Trenchless Technology Center Newsletter

MARCH 2012

Development & Demonstration of Non-Intrusive Duct Lining Technology for Sealing/Rehabilitation of HVAC Ducts in Residential Buildings

Air leakage in forced air duct systems is now recognized as a major source of energy waste in both new and existing homes and commercial establishments. Research conducted by the Florida Solar Energy Center (FSEC), Advanced Energy Corporation (AEC), Proctor Engineering (PE), ECOTOP and other nationally recognized research organizations has shown that testing and sealing leaky distribution systems is one of the most cost effective energy saving strategies. Comparing the energy consumption between a leaky duct (in total around 3 in 2 holes) and a sealed duct, using the Duct-Blaster, revealed that nearly 30 percent energy is lost due to leaks (see Figure 1).

The system for rehabilitation of leaky duct systems under development utilizes a modified CIPP lining technology, whereby an ultra-thin air-tight felt tube system is combined with a commercially available resin to produce a stand-alone air-tight duct system. The system represents an 80 percent savings in terms of material costs compared with commercially available thin liners used by the sewer laterals rehabilitation industry. The research focused on the proper selection of materials and the installation method due to the fact that it's not only dealing with long length and wide varieties of duct geometries, but also the modifications needed during insertion, placement and curing practices which represent unique challenges.

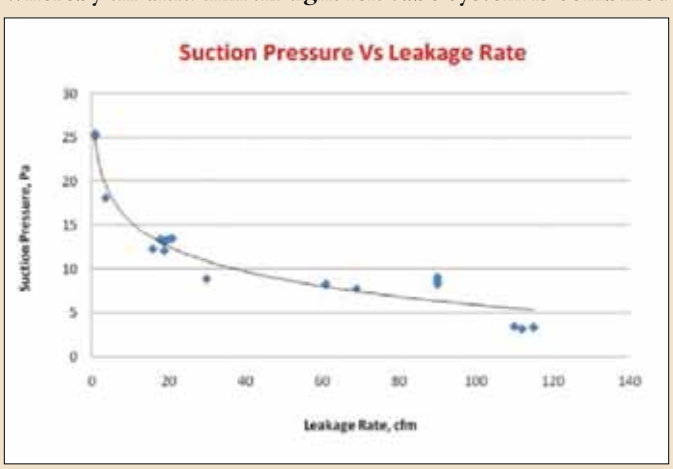
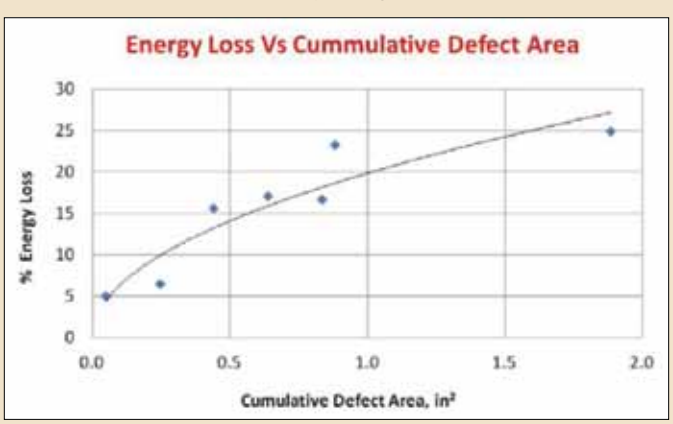


Fig.1 Loss in Suction Pressure (top) and Energy (bottom) due to cumulative area of openings in duct's wall.



Experimental Setup

HVAC ducts are designed to maneuver air and therefore, are not designed to bear additional loads resulting from the cured CIPP liner. Moreover, less resin is required to impregnate thin liners. Three different liner tube materials were used. The first one was an off-the-shelf product (Type-A) commonly used in municipal CIPP applications. The other two were custom-made felt tubes (Type-B and C) fabricated at the TTC lab specifically for this application. Thickness and unit weight of each tube material are given in Table 1.

Liner	Type	Properties		
		Thickness (mm)	Circumference (in.)	Weight (lb/ft)
Off-the-Shelf-Product	A	2.0	31	0.29
Custom Liner Tube	B	1.09	18	0.18
Custom Liner Tube – Ultra Thin	C	0.65	18	0.12

Table 1: Thickness and Unit Weight of the Liner Tube Materials.

As the liner will not be subjected to any external pressure, different types of adhesives were used as impregnation materials in addition to the conventional epoxy resin. Material properties of these resin and adhesives are shown in Table 2.

Type	VOC (gm/L)	Odor	Specific Gravity	Flammability Rating		Auto Ignition	Ambient Cure, hrs
				NFPA	OSHA		
I	0	Faint amine	1.10	1		NDA	2
II	5.40	Slight sweet odor	1.08	0		NDA	12
III	386.00	Organic	1.08	1C		NDA	6
IV	N.A.	Mild	1.15	1	IIIB	NDA	4
V	37	Very Mild	1.10	0		NDA	16
NDA = No Detectable Activity							

Table 2: Material Properties of Resin and Adhesives.

First, a total of six lining systems was prepared. The off-the-shelf liner (Type A) was impregnated with the epoxy resin. The TTC fabricated liners were impregnated using the epoxy resin, as well as other adhesives. Next the

Torpedo type inversion chamber at TTC was used to line a duct where small holes were poked to simulate a leaky duct (see Figure 2).

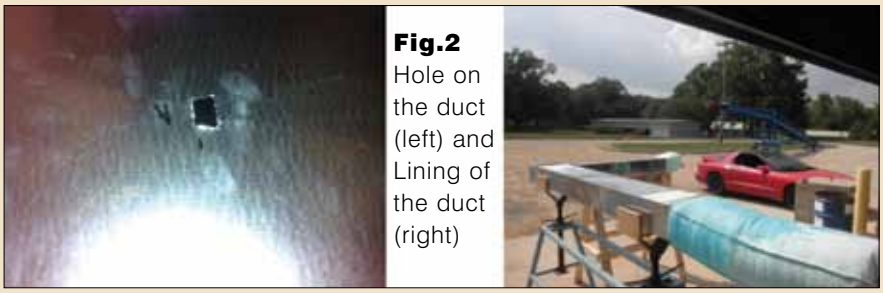


Fig.2 Hole on the duct (left) and Lining of the duct (right)

After lining the duct, the improvement in suction pressure was measured using the Duct Blaster and pressure loss caused by leaks decreased dramatically. Using the inversion chamber in-situ for a residential building is difficult and therefore a bladder system is under development to overcome this issue. Numerical simulation of energy loss caused by leaks is at its infancy stage (see Figure 3).

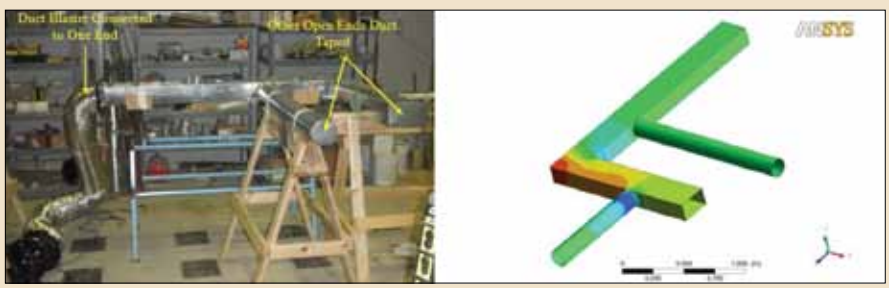


Fig.3 Leak Test using Duct Blaster and Lining using a bladder system

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TTC Prepares for Another Aggressive Municipal Forum Season

For more than 15 years, the TTC has provided municipalities in North America with high-caliber technical seminars focusing on local trenchless technology issues to help solve regional water and sewer problems.

The TTC works with a local municipal representative along with national and international industry experts to organize a one-day workshop (forum) in numerous locations to review and discuss specific trenchless technologies that are of regional interest. The industry experts address each topic through a peer reviewed and vetted presentation that addresses each technology generically. The peer review is conducted by a panel of TTC's Industry Advisory Board members to ensure the forum is receiving the state-of-the-art technical information in a non-commercial environment and format.

In 2011, the TTC delivered 14 Forums and reached more than 750 municipal engineers through 75 high-quality technical presentations and moderated in excess of 100 hours of direct discussion between technology providers and municipalities. The TTC looks first to its Industry Advisory Board for expertise and then to other industry experts as needed. The forums are non-profit and designed to fit the municipal budget.

The TTC is starting its Spring 2012 Municipal Forum Season with Forums planned for Boston (March 29); Seattle (April 18); Aurora (April 19); Dallas (May 3); Columbus (May 15); Bloomington (May 16); and Fairfax (May 30). The Forums planned for Houston, Palo Alto, Calif., and Edmonton, Canada, do not have firm dates set.

Municipalities and industry interested in hosting or participating in a Forum can obtain more information at *www.ttcmf.com* or contacting either Fredda Wagner (*fredda@latech.edu*) or Dr. Robert McKim (*mckim@latech.edu*).

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Trenchless Technology Center Newsletter

March 2012

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The TTC Newsletter is published as a department within *Trenchless Technology*. All newsletter materials are prepared by TTC. Communications should be directed to the center.