Development of New Multifunctional Composite Coatings for Preventing and Mitigating Internal Pipeline Corrosion

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➢ Background and Objectives

Corrosion is one of the leading causes of failures of metallic pipelines in the United States and worldwide[1]. Especially, the internal surface of pipe is vulnerable to corrosion damage. The U.S. Department of Transportation Office of Pipeline Safety estimates that internal corrosion causes approximately 15% of all incidents occurring in oil and gas transmission pipelines with an annual industry cost of almost $15 billion US dollar per year. In this study, new high-performance coatings were developed by incorporating nanoparticles in the polymer resins for strengthening the internal surface of metallic pipelines.

Figure 1. Internal corrosion[2]

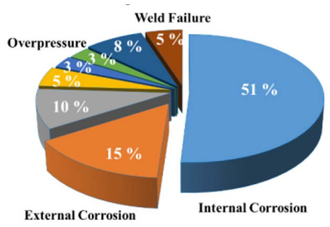


Figure 2. Dominant internal pipe corrosion[3]

➢ Material Selection and Experimental Strategy

We report a experimental study of the epoxy-based nanocomposites reinforced with hybrid nanoparticles. The tribological, water-repellency, mechanical and electrical properties of the epoxy-based nanocomposites were evaluated in this study.

- Corrosion resistance
- Abrasion resistance
- Small-scale tensile test
- Atomic force microscope (AFM)
- Electron microscopy techniques (FESEM)

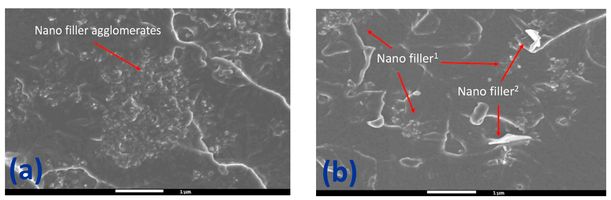
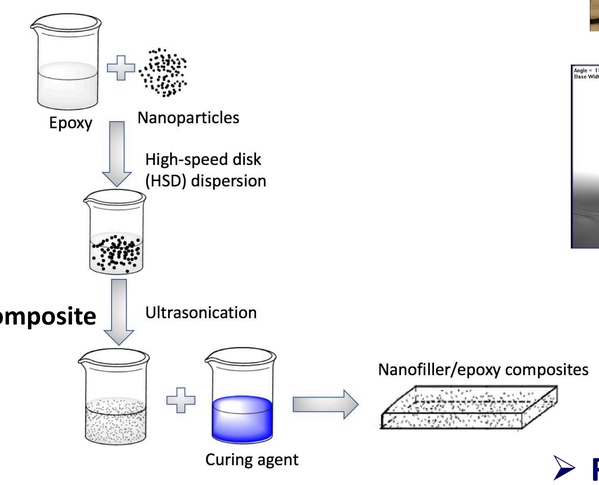


Figure 3. Dispersion of (a) single filler & (b) hybrid filler nanocomposite



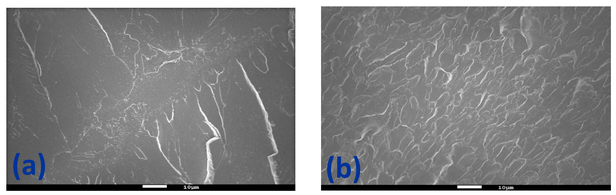


Figure 4. Fracture surface of (a) neat epoxy & (b) nanocomposites

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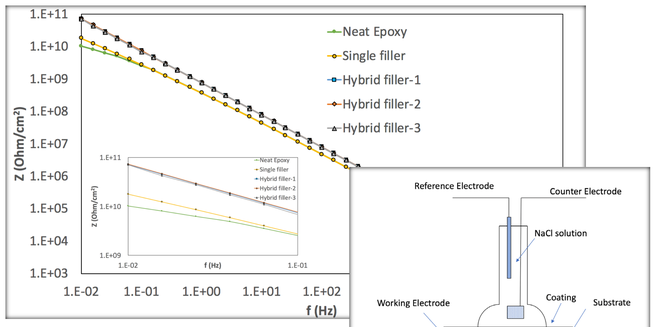
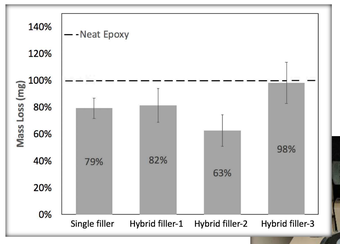
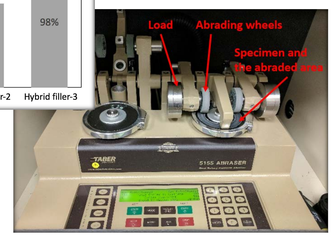
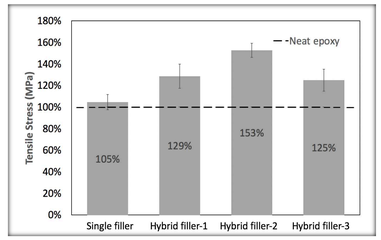
➢ Conclusions and Future Work

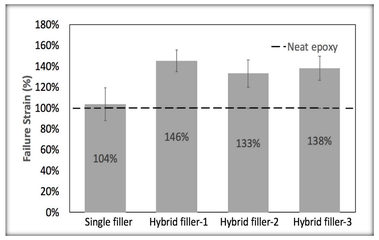
The results indicate the potentials to fabricate high-performance coatings for internal surface of oil & gas pipelines from hybrid nanofiller reinforced polymers. Robust hydrophobic coatings were obtained with a simple fabrication method. Compared with single filler nanocomposite, stronger reinforcement has been observed corrosion barrier performance and mechanical tensile properties in the tested nanocomposites.

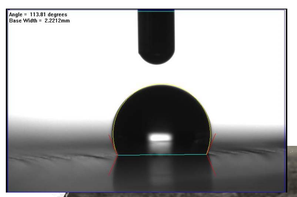


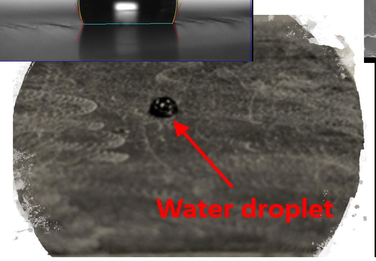


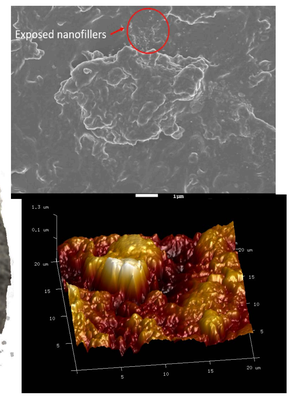


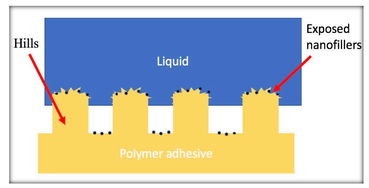


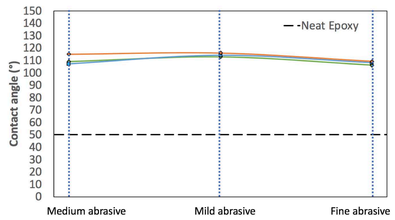












➢ Reference

[1]. Fessler, Raymond “Pipeline Corrosion, final report”, U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration Office of Pipeline Safety, 2008.

[2] Photo from https://c1.staticflickr.com/6/5096/5416927808_82c3fe27d8_b.jpg.

[3]. Nalli, K. “Aovid internal corrosion with glass-reinforced plastic”, Pipeline and Gas Journal, Vol. 239, 2012

➢ Acknowledgment

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