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And, How Does That Cost Compare To Other Corrosion Resistant Materials?

It seems like almost daily we are asked the question about our corrosion resistant filament wound FRP composite fume duct and stacks: "What Does It Cost?"

And, we have to respond, in turn, by asking: "Which cost are you going to be basing your decision on?". You see, there are really three different cost parameters on which to base that cost decision.

These costs for FRP composite fume duct and stacks include:

A. The initial manufactured cost, as it is shipped from the plant, including freight to the job site.

B. The installed cost of the duct or stack; including job site handling, erection, excavation and placement if buried, joining, supports and guides, insulation, guy wires and anchors, lightening protection, lights, post erection painting and coating, etc.

C. Then, there is the actual cost "per year of service life". This cost could also include anticipated annual costs for remedial action, repairs, maintenance, operating costs, etc.; and the initial installed cost amortized over the life of the fume duct and stack.

The initial manufacturing costs (Item #A), of course, is what the customer usually sees first. We have seen those quoted costs vary as much as 200% on the same supposed project basis. These initial costs differences can vary depending upon the quality of the drawings, how well the specifications are written, and whether the purchaser has pre-qualified those manufacturers quoting on the project. For well written and detailed specifications, and, where the customer will insist on quality, we expect to be competitive.

On an installed basis (Item #B), filament wound FRP composite fume duct and stacks gain a significant advantage over alternate corrosion resistant materials. This is because filament wound FRP composite duct and stacks are easier and quicker to handle, install, and support.

Some of the installation advantages for FRP composite fabrications include:

1. Much lighter weight and dramatically easier to handle. As much as 1/7 to 1/10 the weight of alternate materials, especially when compared to metallic and sand filled FRP composite duct.

2. With filament wound FRP composite duct and stacks, the installation contractor can use much smaller equipment to handle and lift. Often, just a small mobile crane can be used. No heavy cranes are required for filament wound FRP composite duct or stacks.

3. The use of filament wound FRP composite pipe can provide significant job site handling savings. The lightweight, ease of handing, and longer lengths can be very important for certain difficult installations. For example: if you are trying to "wrestle" steel, duct or a stack up through ceiling rafters or existing supports, the labor for handling "steel" can be very expensive. In these situations, the lightweight filament wound FRP composite duct can often be handled by hand, or with the lightest of equipment.

   And, if you are trying to lift duct or stack up 40 to 300 feet in the air, or are installing in a crowded industrial environment, the lightweight filament wound FRP composite duct and stacks, and their ease of handling, can be of extreme importance to a successful installation. There also have been many projects where the use of a helicopter is required to move duct or a stack out of the staging area to the final installation site. Here again, because of its lightweight and long lengths, filament wound FRP composite duct or stack provides significant installation cost savings.

4. Longer lengths available in filament wound FRP composite duct or stack. We can provide lengths up to 60 feet (depending upon diameter), which means far fewer field joints to make. A significant cost savings!

5. Easier to make field joints. In many duct sizes with filament wound FRP composite duct, a simple bell and spigot structural adhesive joint can be provided. In larger diameter filament wound duct, bell and spigot mechanical gasketed joints are feasible; which also provide significant labor savings. No special fusion butt welding, requiring outrageously costly field equipment and highly skilled operators, are needed with filament wound FRP composite duct and stacks. The costs for making joints in the field for filament wound FRP composite duct and stacks can be as little as one half the cost of alternate corrosion resistant piping materials.

6. For above ground filament wound FRP composite duct, the required supporting systems are often less costly, because of the lower weight of the ducting materials. Through our sister company, *Pipe Supports, Inc.*, we can demonstrate for you just how much savings can be achieved by using filament wound FRP composite duct. As with all ducting materials, the duct and stack support systems must be properly engineered, designed, and fabricated.

7. For buried installations with filament wound FRP composite duct, you will dig much narrower trenches than for concrete and sand filled FRP pipe. Costs for excavating and

backfilling are directly proportional to the number of cubic yards of earth needed to be moved. Again, those costs are much less for the filament wound FRP composite duct. And, with the longer lengths of duct available, there is much less time spent in the trench field assembling the filament wound FRP composite duct.

8. For burial applications, filament wound FRP composite duct is designed on the basis of the "Flexible Pipe Theory". While careful control of the backfilling procedures and techniques are important; if those procedures are followed, flexible duct is easier to install than rigid duct; such as concrete pipe and sand filled FRP pipe. Again, there is the potential for installation cost savings.

9. When you buy filament wound FRP composite fume duct and stacks, you get the full diameter that you pay for. In other words, if you buy 54" diameter, the inside diameter is 54" or larger. Since you are typically buying fume handling capacity, you need to determine the real inside diameters (i.d.) of all alternate material of piping and duct construction. Many types of ducting material (including smooth wall polyethylene, corrugated polyethylene, ductile iron, sand filled FRP pipe, etc.) all have inside diameters that are often significantly less than the nominal pipe size for which it is labeled.

10. Since pipe and duct and stacks are typically being bought to convey fumes, the other component of flow capacity is what diameter is needed to effectively convey that required capacity? In determining flow capacity, you need to consider the long-term frictional coefficient of the piping material being considered. Materials of construction such as ductile iron, steel, coated steel, cast iron, and concrete pipe do not maintain during their service life the coefficient of friction often initially promoted for these piping materials. Those types of duct and stack materials can quickly become "scaley" inside, and the frictional head loss can jump dramatically.

    One of the advantages of filament wound FRP composite duct and stacks is that they maintain the almost glasslike smoothness of the interior over the entire life of the duct or stack. Often, you will actually need a larger size (diameter) duct or stack for some of the alternate duct or stack materials - than can be used when selecting the superior filament wound FRP composite pipe. This is still another installed cost savings offered by the filament wound FRP composite duct and stacks.

    On a recent project specifying 54" diameter steel pipe, FRP was also considered. We were able to offer a 40" i.d. pipe as having the same long term flow properties as steel. When you think of the cost savings for duct and for duct supports, a decision to use FRP makes sense.

In selecting your best buy in duct and stack materials of construction, we recommend you make your decision on the basis of the cost per year of service life (Item #C above) This cost basis is sometimes also known as the "cost of ownership". It is for this reason that many knowledgeable end users of fume duct and stacks will insist on buying the duct or stack themselves, furnishing it to the installing contractor.

It is the owner or end user that is going to have to live with that fume duct or stack for its entire service life. It is not fair to expect the contractor to pay more for materials for a duct project; when he has bid a fixed price for the installation and materials. It is to the contractor's economic advantage to buy on the basis of the lowest initial cost, regardless of the material of construction - or even the quality of the construction. Again, we recommend that the selection of the types of materials of construction, and even the specific vendor, be made by the end user; based upon the **lowest cost per year of service life**.

In thinking of analogies about the cost of ownership of FRP composite duct and stacks, we are reminded of the story about the young boy and his grandfather. The grandfather had just purchased a new pair of shoes and was wearing them for the first time. The grandson was admiring the shoes and asked the grandfather how he liked them. The grandfather replied: "Just fine". Then, the grandson asked "How much did they cost, grandpa?" The grandfather smiled and replied: "I won't know until they wear out."

Similarly, what will be the cost per year of service life for filament wound FRP composite duct or stacks, in comparison to other material of construction? You really will not know until you have to repair or replace whatever ducting or stack material you have selected. How long will the filament wound FRP composite duct or stack provide trouble-free service? Obviously, this depends in great part upon the service environment. For very aggressive sodium hypochlorite service; that service life might be 10 to 20 years.

In the municipal wastewater service environment, FRP composite equipment has been providing trouble-free service for over 50 years now. Based on independent post inspections of many of these 50 year old FRP composite installations, we suggest you check back again with us in another 50 years. It is estimated that this FRP composite equipment may still be performing to the full satisfaction of all concerned, at age 100.

Thus, filament wound FRP composite duct and stacks have a significant advantage for cost of ownership, when compared to other types of piping materials of construction. Many of those alternate materials when originally introduced, were reported to be "permanent". (That term, permanent, has since been discovered to be relative. Women go to the beauty shop to get a "permanent".) Currently, one of the biggest uses of FRP composite duct is for the re-lining of failing concrete and lined steel pipe and stacks. These alternate materials were originally installed on the basis that they would be a permanent ducting or stack material. We have had reports of a lined steel pipe being used as a pen stock that, after five years, has had to have significant year-after-year remedial (repair) expense.

And, it seems that most everyday, you see an article in the paper, or on television, about a cast iron or ductile iron water pipeline that has "broken" in service, and flooded the neighborhood and streets. And, many of you may remember when sand filled FRP pipe was first introduced (as Techite Pipe). Cracking and field failures started to show up in the sand filled pipe 7 to 12 years later. During this same time, the filament wound FRP composite duct and stacks; when properly installed, has continued to provide year after year of trouble-free service.

And, when competitive materials of construction have to be torn down, removed and replaced, after their shorter service life, you need to factor in the costs for that demolition, removal, and disposal. Sometimes, it costs as much, or more, to remove and dispose of failed corrosion resistant process equipment - as it did to install the equipment new.

For most utility applications, we feel very comfortable in recommending your using a cost of ownership based on a minimum 50 year service life. Thus, the service life of filament wound FRP composite duct compares very favorable with other materials that have demonstrated a typical 20 to 25 year service life.

1. One of the costs of ownership that is often "forgotten" when comparing various materials of construction is the annual cost, after installation; for inspection, maintenance, upkeep, and possible repairs. We strongly urge our customers, regardless of the type of ducting material of construction being installed, to have a planned inspection by qualified service technicians at least once a year. If the duct or stack is large enough to get inside of, that inspection should be conducted both from the inside and outside of the duct or stack. If you so wish, we have skilled and trained service technicians to make those inspections. In deciding whether to invest in making such annual inspections, remember the old saying: "A stitch in time saves nine."

   Again, when comparing the cost of annual upkeep for a ducting system, the filament wound fiberglass FRP composite fume duct and stacks have a significant competitive cost advantage over alternate materials of construction. We know of some customers that have to spend literally several months each year - simply repairing the inside of their lined steel pipe, duct, or stacks.

   In the unlikely event that the fiberglass duct or stack ever needs any remedial action, it is very easy to accomplish, with minimal costs. After proper surface preparation; repairs, patches, and maintenance can be easily provided by the contact molding method. Compare this with the cost of repairing steel, and lined steel, in the field. Filament wound FRP composite pipe offers you a lower cost of ownership for annual maintenance and upkeep.

2. Still another area of the cost of ownership that is often overlooked, when comparing alternate materials of construction, is the annual operating costs. For pipe, there are typically pumps involved that are pumping the fluids through the pipeline; or blowers and

fans that are moving the fumes through the duct. The annual power cost of running those motors for the pumps and fans can often be quite costly.

Once again, compared to alternate materials of construction, the glass smooth inside of filament wound FRP composite pipe provides the absolute lowest frictional pipeline or duct head loss. And, the ready availability of filament wound FRP composite sweep one-piece elbows, laterals, and tees also provides substantially lower frictional loss; and thus lower pumping and fan operating costs.

We have known of situations where the utility savings alone for the pumps for filament wound FRP composite pipe paid for the small premium in initial cost in less than one year of operation. That meant that every year thereafter, the customer was saving substantial additional dollars in operating costs, simply because they had installed filament wound FRP composite pipe, duct or stacks.

We encourage you to determine the cost of various ducting and stack materials, based on the cost per year of ownership, or cost per year of service life. We are confident that, when you look at those costs, you will find that filament wound FRP composite duct and stacks will be the "best buy" for your project.