Glass-Polymer Composite High Pressure Pipes and Joints - Design, Manufacture & Characterize

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Main Objective

This project was awarded to West Virginia University in order to develop, investigate, and compare alternative strategies for creating easily locatable advanced composite pipes made of Carbon and Glass Fiber Reinforced Polymers – CFRP and GFRP - (with carbon fabric, carbon nanoparticles, or aluminum foil overlay in the case of GFRP pipes). Investigation of pipe detectability will be done using Ground Penetrating Radar (GPR).

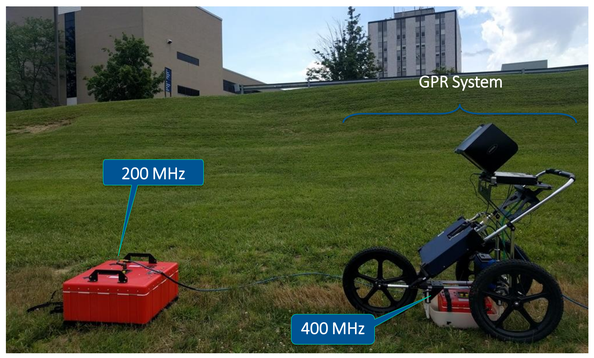


Figure 1. GPR equipment setup.

Figure 2. 200 MHz antenna with survey wheel.

Project Approach/Scope

Major tasks to achieve the objective of the project are:

- ❖ Wrap PVC and GFRP pipes with aluminum or carbon fabric strips for easy detection
- ❖ Wrap PVC and GFRP pipes with metallic or carbon fabric rings for easy detection
- ❖ Coat GFRP pipe surface with carbon nanoparticle-resin mixture to improve detection
- ❖ Burry different diameter pipes with various wraps/coatings at various depth for testing
- ❖ Investigate and compare the detectability of the above pipes (buried) using GPR

Figure 3. PVC pipe with CFRP rings, GFRP pipe with Aluminum strip, and GFRP pipe with carbon nanoparticle coating.

Figure 4. Pipe samples being buried.

Results to Date

1. Use of CFRP and aluminum strips/rings improved detectability of buried non-metallic pipes, producing reflected signals with higher amplitudes.
2. Carbon nanoparticle coating did not improve detectability of non-metallic pipes.
3. 200 MHz radar antenna produced significantly better result compared to 400 MHz radar antenna for buried pipe detection.

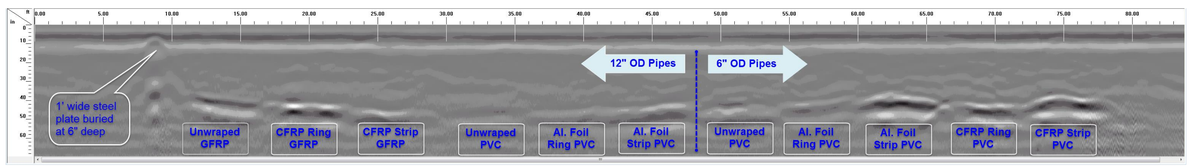


Figure 5. GPR scan from pipes buried at 3 ft. depth.

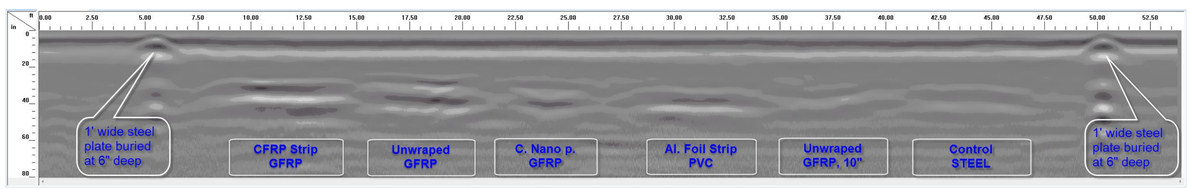
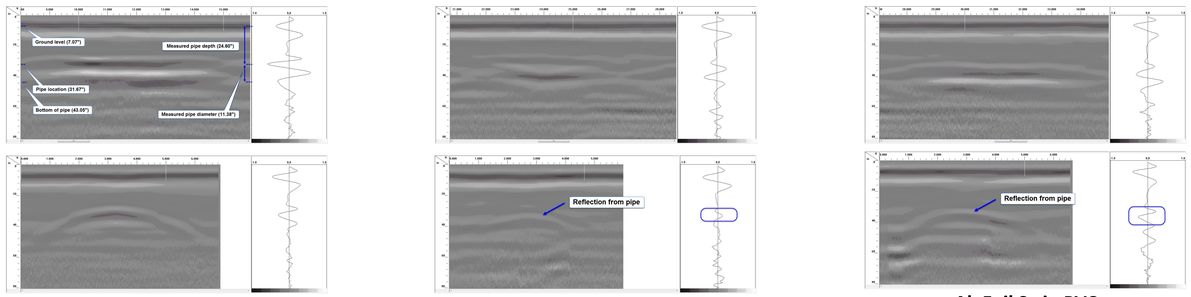


Figure 6. GPR scan from pipes buried at 2 ft. depth.



CFRP Strip GFRP | C. Nano p. GFRP | Al. Foil Strip PVC

Figure 7. GPR scans of some of the detected pipes using 200 MHz antenna; longitudinal scan (top), and transverse scan (bottom).

Acknowledgments

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References

Halabe, U. B., GangaRao, H. V. S., Zondlo, J., Kavi, J., Imes, B., & Cvetnick, A. (2017). Advancement in the Area of Intrinsically Locatable Plastic Materials (Final Report).

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