



MODEL TO OPTIMIZE THE DESIGN OF FIBERGLASS REINFORCED PLASTIC IN CHLORINE DIOXIDE SERVICE

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FRP in Bleaching



- ▶ Service: Chlorine dioxide, bleaching stock, sodium hypochlorite, chlorate, bleach filtrates, wastewater, etc

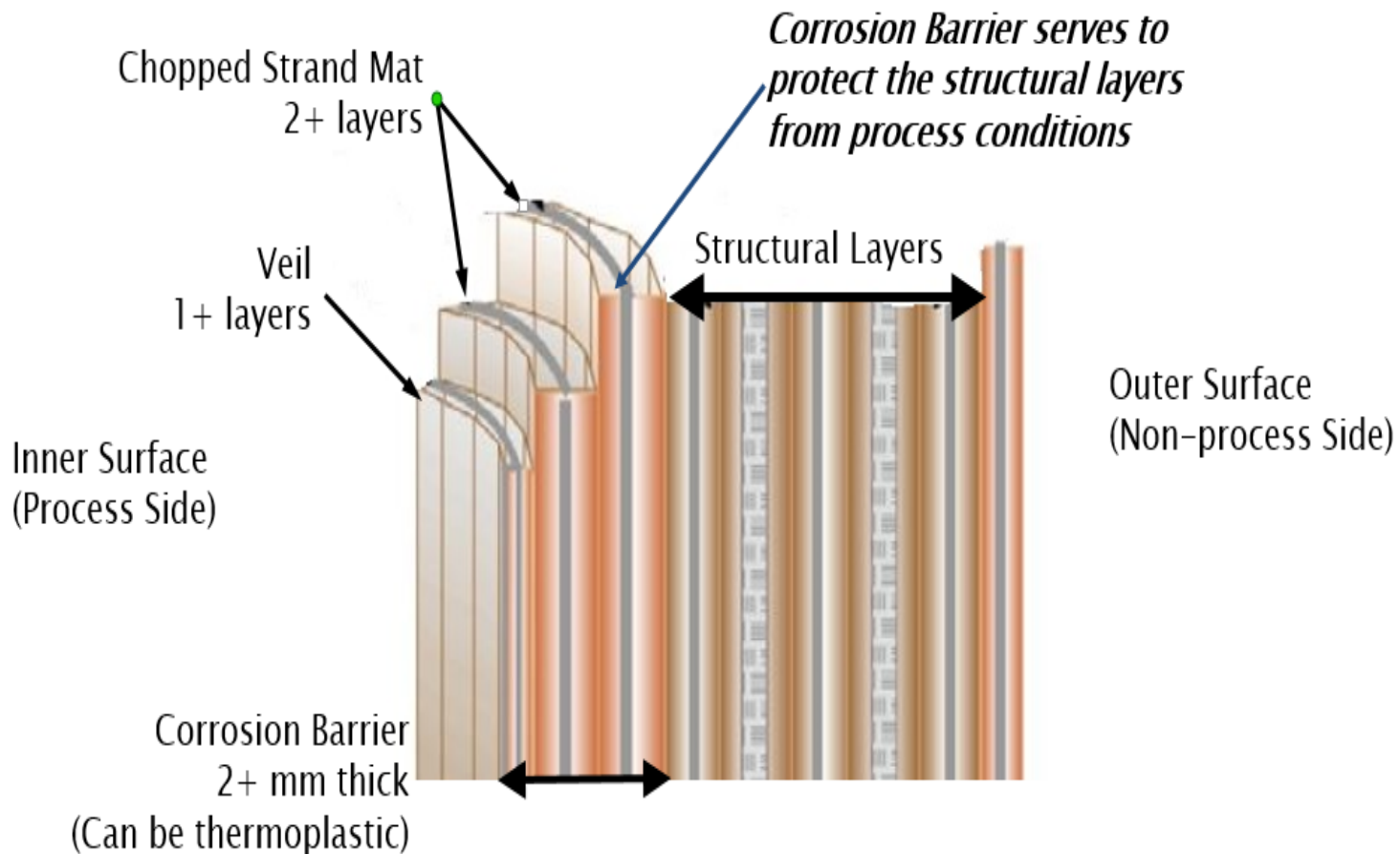
FRP Equipment History

1. Purchase tank or scrubber:
 - Materials selection by supplier
 - Engineering by supplier
 - Require “State of the Art” standards for design and construction: ASME RTP-1, ASTM D-3299, ASME B&PV Code Section X.
2. After 5 to 8 years:
 - Pay 50% to 75% of original cost to reline and repair it.
3. Repeat
4. 30 year lifetime cost: 325%+ of original

FRP Usage Context

- ▶ Study of 1 400 vessels in wide range of services.
 - Average expected life: 49 years
 - Chlorine chemicals: 3% of total. Shorter life.
- ▶ Standards do not provide guidance for specific chemical applications. All guidance is uniform.

Conventional FRP Construction



Current Inspection

- ▶ TAPPI TIP0402 provides guidance.
- ▶ Intrusive Inspection of the corrosion barrier for:
 - Cracks, gouges, blisters, remaining thickness, discolouration, loss of resin gloss.
 - Cutouts when internal inspection is not possible:
- ▶ External inspection for visible damage
 - Flange cracks are most common defect
- ▶ Relies on inspector judgement and opinion.

Current repair

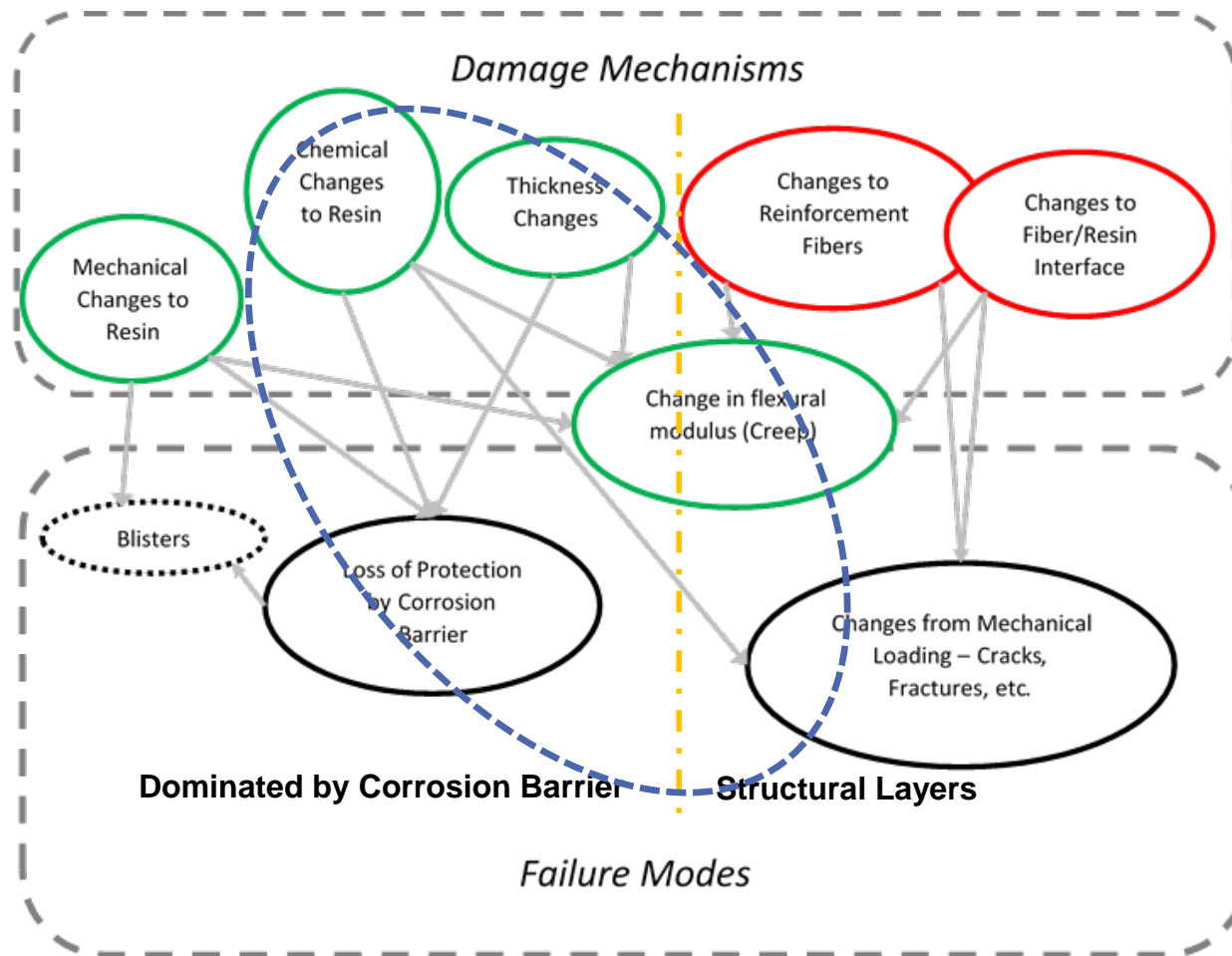
- ▶ Relining



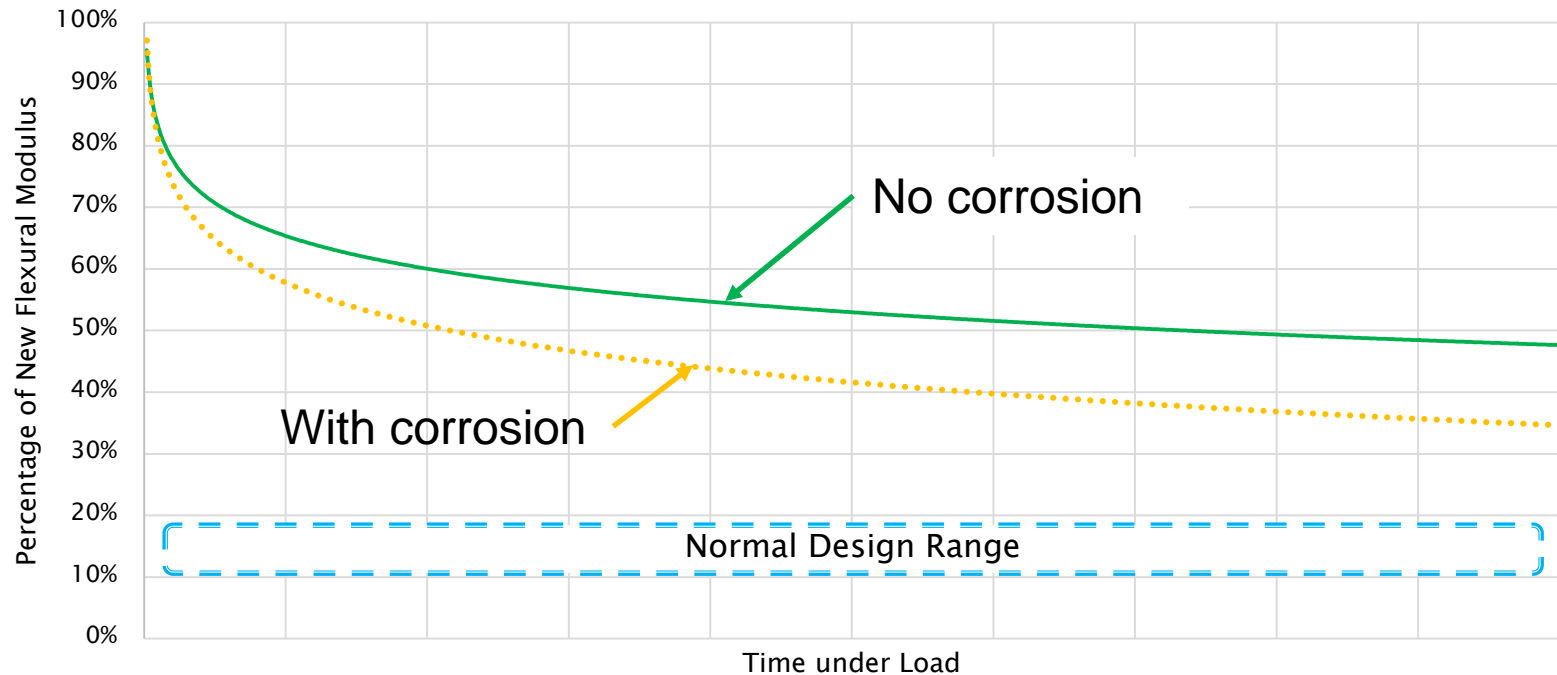
- ▶ Misses inside of small nozzles



FRP Damage and Failure




Creep in Service



Occurs in any chemical service
Damage to CB will depress the curve

Design for Expected Damage

For pulp mill bleaching:

1. Design to reduce flange failures
 2. Design to accept resin oxidation and corrosion barrier thickness loss.
 3. Creep.
 4. Provide criteria for inspector decisions.
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Flange Improvements

- ▶ Avoid Flat Face



- ▶ Use Lap-Joint (Vanstone) Type

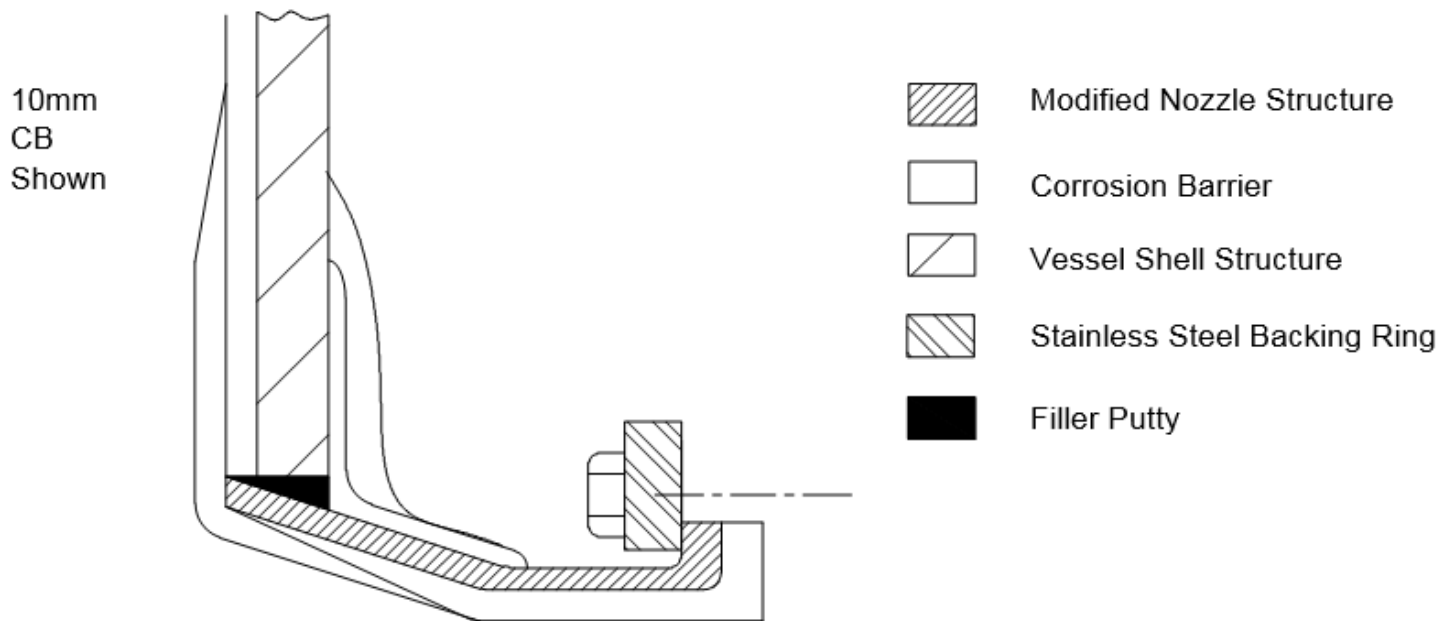


Resin Oxidation and Thickness Loss


1. Use the best resin available.
2. Get the best resin cure possible. Specify post curing.
3. Increase corrosion barrier thickness.
 - Improve nozzle design to suit....

Small Nozzles

► Typical 4" Engineered Nozzle




Or.....PVC corrosion barrier

- ▶ Polyvinyl chloride (PVC) does not oxidize readily.
 - ▶ Vessels with PVC corrosion barrier are easily made and quite common.
 - ▶ More expensive than FRP corrosion barrier.
 - ▶ They give good life in chlorine dioxide service.
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Creep

- ▶ Ensure that adequate design factors are used.
 - Factors in most standards are adequate.

Inspection

- ▶ Incorporate design details to simplify and clarify inspection of key areas.
 - ▶ With increased corrosion barrier thickness, advanced ultrasonic methods can be used to monitor the remaining corrosion barrier thickness and condition of the structural FRP.
 - ▶ Intrusive inspection can be reduced based on engineered criteria.
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Example

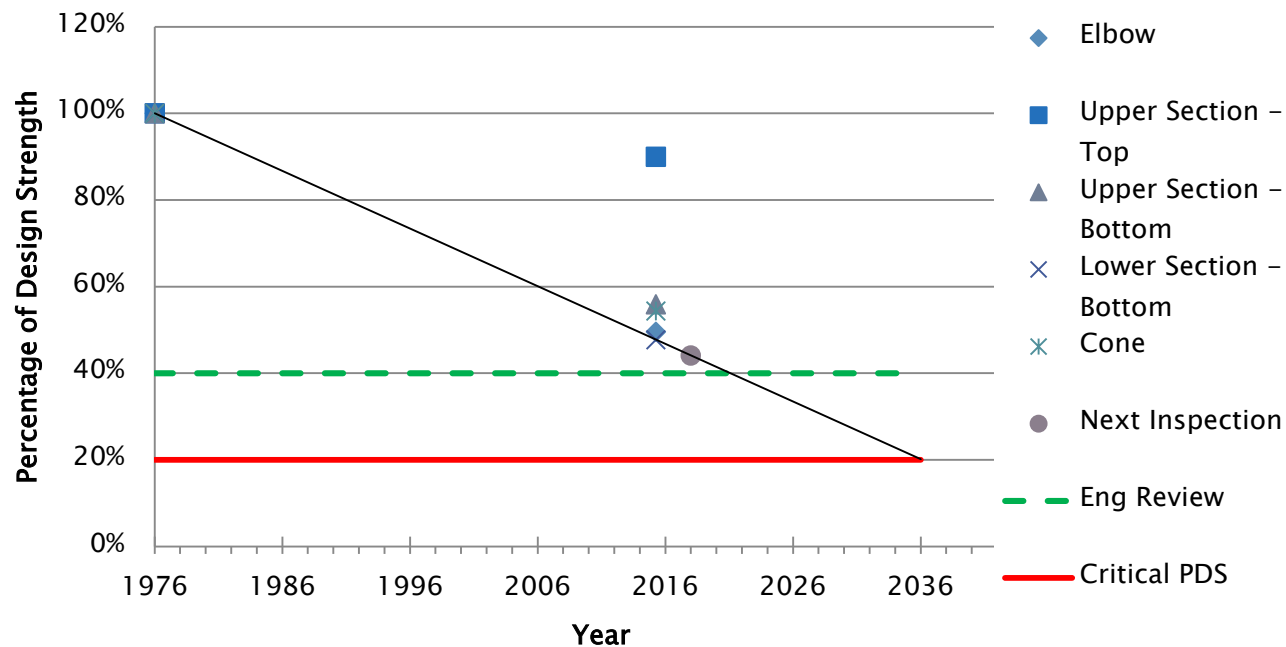
D stage upflow tower

- ▶ Outdoors
- ▶ New in 1970's
- ▶ Structural fibers visible



D stage upflow tower


- ▶ Current inspection results:
 - Tower has 50% of original capacity.
 - Expected remaining life is 20 years.



D stage upflow tower

- ▶ Plans to reline next year
- ▶ Based on structural evaluation, the tower will be 60 years old at the end of its life. Why not plan to replace in 10 to 15 years rather than undertake a repair that is almost as costly?

Conclusions

1. Damage mechanisms are well understood for FRP in pulp bleaching.
 2. Improved corrosion barriers can be used.
 3. Flange improvements can be made.
 4. Inspection can be improved.
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For more information

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