FIBER REINFORCED PLASTIC (FRP) FORUM & EXPO

Non Metallic Application Challenges and Solutions.

PP-Lined GRP Rupture.

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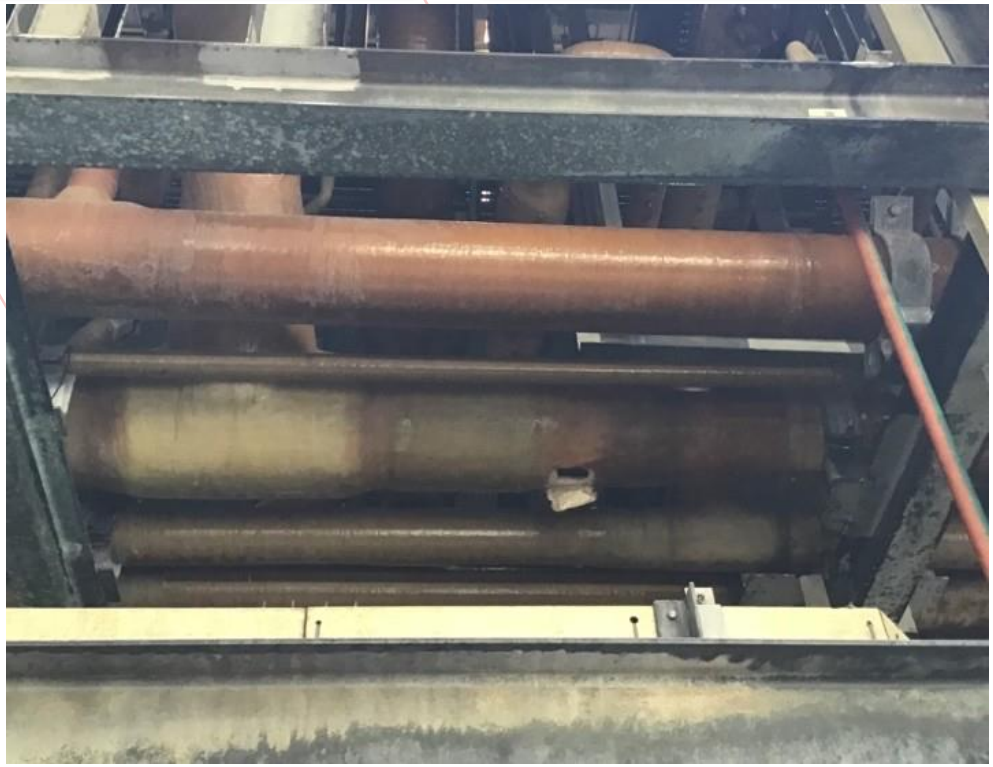
INTRODUCTION

This case study explains a failure of PP lined GRP piping installed in 2014 and failed after 9 years of operations.

Process fluid : NaOH-32% concentration	Operating temp : 85~92° C	Operating pressure: 3 Barg	Failed component : Ecc. Reducer -10”x12”



General view of failure

Close-up view

INITIAL INSPECTION FINDINGS.

Failure#1: @12 '0' clock position	Failure#2: @ 6 '0' clock position.	Defects observed on PP lining fusion welds	Cracks observed on the lining

Leak Occurred through Failure #2: Size : 4"X5"

FAILURE INVESTIGATION-VISUAL EXAMINATION OF SPECIMEN

Change in Color shade

- The color of the reducer PP liner is whitish unlike the adjacent pipe which is grey.

Liner thickness

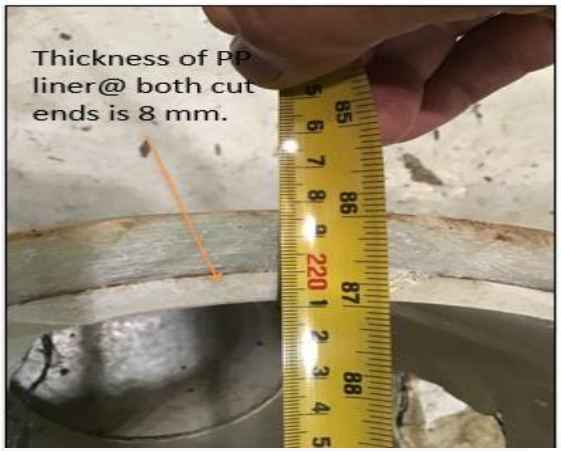
- Pipes : 8 mm
- Reducer @ ruptured area : 4 mm

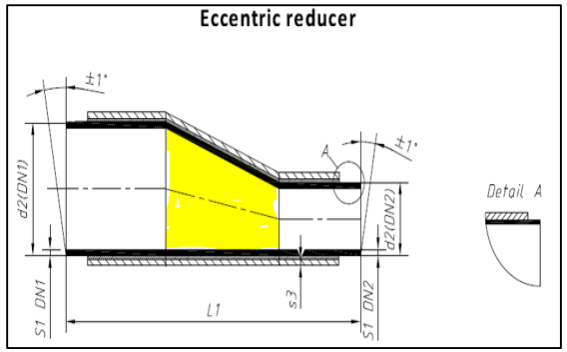
Failure

- confined in between reducer liner weld fusion

Weld Visual

- No weld bead observed
- Cracks from the weld joint were observed.





FAILURE INVESTIGATION- MACRO AND MICRO EXAMINATION OF SPECIMEN

Cross Sectional view

- Variance in thickness (reducing and straight section).

Macro Examination-weld

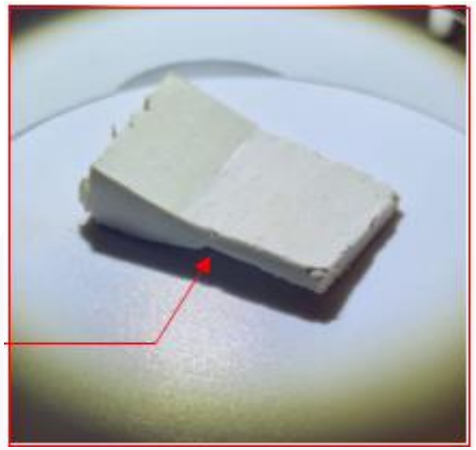
- Cracks at the weld joints
- Several weld defects (LOF)

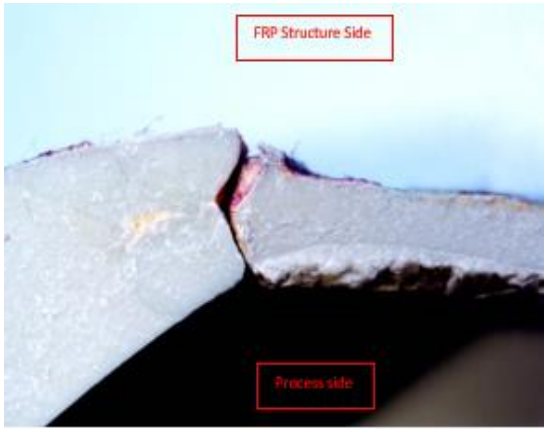
Micro Examination

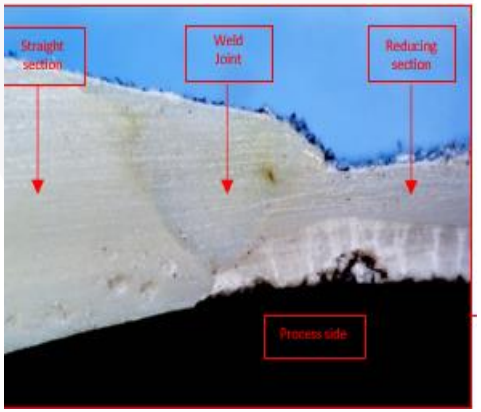
- Lack of fusion in weld
- Degradation of PP lining

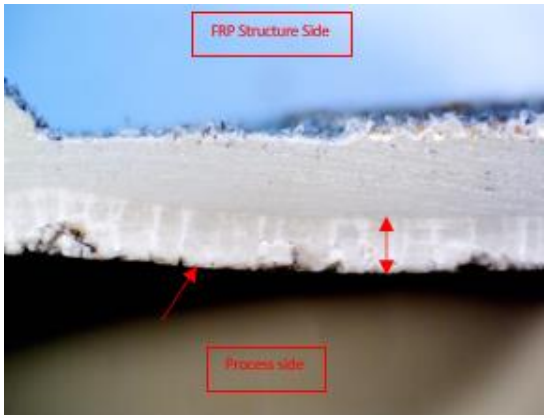
FTIR-Examination

- **Pipe**: Confirms to PP grade
- **Reducer:** Indicates degradation, Change in grade









DISCUSSIONS

General findings

- The line was commissioned in 2014 (9 yrs. in service).
- Two other failures of the PP lined GRP piping had occurred in the past. All the previous failures indicate that failures are in or around the weld fusion areas.
- No life assessment has been done for the Plastic lined and GRP Piping.
- Licensor recommended to replace the headers in 8-10 years.

Inferior PP liner material was used for reducer.

- **Quality factor-Inferior quality**

Micro& Macro Examination

- Lack of penetration observed on welds
- Cracks observed on PP lining material
- both sections were found with different wall thickness
- Joint offset exceeds maximum allowable offset ASME RTP-1

Excess offset in weld-joint fit-up due to low thickness reducer.

- **Quality factor-workmanship**

FTIR

- **Straight sections** : transmittance values are in line with PP standard values.
- **Reducer**
  - Indicates deterioration of PP lining in at reducer area.
  - Different from the PP material of straight portions.

Several weld defects

- **Quality factor-workmanship**

CONCLUSION

The crack of FRP piping happened due to the permeation of NaOH in to the FRP. Failure in the welds of internal PP lining allowed the ingress of NaOH. Weld failed due to defects mentioned below

Lack of penetration of the weld joint.	• Poor Work Manship-CC-1
Lack of fusion between the weld run and parent material.	• Poor Work Manship-CC-2
Low wall thickness of reducer	• Lack of Quality Management System-RC-1
Low PP grade selection for the reducing liner section.	• Lack of Quality Management System-RC-2

RECOMMENDATIONS

Quality Management system to be developed and implemented for non-metallic piping assets to ensure that

- Adequate Procedures and guidelines for Fabrication and installation of non-metallic Materials are in place.
- Welders are qualified for non-metallic fusion welding per ASME RTP-1 section M12H-40.
- Inspection and fabrication personals are qualified in nonmetallic manufacturing.
- Inspection witness and verification points are defined and followed.

Ensure ASME RTP-1 or other applicable standard guidelines are followed during manufacturing and repair.

Ensure the recommended grade of liners (PP) has been received and utilized .

Any Questions?

Thanks