

ENGINEERED SOLUTIONS FOR ABOVE GROUND STORAGE TANKS (AST)

Roof, Shell and Floor Repair - Using Forge Tech Patented Technology

PORTABLE FRICTION BONDING



REPAIRED IN-SERVICE WITHOUT PROCESS INTERRUPTION



SUPERIOR TECHNOLOGY/APPLICATION

Portable Friction Bonding (PFFB) application.

Agile, hand portable system using interchangeable components.

Fast, reliable, mechanical process with high strength bonding results.

Entire process is performed using only compressed air (no electrical source required).

No spark, flame or molten pool produced using comparatively low temperature bonding.

Safe for use in restricted, hazardous or explosive environments.

Energy efficient, economical and adaptive to a wide range of industries and applications.

Ability to reliably bond most dissimilar materials without metallurgical complications.

AVOID DECOMMISSIONING/DE-GASSING

Forge Tech Inc (FTI) technology bonds metal studs at a low temperature that does not produce any sparks or flame and does not generate enough heat to meet API-2207 definition of "Hot Work".

Thus, FTI technology can be used for mechanical repairs on the Tank Roof and Tank Shell without the tank having to be decommissioned or de-gassed.

For Tank Bottom repairs FTI's portable friction bonding process is an excellent alternative for making repairs to "Hot Bottoms". It does not require hot work welding but utilizes a mechanical repair (bolted plate and gasket) to reestablish floor plate integrity back to its original thickness thereby allowing for extended run lengths with minimal repair cost. The FTI bonding process can also eliminate the need and cost for drilling and gas freeing the tank bottom. It also can avoid the potential high cost of soil remediation since the floor plates are repaired in place.

Safe Repair of in-service tanks at Less Than 14% of the Cost as Compared to temporary patching over 5-years

EXAMPLE SAVINGS ANALYSIS

Assumptions

- Analysis compares an individual AST repair between Epoxy patch and FTI Mechanical repair
- 5-year analysis period. Assumes only one tank roof fails per year (conservative)
- Epoxy repairs are done once per year on failed tanks until permanent repair is completed
- FTI Mechanical repair lasts 5 years backed by guarantee
- Opportunity costs: unavailability of tank due to curing time needed for epoxy
- Direct repair cost per occurrence:
 - Epoxy \$3,900 per occurrence | repair repeated once per year
 - FTI Mechanical \$4,500 per occurrence | no additional work on the leak guaranteed for 5 years
- Total costs per occurrence:
 - Epoxy \$14,100 (\$3,900 + \$1,200 + \$9,000) | required to repeat repair once per year
 - FTI Mechanical \$5,700 (\$4,500 + \$1,200) per occurrence and no repeat repairs needed

Calculation of 5-Year Savings Based upon Assumptions Above

END OF YEAR	1	2	3	4	5	TOTAL
Cost of Epoxy Patch	\$14,100	\$28,200	\$42,300	\$56,400	\$70,500	\$211,500
Cost of FTI Mechanical Repair	\$5,700	\$5,700	\$5,700	\$5,700	\$5,700	\$28,500
Savings (cost avoidance)	\$8,400	\$22,500	\$36,600	\$50,700	\$64,800	\$183,000
# Tanks requiring on-going patching	1	2	3	4	5	5

Data from a large Gulf coast refinery was scrutinized to develop data for the example:

Typically 50 - 100 total tanks on site. About 20 - 40 are floating roof tanks (FRT). The example (conservatively) assumes one NEW FRT's will show a leak every year.

Assumed that tanks will be repaired for the next 5 years until an expensive scheduled down time to fix a tank occurs.

Need for repairs driven by Regulatory rules.

Refinery DOES incur costs due to employees having to be diverted to prepare the tank instead of being available for regular refinery work.

Cost impact of a leak on a tank

Direct Costs: \$1,200 (Both Methods)

- Clean for inspection and repair. Typically contracted at \$450 per event
- Refinery Shift Supervisor reviews detected leak, issues environmental report etc.(\$70)
- Inspection called and permitted on roof to determine source of leak (\$70)
- Inspection identifies leak area and type, UT done etc. (\$400)
- Inspection approves repairs and tank can return to service(\$70)
- Inspection files report placing tank on deficiency list (\$70)
- Operations stewards quarterly deficiency list (\$70)

Margin Losses Due to Unavailability of Tank (Opportunity Loss, per occurrence)

Epoxy \$9,000 | FTI Mechanical \$0

- Epoxy needs to dry for about 1 1/2 days before tank can be placed into service at \$6,000/day of margin loss for typical sized tank
- FTI Mechanical Repair can go into service after inspection approves the fix. No time lost.

Mechanical Repairs = No Emissions

No Sparks, No Flames = No Ignition Source

No Shutdowns, No Decommissioning = Lower Costs

Significant Lifecycle Cost Savings = Improved Cash Flow

5-Year Warranty