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# Maximize the Service Life of your Process Tanks

*PVDF Liners stand the test of time in harsh thermal and chemical environments*

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Electroplating or surface finishing processes are commonly used to provide increased wear and corrosion resistance to finished parts. Many finishers, however, are burdened by corrosion of their own equipment. Process or "dip" tanks hold aggressive solutions that are frequently at elevated temperatures. It is imperative that these tanks withstand aggressive conditions to maximize productivity while limiting production downtime. Repair or replacement of failed tanks, linings / liners drastically cuts productivity and can become a costly financial burden.

Steel tanks are known for their high temperature ratings and mechanical strength, but often, they cannot be used to contain plating solutions. These corrosive solutions attack steel, even stainless steel, and can lead to leaks and premature failure. The common alternatives to steel tanks include using plastics, both as liners and free-standing structures. Plastics protect the steel from corrosion and the solution from contamination. Plastics such as flexible polyvinyl chloride (PVC-P) and propylene (PP) are common alternatives to solid steel tanks. However, as temperatures climb and chemistries become more complex, these materials face challenges. Polyvinylidene fluoride (PVDF) liners, which will be discussed in this paper, have proven to be a higher temperature, more chemically resistant and robust option.

## Materials of construction

The most common materials used as process tanks include steel with a PVC-P lining or PP tanks. While displaying "good enough" chemical resistance in some applications, there are many instances where aggressive plating mixtures are very challenging for PVC-P or PP. Many finishers are no longer satisfied with "good enough", and therefore demand a higher quality, longer lasting and more trouble free tank. While PVC-P lined steel tanks do not pose a fire risk, PP tanks have a high fire risk associated with elevated temperatures and electric immersion heaters.[1] Polypropylene tanks are quickly combustible and difficult to extinguish. The limited service life, high cost of repair or replacement, desire for minimized unplanned downtime, and risks associated with these commonly used tank materials, have led many finishers to evaluate their tank purchase decision making process. Many have concluded that spending more upfront can greatly reduce the total cost of ownership over the lifetime of a process tank.

## PVDF Liners – an upgraded solution

For finishers who desire more from the life of the tanks, polyvinylidene fluoride (PVDF) is increasingly specified as a material of construction. PVDF can outperform its competition by providing longer lasting and trouble free containment for the most aggressive plating solutions, even at elevated temperatures.

PVDF falls into a category of plastics known as fluoropolymers. In general, the fluoropolymer family is known for its robust chemical resistance, high purity, heat and temperature resistance, and good flame and smoke properties.[2] PVDF is selected for plating tanks due to its superior permeation resistance and strong mechanical properties.

Special formulations of PVDF, known as PVDF copolymers, are the main materials used as tank linings or liners. PVDF copolymers have higher flexibility and better ductility than standard grades of PVDF. The PVDF copolymers also exhibit a wider range of chemical resistance, allowing them to be used in applications from pH <<1 to 13.5. PVDF is highly abrasion resistant, a key property to ensure integrity of the liner. Table 1, compares the properties of PVDF to other tank liner materials. A cost comparison with PP is shown in Fig. 1, showing that the higher initial cost is offset by significantly longer tank life and lower total costs of ownership (TCO) over the life of the tank.

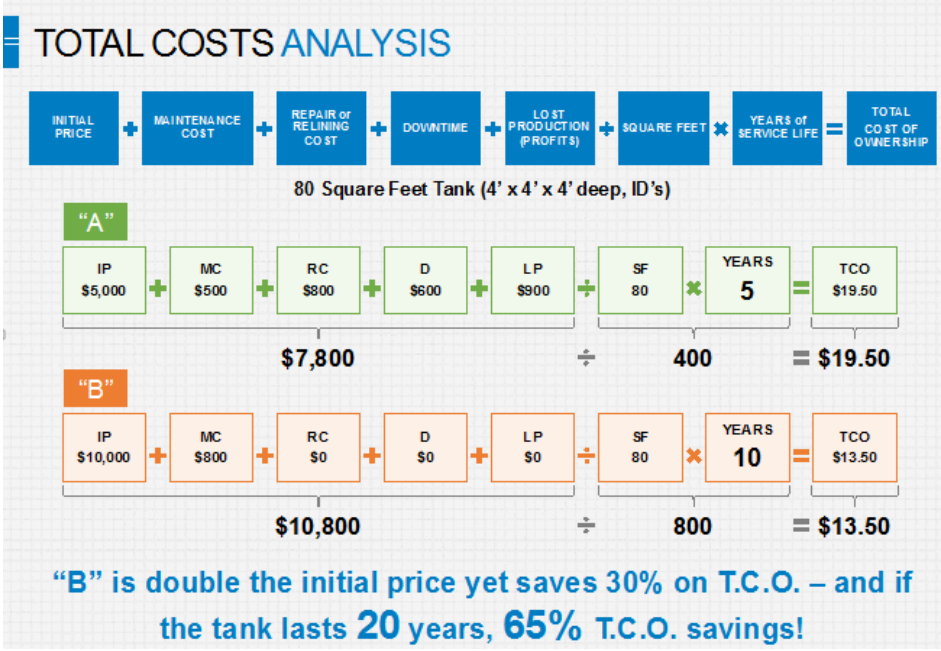


Figure 1 - Theoretical cost analysis for liners where "A" represents a commodity tank such as PP and "B" represents PVDF.

Table 1 - Properties of commonly used lining materials.[3,4]

| | Tensile ASTM D638/73°F (23°C) | Impact ASTM D256/73°F (23°C) | Abrasion (mg/1000 cycles) CS-17 1000g:pad | Continuous Temperature | LOI |
|---|---|---|---|---|---|
| Polypropylene | 3,000 psi | 1-3 | 15-20 | 80°C | 17 |
| Flexible PVC | 2,000 psi | No Break | 12-20 | 80°C | 30* |
| Rubber | 1,000 psi | No break | 70-90 | 85°C | 20 |
| Flexible PVDF | 5,500 psi | 4-8 | 6-9 | 140°C | 42* |

*Denotes self-extinguishing

## PVDF fabrication

As finishers become aware that there are longer lasting solutions available, PVDF is increasingly in demand. However, it is not only the proper material selection that affects the lifespan of a process tank, but also the experience and qualifications of the fabricator constructing the tank. Qualified fabricators should have fabrication standards and procedures in place and utilize AWS Certified plastic welding technicians. State-of-the-art plastic fabrication equipment and patented welding advancements (U.S. Pat. Nos. 8,133,345 / 9,278,478 / 10,138,053) allow tanks and liners to be constructed with only the highest quality machine welds.

## Case studies

Case studies of the successful implementation of PVDF Copolymer liners are discussed below:

*Solution #1 – Improving service life and eliminating contaminants.*
A landing gear processor was told they would have the latest and greatest in material when they elected to have their hard chromium plating tanks lined with fiberglass overlaid with an exotic resin. In the first year, the fiberglass linings appeared to perform well, but soon thereafter the fiberglass linings began to come under attack by the chromic acid. The customer was left with failing tanks compounded by contamination issues, as the fibers from the failed lining were found in the plating bath.

In 2015, twelve PVDF copolymer liners were installed into the customer's hard chromium plating tanks. A significant advantage of the PVDF copolymer liners is that they were installed over the failed fiberglass, eliminating the expense of new steel tanks and demolition and disposal of the failed ones. These PVDF liners have been in continuous operation since installation and show no sign of degradation, outperforming all alternative materials.

*Solution #2 – total cost of ownership / ROI*
An automotive parts manufacturer had seven large hard chromium plating tanks. Between the seven tanks, stripping and relining the PVC-P lining of at least one tank per year was the norm, with an approximate annual expense of $55,000.00). With the customer's willingness to make a larger initial investment, they purchased seven PVDF copolymer liners for their hard chromium tanks.
After installing the seven PVDF liners over the flexible PVC-lined steel tanks in May of 2001, the customer never required the lining supplier to rework these tanks. The lining supplier was advised that the customer's investment paid off in a couple of years, by eliminating downtime and repair expenses. Unfortunately this facility closed its doors in 2010 after nine years of the PVDF liners continuous service in the chromium tanks. It is our belief that the tanks would still be in operation today, with no problems, had the plant remained open.

## Summary

The materials of construction utilized in plating tanks are often the deciding factor in maximizing the service life of the tank. Chemical resistance and temperature resistance, as well as good anti-flammability

properties are key properties to consider. PVDF liners have a proven history with delivering end users longer lasting, lower maintenance plating tanks.

## References


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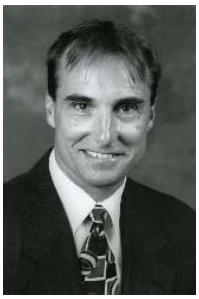
## About the authors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