Research, test results & ND Dept. of Health Approval

Viscous Elastic Coating for Protecting Bell & Spigot Water Lines from Crude Oil Exposure

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A better way to protect Bell & Spigot rural water supply pipes (PVC) at crude oil pipeline crossings.

Improving Safety of Crude Oil and Regional Water System Pipeline Crossings

Pipeline and Hazardous Material Safety Administration

Technical Assistance Grant DTPH56-10-G-PHPT13

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2012

"A major concern at the crossing of crude oil pipelines and rural water supply pipelines is the potential impact of a crude oil spill on the integrity of the polyvinyl chloride (PVC) pipe used for water pipelines in the unlikely event of an oil pipeline leak. One of the commonly used methods to provide an assumed layer of protection for water pipelines is to case them with additional PVC pipe at crude oil pipeline crossing points; however, a study conducted by South Dakota State University to examine the impact of crude oil on the integrity of PVC and high-density polyethylene pipes and casing materials demonstrated that exposure of pipe joints to crude oil resulted in hydrocarbon permeation through the pipe joint gaskets within 5 to 9 weeks of exposure. The study results suggest that casing of PVC pipelines may not provide adequate protection in the event of an oil pipeline leak."

EVALUATION OF VISCOTAQ® PIPELINE WRAP PERFORMANCE RELATED TO CRUDE OIL EXPOSURE

Final Report

Objective & Issues

- Prevent exposure of polyvinyl chloride (PVC) joint gaskets to crude oil in case of crude pipeline release.
- Cost effective
- Ease of installation
- Long term performance

- Scott Besmer, KLJ Engineering, Bismarck, ND
- VISCOTAQ bell & spigot sealing system w/ProKote's X-Wrap
- Funding through a grant from the North Dakota Oil & Gas Commission and provided by BOE Pipeline LLC
- Energy & Environmental Research Center (EERC) at the University of North Dakota in Grand Forks
- Six month initial testing procedure, plus 3 more months
- Approved by the North Dakota Department of Health

Testing Apparatus

May 2015 Fabrication of test box at the EERC.

- 14-gauge, 304 stainless steel plate and 1⁄8" angle
- all plate materials were laser-cut
- six bell and spigot sample pipes were constructed of 6" PVC pipe with flanges and caps

5502

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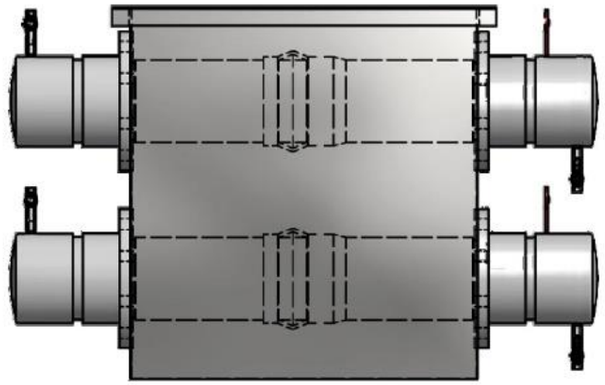

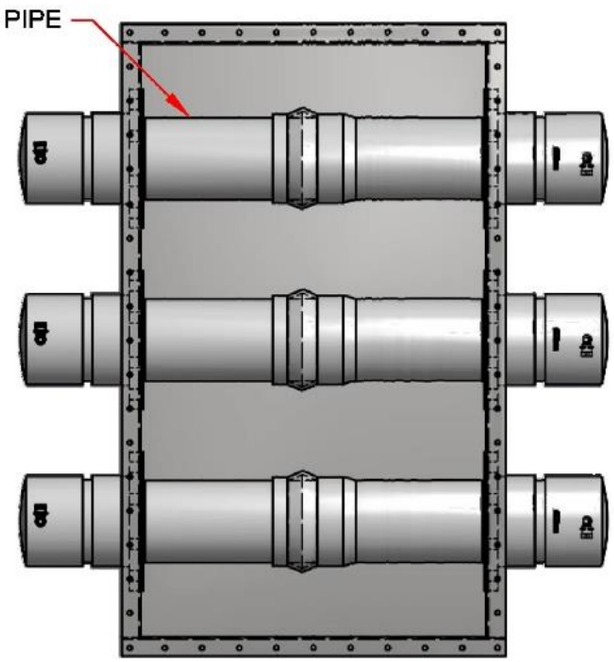

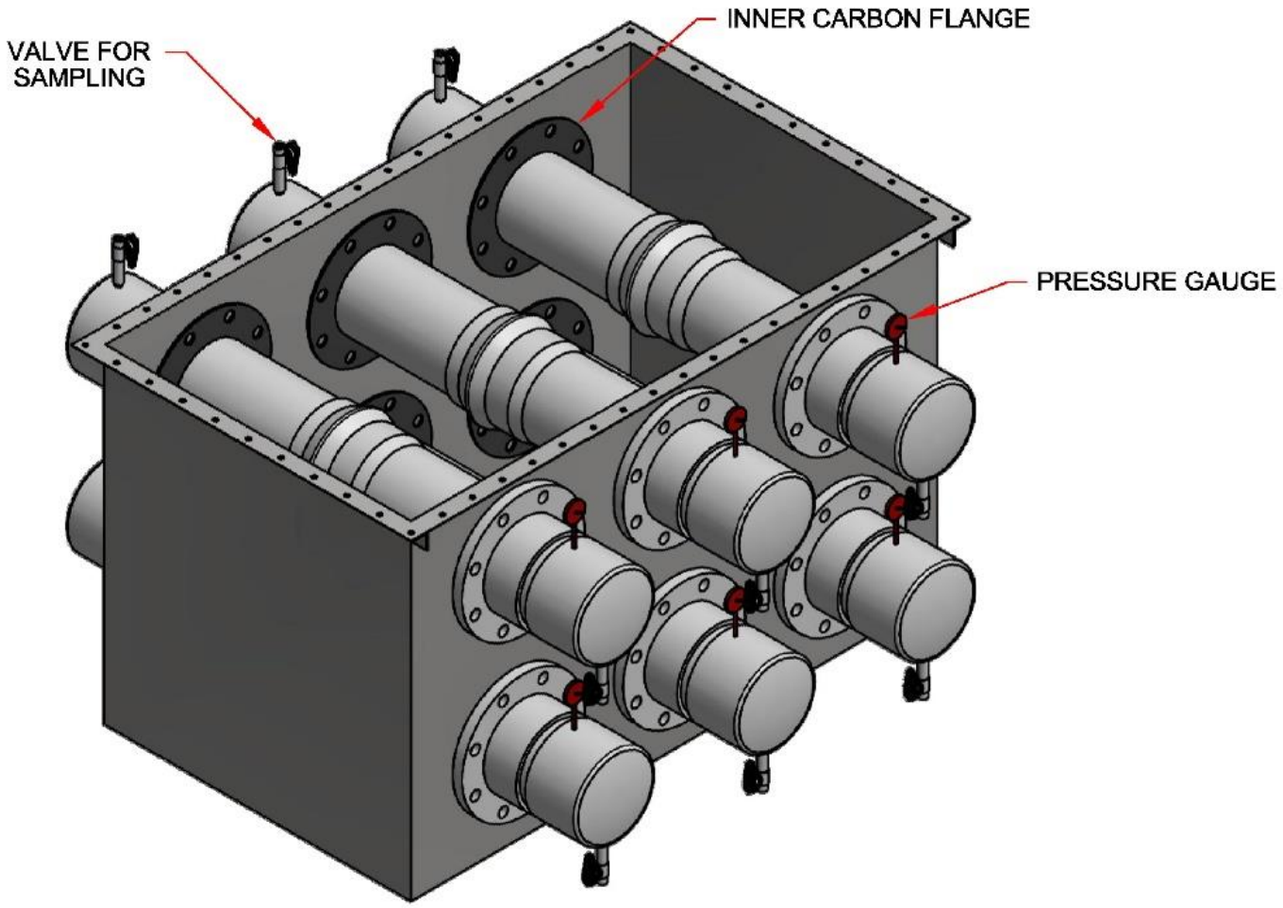

ENERGY AND ENVIRONMENTAL RESEARCH CENTER

GRAND FORKS, NORTH DAKOTA, U.S.A.
UND-EERC PROPRIETARY DESIGN DRAWING

PROPOSED PVC CONNECTION TEST, EERC

DRAWN BY:	KG	ESS CHK:	J. RICHTER	DATE:	2/24/15	W: 724	E: 642
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		CLIENT:	-	DATE:	-	REV:	-
		EERC S.O.	K. GROHS	DATE:	2/24/15	SCALE:	1:1
		MGR:	B. KURZ	DATE:	2/24/15	SHEET 1	OF 1
		APVD:	D. HAJICEK	DATE:	2/24/15	PRESSURE TEST DRAWING LEVEL:	-
		FINAL ASSY:	2030	NEXT ASSY:	-	DWG. NO:	5502

Pipe 1: Single wrap extending to the flanges on the internal walls of the box and sealed with silicone. Internal water pressure of 45 to 47 psi.

Pipe 2: No wrap. Internal water pressure of 45 to 47 psi.

Pipe 3: Single wrap with no silicone sealant. No internal water pressure.

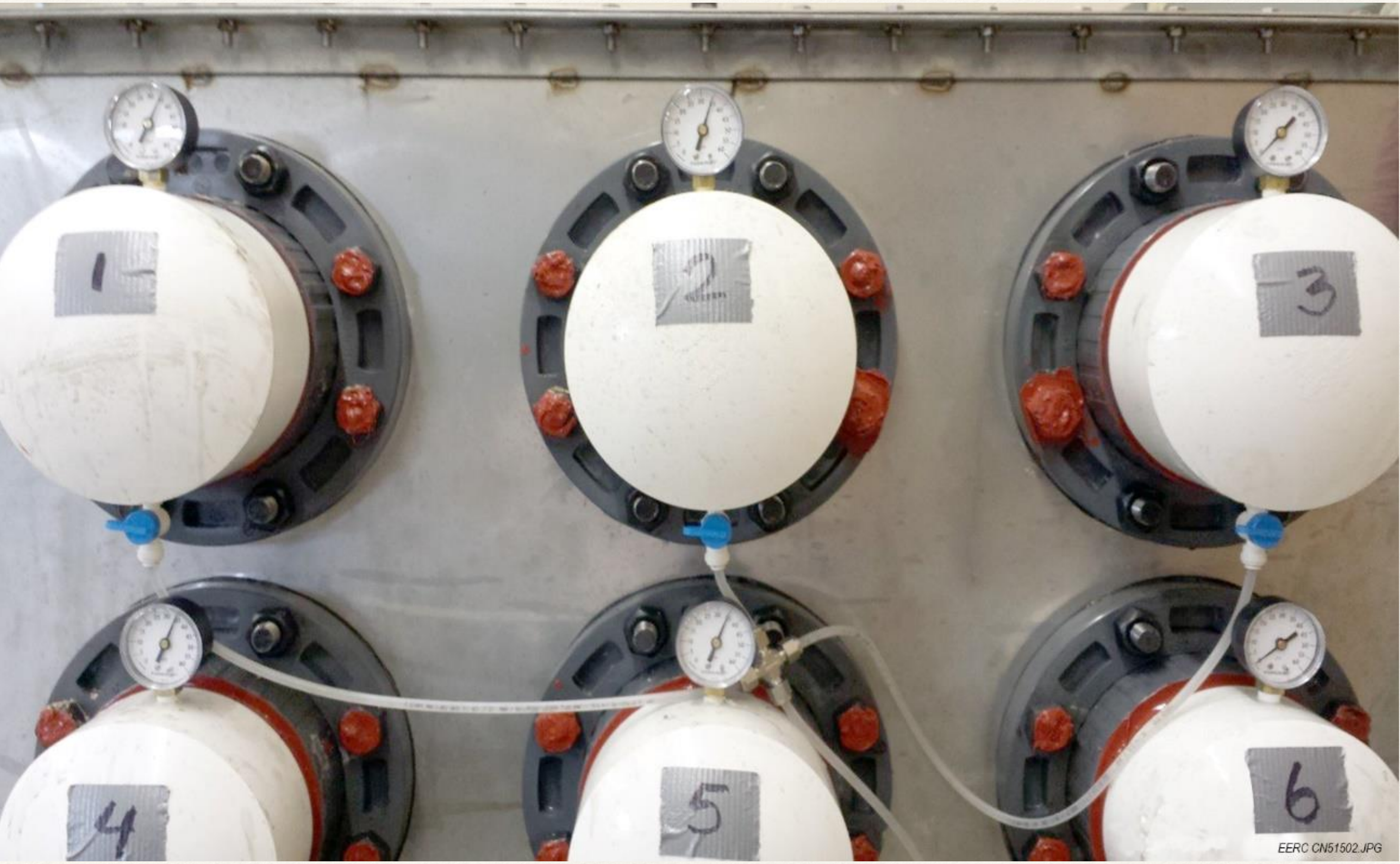
Pipe 4: Double wrap with no silicone sealant. Internal water pressure of 45 to 47 psi.

Pipe 5: Single wrap with no silicone sealant. Internal water pressure of 45 to 47 psi.

Pipe 6: No wrap. No internal water pressure.


Machine Shop
RADNOR
PROSELECT


EERC C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On June 11, 2015, the box was filled with a mixture of damp sand and Bakken crude oil.

- The sand and oil were added in layers by filling the box approximately one-third full with sand and then pouring 20 gallons (four 5-gallon pails) of crude slowly over the sand, and repeating. Total of 55 gallons of crude oil were used.
- The test box was covered with a stainless steel plate lined with a Viton® gasket and bolted along the edges. A pressure release valve was installed in the center of the top cover, with a pipe vent to an exhaust fan.


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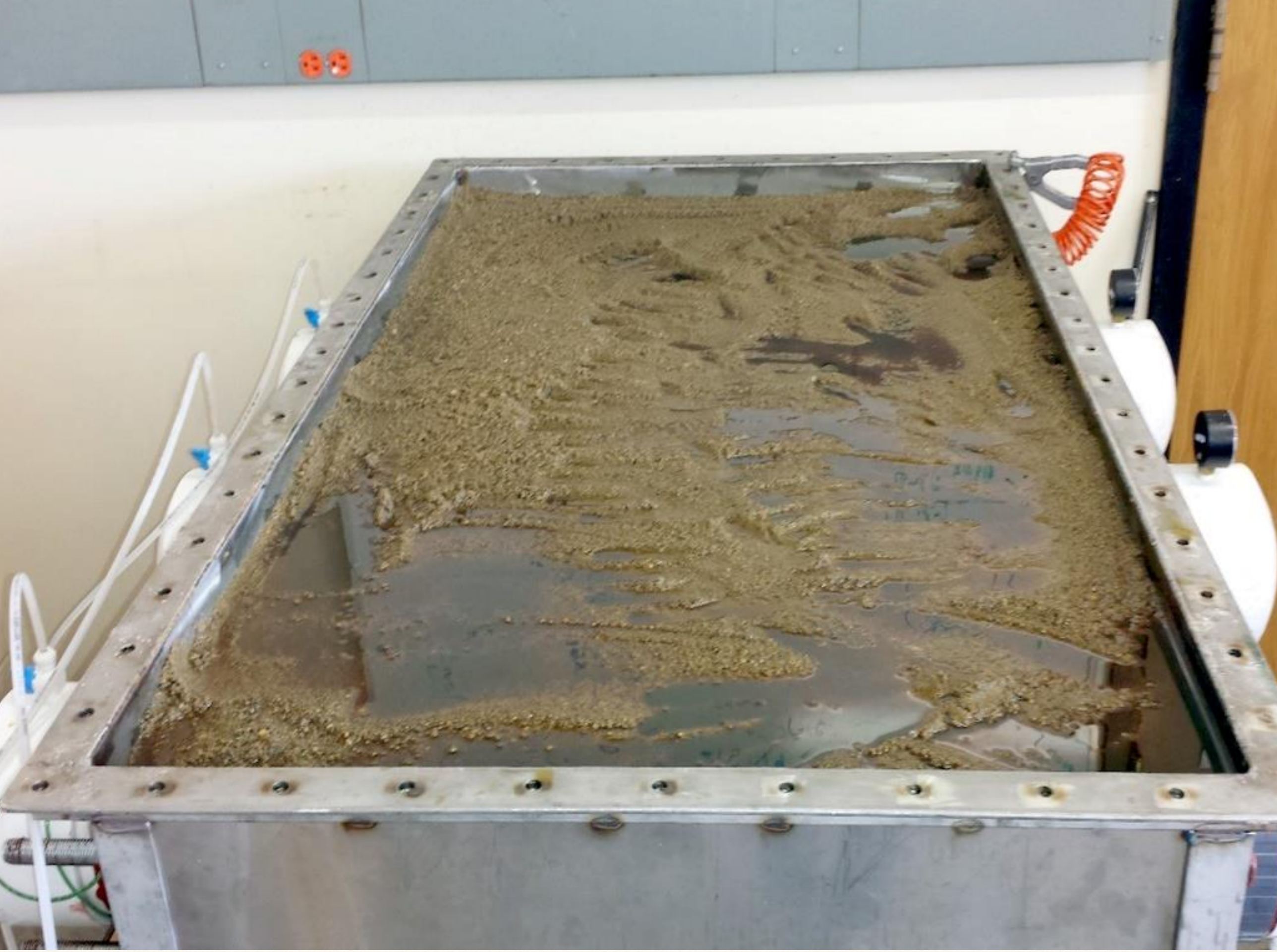

Water Sampling and Analysis

6 month test cycle (original plan) *Final test 9 month*

Water samples

- collected from each pipe once a week for 1st month
- every 2 weeks for months 2 & 3
- every 3 weeks for duration of 6 month

Test results did not show definitive signs of crude oil leaking into the pipes until the final sampling event, sampling was extended to include three more sampling events to take place at approximately 6-week intervals.

Water Sampling and Analysis

Testing

All water samples were initially screened for organic carbon by analyzing for total organic carbon TOC using Standard Method 5310B as a first indicator of hydrocarbon breakthrough.

Additional analytical methods included:

- Semivolatile petroleum hydrocarbons by U.S. Environmental Protection Agency (EPA) Method 8015B using a solvent extraction followed by gas chromatography–flame ionization detection (GC–FID). This method detects diesel range organics (DRO) or other hydrocarbons eluting between C10 and C28.
- Volatile petroleum hydrocarbons by EPA Method 8015B using purge and trap followed by GC–FID. This method detects gasoline range organics or other hydrocarbons eluting between C5 and C10.
- Volatile organic compounds by EPA Method 8260B using purge and trap followed by GC–mass spectrometry (GC–MS). This method detects benzene, toluene, ethylbenzene, and total xylenes (BTEX).

Results

- Initial testing through Week 2 showed a continual increase in total organic carbon (TOC) in the water from all pipes.
- Determined to be caused by pipe assembly materials (i.e., cleaning solvent, primer, or glue) rather than a crude oil leak.
- To confirm this, all six pipe samples were screened for crude oil components by GC, and none were detected.
- Thereafter pipes were thoroughly flushed and refilled after each sampling event. (similar procedure was used in the South Dakota State University pipeline crossing study)

Results

continued

- From week 3, the TOC levels remained relatively consistent for the remainder of the exposure experiment.
- TOC results showed little change over the course of the 6-month experiment.
- As a result, the last set of samples (collected at Week 25) were analyzed for volatile petroleum hydrocarbons and volatile organic compounds (BTEX) in addition to the regular TOC analysis and the total extractable hydrocarbons (TEH) analysis.

Results

continued

BTEX results- “most definitive and telling test”

- Pipe 2 sample show BTEX compounds in concentrations significantly above the Method 8260B reporting limit of 0.0010 mg/L (1 ppb)
- Pipe 6 shows benzene levels slightly above the reporting limit. All other pipe samples showed ND values.
- Pipes 2 and 6 were the only pipes that were not wrapped with the VEC sealing system.

Results

continued

BTEX results- “most definitive and telling test”

- Ratios of the individual BTEX compounds found in the Pipe 2 sample are reasonable for petroleum-derived BTEX. BTEX compounds are among the most water-soluble of crude oil components, it is possible they came from crude oil via small leaks in the two pipes that were not protected with the VEC wrap (Pipes 2 and 6).

Results

continued

BTEX results- “most definitive and telling test”

- Results also show slightly higher levels in the pressurized pipe vs. the non-pressurized pipe. There is no explanation for that at this point, and additional testing would have to be performed to determine if that was a consistent trend between pressurized and non-pressurized pipe.

Results

Final summary

- TOC was detected in all pipes early in the testing; however, it was confirmed that the organic carbon was from the pipe assembly materials and not from a crude oil leak.
- After approximately 6 months of exposure, minor concentrations of water-soluble crude oil components, including benzene, ethylbenzene, and xylenes, began to appear in the two pipes that were not protected or wrapped with the VEC sealing system.
- Samples taken after 8 months of exposure confirmed the presence of BTEX in the same two pipes, and the levels approximately doubled, while no compounds were detected in the wrapped pipes.

Results

Final summary

"…results indicate that for the 8-month exposure period during which this effort was conducted, the Viscotaq sealing system appears to be an effective mechanism to prevent the leakage of crude oil through bell and spigot pipe joints commonly used for rural water supply pipelines.

Additional testing may be warranted to confirm the effectiveness of the Viscotaq sealing system over longer periods of exposure to crude oil.

This method of protecting water supply pipelines at crossings with crude oil pipelines appears to be a more robust method of protection than current practices, since simply using a second PVC pipeline as a casing around the first PVC pipeline may extend the time it takes for oil to penetrate through the PVC joints, but not ensure that they will remain leak-proof for extended periods of time."

Tension Testing

- An additional tension test was established to test and evaluate the cohesiveness of the VEC sealing system when subject to expansive and compressive stress conditions as a result of seasonal temperature fluctuations in the subsurface.

Tension Testing

- 30 psi was applied to one end of the pipe
- One end was fixed to a stable bracket.
- Spring gauge was used to monitor the tension on the pipe
- Gauge was checked regularly for the duration of the project.
- The tension remained at 30 psi
- Conclusion: no visible changes to the pipe or the VEC pipe wrap were detected.

EERC CN51509.JPG

Conclusion & Approval

The VISCOTAQ Bell & Spigot Sealing System
has been approved
by
North Dakota Department of Health
as a means of protecting rural water supplies from potential contamination.

Thank you for your time and attention.
QUESTIONS???

Research, test results & ND Dept. of Health Approval

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