-cost metal substrates, and many of the existing specifications with the market-leading suppliers are already in place. As one begins the evaluation process the next time you decide to build an FGD ask yourself this question. Would you be happy with a lining system that afforded you to keep your units on-line at a rate of 99.85% for in excess of fourteen years and still going strong with minimal maintenance lining upkeep costs? You may find that a carbon steel resin-lined vessel offers you the reliability you want with a price tag you can live with, and turns out to be the real best value on a total evaluated cost basis.